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Estimating the Economic Costs of Occupational Injuries and Illnesses in Developing Countries: Essential Information for Decision-Makers



Working paper


SafeWork

Programme on Safety and Health at Work and the Environment
(SafeWork)

Working Paper

Estimating the Economic Costs of Occupational Injuries and Illnesses in Developing Countries: Essential Information for Decision-Makers

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This paper was produced under the ILO-EU joint project “Improving Safety and Health at Work Through a Decent Work Agenda” (2009-2012).

The SafeWork/EU project aims at playing a part in a more inclusive and productive society by seeking to advance occupational safety and health, in five pilot countries, spread over three regions – Honduras, Malawi, Moldova, Ukraine and Zambia. It aims to incorporate occupational safety and health at the highest level in the national political agenda, integrating it into national development policies, as well as implementing national occupational safety and health programmes and translating them into action at the workplace level. The project also developed guidelines on reporting and notification of work-related accidents and diseases, which, together with this report on the economic costs of work-related accidents and diseases, form part of the methodological tools to sensitise decision-makers and the general public on the true scope of poor working conditions.

Table of contents

Preface	vi
Acknowledgements	ix
1. Executive summary	1
2. Objectives – Looking for Data Lost in the Dark	1
2.1. Why estimate the economic costs of occupational injuries and illnesses?	7
2.2. Integrating economic considerations into OSH policy	9
3. Research on Economic Costs of Occupational Injuries and Illnesses in Industrialized Countries – Looking in, and Learning from, the Light	13
3.1 Employer costs.	15
3.2 Worker costs	19
3.3 Costs to society	21
3.4 The example of Great Britain	21
3.5 The example of the US	24
4. Research on the Economic Costs of Occupational Injuries and Illnesses in Developing Countries	27
4.1 Two cases.	27
4.2 The incidence of work-related injuries and diseases	28
4.3 Economic costs	31
5. OSH in the Context of Development	35
6. A Framework for Future Study	39
6.1. Objectives	39
6.2 Household survey	40

6.3	Enterprise costs	43
6.4	Socially externalized costs.	43
6.5	Getting to grips with fatalities	44
6.6	Sequencing the study	44
6.7	Benefits from the data collection process	45
	References	47

Preface

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The ILO estimates that 2.34 million people die each year from work-related accidents or diseases. A further 317 million suffer from work-related injuries. With such figures, it is imperative to prevent what can only be seen as a downward spiral of workplace injuries leading to disability, reliance on benefits (if they exist), early retirement, exclusion from the labour market, the loss of a breadwinner, and poverty. Creating a safe and healthy working environment will help prevent exclusion and poverty, suffering and economic costs to victims and their families, businesses and governments.

Almost everyone says that they are committed to improving safety and health at work and preventing human suffering, but it is often difficult to see this stated commitment being translated into practice, for any amount of reasons – many countries lack comprehensive data on occupational injuries or because of the perceived costs to businesses, for example. However, the ILO estimates that four per cent of global GDP is lost due to occupational accidents and diseases, a sum which governments cannot afford to lose.

If the aim of any country is sustainable growth, more and better jobs and greater social cohesion then it must factor in the high cost of work-related accidents and ill-health in the quest for higher productivity and economic and social renewal. Being aware of the high costs of poor workplace safety and health conditions is therefore essential to decision-makers attempting to wisely allocate scarce resources.

This advocacy report attempts to identify the elements which should be taken into account in determining the cost of occupational accidents and diseases at the national level, with a focus on developing countries. As it points out, few studies have been done on the economic burden of occupational accidents and diseases to a country (as opposed to an enterprise). Where they have been done, it is in industrialized market economy countries. The report therefore analyses what has been achieved in the way of economic research in relation to occupational safety and health outcomes in developed countries, and what factors and methodologies have to be taken into account to get an idea of the costs to the national economy. It looks at the challenges in obtaining credible numbers of occupational accidents and diseases and the associated costs. It goes on to describe the sampling requirements that need to be met to be able to determine estimates of rates of occupational injury and diseases and costs in a country.

The aim is to help countries identify the economic costs of not improving workplace safety and health – to employers, to workers and to society as a whole – and to inform decision-makers of the net costs of policies presented to them. The idea is to raise awareness among policy-makers and decision-makers and facilitate policy integration by making the linkages between occupational safety and health and other policy interventions.

We want to raise safety and health at work into the mainstream of the development agenda.

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This paper was prepared by Peter Dorman, political economist and author of many reports and studies on “scientific economics”. We would like to extend our thanks and special acknowledgements to Mr. Dorman for bringing his wealth of experience and erudite mind to this issue of highlighting the costs that poor working conditions impose on the national economy.

Mr. Dorman benefited from the experience and insights of the UK Health and Safety Executive, which had recently updated its methodology to estimate the costs of workplace safety and health failings. Our thanks go to Anna Barnes and colleagues of the HSE for their time and interest in this project.

Our appreciation also goes to SafeWork colleagues and the occupational safety and health specialists in ILO field offices who provided comments on the report. In this context we would also like to thank Lawrence Egulu of the ILO’s INTEGRATION unit, and Valentina Stoevska and David Hunter of the Statistics department.

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1 Executive summary

Many of the most urgent questions in occupational safety and health (OSH) are also the least investigated. We know that work-related illnesses play a much larger role in morbidity and mortality than work-related injuries, yet we know far more about the latter than the former. Similarly, it is probably the case that disability and premature death from poor working conditions is a much greater problem in developing countries than in the developed world, but nearly the entire research literature is devoted to the latter. This can be explained, but not ultimately excused, by the observation that it is much easier to study work and health in societies with abundant record-keeping. The overarching purpose of this paper is to put the case for developing countries what epidemiological and economic research has already achieved for OSH in the developed countries.

The role for an economic perspective in OSH research is not immediately obvious. Shouldn't OSH goals be pursued for their intrinsic health benefits? Why do we need to calculate the economic costs of poor working conditions? National law and international agreements, such as the ILO Promotional Framework for Occupational Safety and Health Convention, 2006 (No. 187), typically combine calls for the improvement of safety and health with recognition of the economic benefits of OSH. They do so for a number of reasons:

- They play a large role in awareness-raising and strengthening incentives for meaningful OSH policies at all levels, from the individual enterprise to the national legislature. Indeed, the absence of economic studies of OSH in developing countries correlates with an absence of recognition that OSH has a key role to play in development itself.
- Economic analysis can reveal not only the total costs of poor working conditions, but also how they are distributed among the major stakeholders, employers, workers and the wider community. This can serve to motivate stakeholders and also point to aspects of the OSH system in which costs are externalized and fail to provide appropriate incentives.
- Identifying the economic costs from not improving working conditions can make it possible to compare the costs of action and inaction in the same units. This can inform decision-makers of the net costs of policies presented to them – information they would otherwise not have.
- Economic analysis can assist in identifying particular safety and health risks or sectors that ought to be addressed as a matter of priority.
- Economic analysis can facilitate policy integration by making more visible the linkages between OSH and other policy interventions. In a sense, the main goal of the paper is to bring OSH into the mainstream of development discourse.

All of these objectives apply with particular force in the developing country context.

We can build on two decades of research in the industrialized countries, where economic studies of OSH have reached a high degree of sophistication. Establishing the cost of work-related injuries and illnesses is essentially a two-step process: first it is necessary to have epidemiological data on incidence rates of the health events of interest, and then to determine their economic costs.

The epidemiological step relies on four potential sources of information: insurances, company records, labour force surveys and public health surveillance systems. All have been used by researchers, although adjustments are usually required to correct for incomplete coverage and underreporting. Injuries are underreported due to a set of filters that prevent some events from being recorded at each step in the process of establishing, classifying and communicating them. Illnesses are even less likely to be counted due to the difficulty in identifying which should be regarded as work-related, as well as the more porous reporting systems through which they are captured. Nevertheless, plausible incidence rates for both types of events have been published for countries like the United States and Finland.

The economic step consists in identifying the costs borne by employers, workers and the wider community resulting from preventable injuries and diseases. **Employer costs** have been subject to intense scrutiny, since there is a vibrant demand from the business community for this type of work. Broadly speaking, these costs are divided into “direct” and “indirect” costs. The former includes payments made by firms to workers who have suffered an injury or disease or to medical providers to defray treatment costs. The latter includes primarily lost, delayed or degraded production. While the measurement of direct costs is usually relatively straightforward, several issues have arisen in recent years concerning the measurement of indirect costs:

- 1) Can it be assumed that unplanned worker absences necessarily result in lost output? Some researchers find this a useful simplifying assumption, but others hold to the “frictional” view that enterprises can normally reorganize temporarily to make up for episodes of short-handedness. Supporters of this second perspective have produced estimates of the fraction of absences that result in actual output losses.
- 2) It may also be the case that the absence of a worker who has suffered an unexpected health impairment affects the work of his or her colleagues. This could be the case if equipment or materials are damaged during an accident, if the work process involves significant interaction, if the worker in question is difficult to replace, and if timeliness is an important consideration in light of the firm’s market situation. Researchers have found “absenteeism multipliers”, ratios of indirect costs to missing workers’ wages, substantially greater than one.
- 3) The term “presenteeism” has been used to refer to the reduction in work quality or intensity attributable to a health impairment, even though the impaired worker is not absent. Again, empirical studies have found that presenteeism can be as important a contributor to indirect costs as absenteeism.

Worker costs are primarily tangible, in the form of lost income and medical expenses not replaced or defrayed by the employer or employment injury scheme/workers compensation insurance. Other costs are possible, however. Some economists believe that pain and suffering can be given a monetary equivalent via a questionnaire or through market analysis. Without getting into details, it can be said that the position of this paper is that imputations of this sort will not be productive in achieving the goals of cost research. In any case, while similar imputations could be performed for other risks to health, such as malaria and HIV/AIDS, in practice no one chooses to do them. Other indirect costs may be more relevant, however. For example, health-impaired workers may face poorer economic prospects than those in better health. They may acquire debt or lose productive assets, like a home or automobile (in developed countries). Their other household members may also pay a price, reducing home production, market work

or education in order to care for them. There is little current empirical research on these topics, but they will play a role in the methodology developed for estimating the costs to the national economy of occupational injuries.

The **costs to society** are manifested through programs that indemnify workers and employers or directly finance health care providers when the funding is not tied to the health events themselves. For example, if an employer's employment injury insurance premium increases as the result of an accident, that increase is part of the employer's cost of the accident. The difference between that increased premium and the payment made by the compensation system is borne socially. If the premium is unrelated to the rate at which accidents occur, the entire compensation cost is social. The same principle applies to public and private health insurances, whose rates are at most only partially sensitive to individual claim histories. (Otherwise they would not serve the function of risk-pooling.)

One example of careful economic cost accounting in the field of OSH is the ongoing effort of the United Kingdom Health and Safety Executive (HSE) to periodically update its estimates of worker, employer and social cost. HSE's approach considers fatal injuries and nonfatal injuries and illnesses, but not fatal illnesses, due to problems of long time lags and attribution. (They continue to work on this.) Because of incomplete record-keeping, rates of nonfatal events are derived from a regularly-administered household survey; pooling of multiple years is employed to acquire more observations. HSE methodology assumes an extreme form of frictional cost theory: firms always and completely make up for the absence of missing workers at no additional expense, and presenteeism is assumed not to be a problem. At the same time, its methodology assumes that a worker withdrawn from employment reduces output somewhere in the economy by an amount equal to lost earnings. Highly significant for its results is the inclusion of a monetary measure for pain and hardship experienced by workers who are injured or made ill at work. All of its cost items combined yield an economic burden of hazardous working conditions equal to about 1 per cent of GDP in 2010.

A second example is J. Paul Leigh's recent updating of his estimate of the economic costs of occupational injuries and diseases in the United States. Leigh takes his incidence data for nonfatal injuries and diseases from employer records, but he scales up these numbers to reflect pervasive undercounting. Fatal injuries are derived from a national census of such events compiled by the US Bureau of Labor Statistics. Fatal occupational diseases are estimated by applying attributable fractions, based on previous studies, to numbers for all fatal diseases. The main cost item for Leigh is lost earnings, which he equates with lost output; the other two are medical expenses and lost home production. Unlike HSE, he does not attempt to monetize the pain and hardship associated with occupational impairments. Summing all his costs, he finds that the economic burden amounted to about 1.8 per cent of US GDP in 2007.

The difficulties facing researchers who wish to do for developing countries what is regularly done for industrialized ones can be illustrated by two recent studies. One looks at the cost of occupational accidents in Mauritius, the other in Mexico. Both are pioneering attempts to extrapolate from limited data, but they face serious shortcomings: both exclude occupational disease, utilize data only from the formal sector, fail to adjust for underreporting, make "heroic" imputations in the face of missing cost data, and avoid the problem of indirect cost on both the workers' and employers' side. These limitations are not the fault of the researchers but are attributable to the enormous data gaps they faced.

A more detailed look at the literature brings these gaps into clearer focus:

- Only a minority of workers in developing countries is employed in the formal sector, but even here OSH reporting systems are highly deficient, more so than in developed countries.
- Public health registries for major injury and illness types are largely nonexistent.
- Attempts to plug these gaps by extrapolating from developed countries data patterns are doubtful in light of the many reasons for expecting greater incidence of work-related injuries and illnesses in the developing world: the higher share of informal employment, the greater predominance of small enterprises, the greater role played by more hazardous industries, the more frequent use of child labour and the tendency for working conditions to be worse even in industries otherwise comparable to those in the wealthier countries.
- Employer cost data are almost completely absent.
- Workers rely to a greater extent on the informal provision of unpaid care within the household, but these costs are largely unrecorded and unnoticed. In particular, disruption of education is likely, but thus far invisible.

In spite of these enormous challenges, it is important to press ahead. Beginning with *Investing in Health*, the World Development Report for 1993, and continuing with the 2001 report of the Commission on Macroeconomics and Health and the establishment of several health-related Millennium Development Goals, health has moved to the center of development theory and policy. Researchers debate the relative importance of health compared to other factors in the development process, but there is now little doubt that combating preventable diseases is a major task for those pursuing development, and that the shocks generated by sudden health impairments play a significant role in the spread of poverty. The result has been increased attention and funding, especially to certain “headline” diseases like tuberculosis, HIV/AIDS and malaria. While not disputing the urgency of addressing these threats to health and social progress, it is important to note that, using the Disability Adjusted Life Year metric of the World Health Organization, work-related morbidity and mortality likely accounts for perhaps twice the burden of each of them – and possibly as much as all three taken together.

The paradox is that, in an era in which the health dimension of development has gained far greater prominence, one of the chief preventable causes of ill-health – poor working conditions – remains largely invisible. Precise data on its extent and the size of the burden it imposes are lacking, and OSH continues to be a specialist concern divorced from the mainstream of policy. The principal goal of the project sketched in this paper is to change this situation.

An initiative to put numbers on the economic costs of work-related injuries and illnesses at the national level has to cope with the data limitations that have hampered previous efforts. Its data collection strategy for epidemiology has to be based on a household survey, roughly based on the methods used in the UK, but extending also to occupational disease along the lines developed, among other places, in Scandinavia. Fatal injuries and diseases, however, are likely to be beyond the resources of developing country studies, since there would be too few observations to obtain reliable estimates. This judgment could be altered for diseases if national estimates of fatality due to the relevant diseases exist. The final section of this paper describes in some detail the sampling and content requirements that need to be met if estimates of rates of injury and illness are to be credible. Similarly, the same survey instrument must delve into the direct and indirect costs borne by workers and their households. This should include estimates

of unpaid care and the burden they impose on household income and production, as well as education. It will be cost-effective if the instrument can take the form of a module attached to a pre-existing survey.

Employer costs can best be addressed by analyzing a set of reference cases, selected to represent the range of industries and enterprise types. Analysis should be based on both objective measures (those based on tools currently used by OSH economic consultants in developed countries) and subjective ones (using surveys such as those employed by researchers investigating absenteeism and presenteeism multipliers). Results from these reference cases can be matched to household responses through a set of questions pertaining to the worker's employment situation.

By finally shedding light on the heretofore unobserved world of developing country working conditions and their economic effects, this initiative can potentially restore parity to OSH in the discourse on health and development. It can also be of value to stakeholders in countries where the research takes place: employers can benefit from a careful analysis of how OSH investments can improve economic performance, and social partners can use the study as an opportunity to increase their understanding of the role of healthy work and the options for achieving it.

2. Objectives – Looking for Data Lost in the Dark

One of the canonical stories told by economists (and perhaps other researchers) is about the drunk and the lamppost. Late one night a police officer sees a drunk crawling on his hands and knees near a lamppost. “What are you doing there?” calls out the officer. “Looking for my lost keys,” replies the drunk. The conversation continues:

Officer: Did you lose them here?

Drunk: Probably not.

Officer: Then why are you looking in this spot?

Drunk: I can see better under the lamppost.

This may not be the funniest story ever told, but it expresses perfectly one of the dilemmas in research: often we spend too much of our resources looking in the well-lit places, when the answers we actually need can be found only in the dark.

Nowhere is the lamppost effect more evident than in the world of occupational safety and health. A rule of thumb has it that fatal occupational illnesses outnumber fatal injuries by about an order of magnitude, yet injuries are studied in great detail while illness research is sparse. The reason, of course, is that we have much better data on injuries – they are under the lamppost. Similarly, the great majority of research and analysis in this field examines conditions in industrialized countries, while the fragmentary data available to us, as we will see, suggest that the most serious health and safety problems are to be found in the developing world. Again the reason is clear: developed countries have relatively well-funded institutions that collect occupational safety and health (OSH) data; developing countries don't. At its core, the purpose of the initiative at hand is to resist the lure of the lamppost and collect OSH data where it is most difficult to find, above all in the informal sectors of low and middle-income countries.

2.1. Why Estimate the Economic Costs of Occupational Injuries and Illnesses?

The interest in the economics of OSH is relatively recent, with estimates of costs at the national level appearing only in the last 20 years. (Beatson and Coleman, 1997; Schulte, 2005) At first the main purpose behind this work was awareness-raising, but other goals have become progressively more important. It is worth spending some time on the objectives of cost research, since they provide the basis for determining whether this work is successful.

First, however, it is important to clear up an objection that is sometimes raised against economic assessments of improvements in OSH. Don't estimates of the economic cost of poor working conditions imply that economic considerations rather than principles of human rights and public health should guide policy? In fact, the right to safe and healthy work has been acknowledged as

a matter of national and international statute. The framework directive of the European Union (89/391/EEC), for example, appears to put the right to safer (if not completely safe) working conditions ahead of other considerations: “*the improvement of workers’ safety, hygiene and health at work is an objective which should not be subordinated to purely economic considerations....*” An even stronger position is set forth in the Seoul Declaration of 2008, which refers at the outset to “*a basic right for workers to work in a safe and healthful working environment...*”, echoing Article 3 of ILO Convention 187. Nevertheless, it couples this commitment with a second principle finding “*a positive impact on economic and social development by investing in OSH.*” This is a claim that needs to be substantiated by economic analysis.

In practical terms, while an ethical commitment to workers’ health and well-being could be a sufficient guide, evidence that OSH improvements are economically beneficial typically has a role to play as well. This is clear at the enterprise level, where a long tradition in human resource management points to the threat that poor working conditions pose to productivity and cost containment. Investments in OSH, it is argued, should be evaluated to determine whether they bear a positive rate of return. From an ethical standpoint this would have to be judged as redundant at best, yet it is beyond doubt that the economic argument provides extra motivation to managers.

The same process can be seen at the national level. Every industrialized country has national laws and adheres to international conventions that oblige it to protect the health and safety of its workforce, yet OSH advocates have also found it useful to demonstrate the economic costs of falling short on the job. “Safety in Numbers”, one of the highest-profile publications of the ILO in the realm of OSH, suggests that 4 per cent of global income is lost due to occupational injuries and illnesses, a finding that has been cited throughout the world innumerable times. (ILO, 2003) In their pathbreaking study of OSH costs in the US, Leigh et al. (2000) make the point that, in the aggregate, death and ill-health arising from the workplace cost about as much to society as more publicized risks like cancer. (A considerable portion of cancers are attributable to occupational factors, of course.) There is no way to know what role such studies have played in the social consensus that has formed around proactive OSH policy in most industrialized countries, but their prominence in the public domain and the resources that continue to be allocated to updating and improving them both suggest that they have the power to motivate.

Perhaps the attention-focusing effects of national-level cost estimates are best seen in the breach. As mentioned above, nearly all of the national economics-of-OSH studies have been based on data from the industrialized world; most developing countries have no such numbers to point to, and the few that do have had to rely, as we will see, on extrapolations from developed-country results and are viewed as less persuasive for this reason. At the same time, it is clear – and unfortunate – that no corresponding policy consensus on OSH has emerged in most developing countries. As this paper will argue, the cause cannot be that working conditions are superior outside the wealthiest regions; in fact, the contrary is true. More plausible is the “cycle of neglect” proposed by Nuwayhid: for various reasons OSH is a low priority, which results in less commitment of resources to gather information, which results in public ignorance regarding the actual incidence and costs of occupational accidents and diseases, which in turn reconfirms the low priority given to OSH. (Nuwayhid, 2004) This invisibility can extend to the workforce as well as higher-level decision-makers, making it less likely that there will be political pressure from unions and other worker organizations to put OSH on the front burner. (Joubert, 2002) Thus the absence of convincing, high-profile cost-of-OSH estimates is tied to the absence of strong political support for improvements in the work environment.

2.2. Integrating Economic Considerations into OSH Policy

Thus awareness-raising should not be dismissed as a valid goal of economic analysis. That said, there are several other objectives that also shed light on how OSH policy should be developed. These include stakeholder analysis, net cost analysis, prioritization and policy integration.

1. Stakeholder analysis. It is now recognized that it is not enough to just sum up OSH costs; their distribution is also crucial. This is useful information for the stakeholders themselves, of course, but it is especially important in locating aspects of a country's OSH system in which incentives work at cross purposes with policy. In particular, a careful cost estimation exercise will try to quantify the extent of several key potential externalities:

- Externalization of enterprise costs. Enterprises inevitably bear a substantial portion of the social cost of occupational injuries and illnesses through added expense and diminished output. But it is likely that some of these costs are also externalized on workers or society as a whole. The former occurs if workers are not fully compensated by their employers for the costs of job-related ill-health, the latter if some expenses, like medical costs, are subsidized by public programs.
- Externalization of workers' costs. While workers and their households bear the brunt of economic costs – and the entirety of quality of life costs – resulting from workplace health and safety factors, they too may benefit from social subsidies, particularly when most medical expenses are defrayed by social insurance programs.

Either of these can lead to behavior that fails to reduce workplace risk to the extent justified by their true (social) costs. In practice, studies in the United States (Leigh et al., 2000), Australia (Australian Compensation and Safety Council, 2009) and the UK (HSE Economic Advisors Unit, 2004) have documented that enterprises are net externalizers of a high per centage of costs at the expense of workers and society at large. This suggests that ordinary market forces are not sufficient to induce a socially desirable level of investment in better working conditions. Their results also indicate that one fact in this cost-shifting is the impact of social insurance systems which, while desirable in general, transfer costs from direct stakeholders to the broader society. An important question to investigate is whether the cost externalization problem is more severe in developing countries, or less.

2. Net cost analysis. At both the enterprise and social levels, decisions must be made about the pace and scale of OSH investments. How urgent is the need to reduce occupational risk compared to other worthwhile objectives? How much risk reduction should be targeted in the near future compared to spreading out the OSH programme over many time periods? What level of investment can decision-makers afford? There is no single formula for generating the best answer to all such questions, but credible economic data on both the cost of OSH investment and the cost of not investing can provide valuable input. The core idea is to compare apples with apples. Monetary costs cannot be compared directly to health outcomes without making a number of cross-category assumptions – assumptions that are likely to be controversial and that, in any case, really encapsulate the decision process itself. (That is, to make an assumption about the tradeoff between financial resources and human health is not just to facilitate judgment; to a large extent it is the judgment.) On the other hand, since there are monetary costs to both investments and adverse health outcomes avoided, these can be compared and even combined into a single measurement of net cost.

For instance, suppose that it is possible to reduce the number of expected accidents at a workplace by five as a result of a process improvement (better machinery, a training programme, etc.) that costs \$10,000 to implement. Whether it is justified to spend this money in order to reduce all the human costs that arise from occupational accidents is not usually a question that can be answered by economics alone. But if careful analysis shows that the average financial cost (lost production etc.) associated with an accident is \$3,000, the program can be justified solely on its merits as an economic investment. (This abstracts from issues of time and discount rates.) Even if it happens that the average cost of an accident is only \$1,000, the analysis is enlightening: it shows that the net cost of the investment is \$5,000, and it is this sum – not the full \$10,000 – that should be weighed against the other, less tangible effects of injury on the job. (Lahiri et al., 2005)

The same logic applies at the aggregate level. A government that puts forward a budget for OSH services benefits from having a reasonable estimate of the purely financial savings that would be expected to ensue. This enables it to act on the basis of net costs – to compare these net costs to other, noneconomic (or perhaps simply nonquantifiable) objectives it hopes to realize.

3. Prioritization. We have spoken of OSH only in general terms thus far, but as a practical matter there is a multitude of risks and risk contexts in which decisions have to be taken. Within an overall OSH budget a variety of potential initiatives compete for attention. While economic considerations may not be decisive in setting priorities, neither are they likely to be irrelevant. To give one example, studies in several industrialized countries have highlighted the economic costs of musculoskeletal impairments, due to long periods of rehabilitation. (Dagenais et al., 2008) For this reason, ergonomic and related risks have been given added attention in national policy-making. There are other factors to consider, but ignoring economic aspects would be pointless.

4. Policy integration. The size and incidence of economic cost provides a common language for making linkages between OSH and other policies. How, for instance, do OSH expenditures compare to training, school-to-work interventions and other programs to secure a desired labour force? How do they contribute to anti-poverty objectives through avoiding negative household economic shocks? How can targeted OSH services complement other programs designed to support small and medium enterprises? Simple OSH cost accounting is only a first step, but it is a necessary one in order to provide an overall framework for considering cross-policy synergies.

To be honest, policy integration has played only a very minor role in OSH programming in the industrialized countries. (Perhaps it merits more attention.) On the other hand, it will be the contention of this paper that mainstreaming OSH into the core concerns of economic development is central to raising the profile of the work environment in the developing world. Indeed, we have already witnessed a parallel process, spearheaded by the World Health Organization's program in Macroeconomics and Health. (World Health Organization, 2004) Resources allocated to gaging the aggregate contribution of health improvements to economic development were well-spent; it is now accepted wisdom to recognize that good health is a precondition for other development goals. (This health-aware view is fundamental to the Millennium Development Goals, of course.) It is difficult to say how widespread this understanding would be had there been no organized effort to assess the aggregate economic impact of ill-health, but it is reasonable to assume it would have arisen more slowly. Once again, the best evidence is negative: there has been no such organized effort for the occupational dimension of ill-health, and

poor working conditions are given little attention in most development circles. A fundamental goal of the project outlined in this paper is to address this gap.

Thus, to summarize, there are both advocacy and pragmatic justifications for estimating the economic burden of poor working conditions, and all of them should apply with extra force in the developing country context. Above all, more effective advocacy is sorely needed. Yet a wide range of social and public health policies can also be made more effective – better targeted, prioritized and integrated – with appropriate economic data. It is exactly in the context of a relatively poor country, one with many worthwhile but competing needs and severe resource constraints, that such effectiveness has the largest payoff.

3. Research on Economic Costs of Occupational Injuries and Illnesses in Industrialized Countries – Looking in, and Learning from, the Light

The first step in developing a methodology for uncovering the economic costs of work-related ill-health in developing countries is to survey studies that have been conducted in the industrialized world. Our interest is primarily methodological: what overall models of cost have been employed, what data did these studies draw on, and what choices had to be made along the way? Very roughly, we are interested in best practice, although there are still many ambiguities that prevent a single standard from being applied to all cases. Later we will compare this work to the (fewer) studies that have looked at low- and middle-income countries. In the process it will become clear that the research strategies that have succeeded in the first domain will have to be radically revised in order to make progress in the second.

The general approach taken in aggregate OSH cost research is bottom-up, generating totals for fatal and nonfatal work-related injuries and illnesses, identifying a range of worker, employer and social costs, and matching costs to incidents. Logically this method is separable: the first step is epidemiological, counting the numbers of occupational accidents and work-related diseases of all sorts, and the second economic, tallying the costs. They can be performed independently, by separate researchers if necessary, provided only that the same identifiers are used to categorize health outcomes and assign costs to them. For instance, if the cost model asserts that musculoskeletal injuries that result in at least three days of absence are associated with a certain period of reduced productivity after return to work, it is necessary to have an injury category based on this type of impairment and duration.

We can begin, then, with the count of injuries and illnesses. There are four potential sources of incidence data: insurances, company records, labour force surveys and public health surveillance systems.

- (a) Employment injury insurance workers compensation systems cover most employees in industrialized countries, and claims data can be used as a primary source for work-related health impairments. The chief advantage is the wealth of information contained in these claims – the occupation and industry of the claimant, demographic information, details concerning the nature of the impairment, length of absence from work and medical expenses. Disadvantages include incomplete coverage (some public employees and the self-employed may be outside the system) and the failure of many individuals to file claims even though compensability criteria have been met. In addition, injuries are covered more comprehensively than illnesses.
- (b) Companies are normally required to maintain records of OSH incidents. As with the workers compensation claims data, these records can be a rich source of information. Despite oversight from public OSH agencies, however, there may be disincentives that result in underreporting, as we will see shortly.

- (c) Labour force surveys contain periodic modules that ask respondents to self-identify work-related injuries and illnesses; an example is Australia's Work-Related Injuries Survey (WRIS). These have the advantage of being recorded in conjunction with many other variables in recurrent samples.
- (d) Surveillance systems have proven to be of special value in two realms, fatal injuries (such as the US National Traumatic Occupational Fatality database) and occupational diseases. In the latter category, cancer and similar registries have played an important role, although medically-defined stressors do not always make it possible to discern which cases are work-related.

Unfortunately, despite extensive record-keeping involving accidents in particular, research indicates that many are missed. Leigh et al. (2004), for instance, find that perhaps a quarter of all US workers are excluded from the statistics published by the Labor Department's Bureau of Labor Statistics, which draws primarily on company records. Because of undercounting even among workers whose employment is covered, they estimate that as many as 2/3 of all occupational injuries may go unrecorded. This finding was supported by Boden and Azonoff (2008), using capture/recapture methodology. (Company records and workers compensation claims were treated as two "captures".) A survey administered in ten US states found that between 23 per cent (Kentucky) and 53 per cent (Texas) of all injuries requiring medical treatment were not compensated by state workers' compensation systems. (Bonauto et al., 2010) Nor is the United States exceptional in this respect. Hämäläinen et al. (2009) found that only 40-50 per cent of nonfatal occupational accidents are reported in a selection of EU member states.

Why, despite the abundance of sophisticated data sources, are official statistics so prone to undercounting? Azaroff et al. (2002) provide an illuminating discussion of the various "filters" that may impede a proper recording of work-related cases in systems based on employer records, compensation claims and public health surveillance. It is worth reproducing their list of potential failures that could prevent a case from entering the official tally:

- Failure to report an injury or work-related disease to supervisors. This may occur because of non-recognition or intimidation.
- Failure to be absent from work. Even though the health impairment justifies absence (and may be exacerbated by continued work), the worker may not be able to afford loss of pay, may not be aware of the availability of insurance, or may be pressured into remaining on the job. Lost workdays are typically the characteristic that distinguishes a case as passing a threshold of seriousness.
- Failure to seek medical care. This may be due to the inability to afford care, the lack of awareness regarding insurance, or not recognizing the need for treatment.
- Failure to have the impairment deemed work-related. Workers seeking medical care may not realize their impairment is work-related; this oversight may also be attributable to medical personnel. Clearly, this is especially pertinent for occupational diseases.
- Failure to file for reimbursing medical expenses with employment injury insurance schemes. This may result from lack of knowledge regarding the compensation system, delays or gaps in coverage caused by the system itself or employer intimidation.
- Failure to have the incident recorded in company books. Employers have economic incentives under virtually all national OSH systems to under-record cases if they suspect they will not be discovered.
- Failure to file a claim for wage replacement with employment injury insurance schemes. This may be due to lack of understanding or pressure emanating from the employer.

- Failure of medical personnel to participate in surveillance systems. Because work-related disease has a relatively low profile in the medical arena, many physicians and other personnel do not follow through on identification and reporting routines.
- Failure to identify work-related impairments in surveillance systems. Even personnel who do participate may fail to recognize instances in which impairments are attributable to occupational factors.

Azaroff et al. provide references from the literature indicating that all of these filters are materially significant; together they readily account for the shortcomings of even the best-funded and -organized OSH statistical system.

There is still more to be said about occupational illnesses. Unlike injuries, even if all filters are completely permeable, illnesses cannot readily be attributed to occupational factors coincident with their onset. Causation is probabilistic, and latent or cumulative effects complicate the task of linking exposures to outcomes. This has forced researchers to augment official statistics with estimates they construct themselves. The procedure calls for the use of a multi-step process:

- (a) a literature search is conducted to identify reputable studies estimating the dose-response relationship (risk ratios) between exposures that may have an occupational etiology and various health outcomes;
- (b) exposures identified in the literature are attributed to locations in the industry-occupation matrix;
- (c) the number of workers in each of these locations is tabulated;
- (d) the number of predicted disease cases in each location is tabulated;
- (e) the number of predicted cases is compared to the total of actual cases to calculate attributable fractions; and
- (f) these attributable fractions can then be applied to populations other than the one originally studied, if necessary.

A particularly influential study of this sort is Nurminen and Karjalainen, thanks to the abundance of data sources in Finland. They estimated that 7 per cent of all fatal diseases could be attributed to occupational causes, including 24 per cent of lung cancers and about half that percentage of fatal coronary diseases. In all, approximately 1,800 workers, just under 1 in 1,000, was thought to have died of an occupational disease in the study year (1996). Similar calculations were performed for the United States by Leigh et al. (2000) and Steenland et al. (2003). Both corroborated the rule of thumb that, for every fatal accident at work, there are about ten fatal diseases.

Once incidence of work-related injuries and illnesses is established, the second general task is to ascertain an economic cost for each outcome category. The simplest approach is to classify these costs according to who bears them, the employer, the worker or the rest of the community. Since this is the core of the economic accounting exercise, we will take a close look at the methods that have been used in research on industrialized countries.

3.1 Employer costs.

It has become common to distinguish between “direct” and “indirect” costs borne by employers as a result of work-related injuries and illnesses, although there is some dispute about what should be included under each heading. The broadest definition of direct costs includes all those

for which monetary payments are made. (Dagenais et al., 2008) More commonly, analysts have settled on three, employer payments into employment injury insurance funds, wages paid to workers during an injury- or illness-induced absence (sick pay) and medical expenses for which the employer is held responsible, the latter two both net of reimbursement by insurances. The first, employment injury insurance premiums, tends to be the largest in most industrialized countries, reflecting the intention of such programmes to cover the bulk of medical and wage replacement costs. The disadvantage of premium costs from an economic point of view is that they are usually regarded as overhead rather than a component of the cost of specific work-related health incidents, thus providing little incentive for investments in safety. The main reason for this perception of employment injury insurance costs is the limited role for experience rating in setting premium levels (unavoidable to maintain the risk-pooling function); even if premiums were fully determined by injury and illness experience, in the absence of activity-based accounting methods to allocate these costs to units where risk exposures occur, relevant managers would still see little financial rewards to OSH investments. (Dorman, 2000) That said, if employment injury insurance coverage is incomplete, employers may be liable for a portion of wage replacement and medical expenses. These should be viewed as direct costs, although, once more, the allocation problem within accounting systems has to be acknowledged.

It is in the area of indirect costs that the greatest differences have emerged, less over the conceptual content than the measurement strategy. The main elements in indirect costs are:

- Collateral damage to equipment and materials. If injuries occur as a result of accidents, there may be damage to items in the firm's inventory or capital stock.
- Downtime. The production process may be halted due to an accident.
- Absence of the insured or sick worker. Firms may lose productivity when workers are away from their jobs. Note that reduced productivity due to this and other causes may appear not only in the form of reduced output, but also a deterioration in quality or timeliness.
- Negative effects on coworkers. Coworkers may be distracted or suffer a loss of morale as a result of an injury or illness episode.
- Compensatory overstaffing. Firms may employ extra workers in anticipation of future absences due to work-related ill health. This point has been emphasized in particular by Oxenburgh. (Oxenburgh and Marlow, 2005)
- Reduced productivity when workers' health is impaired. This may be formalized through light duty or take place without formal recognition or even awareness. Researchers have referred to this cost as "presenteeism".
- Costs of administrative response. If firms take action in response to incidents of work-related injury and disease – as they should – their costs of investigation, supervision and employee relations should be accounted for.
- Additional recruitment costs. Work-related injuries and illnesses can increase turnover directly, if workers affected cannot return to their former positions, and indirectly by undermining morale and commitment. In either case, employers face added costs in searching, screening, hiring and training replacements. (Berger et al., 2001)

Measurement problems arise because many of these categories, while potentially significant in their impact, are difficult to observe and quantify. For example, the responses of coworkers to a health impairment episode may be subtle and hard to detect, yet quite important for

the firm's bottom line. Presenteeism has also proved to be a problematic aspect, since reduced employee ability and commitment is difficult to identify; in many cases, workers suffering from an impairment will have an incentive to persuade supervisors that no such impairment exists.

Finally, large differences of opinion have arisen over how worker absences should be evaluated. A starting point for most researchers is the economic hypothesis that a worker's wage is equal to the value of her marginal product, the additional productivity attributable to his or her employment. (This would be true if various conditions regarding labour markets, workplace organization and technology were met which, collectively, are unlikely.) Thus, lost pay should be equal to the value of lost output. Nevertheless, another view has taken hold, which rejects any simple relationship between absenteeism and lost production. Some researchers argue that firms can temporarily reorganize work processes to offset reduced staffing until the worker who had suffered a health impairment can return to work or a replacement can be found. Thus any reduced output is a transitory phenomenon, disappearing when reorganization takes effect; this explains why it is called the "frictional" cost approach. (Koopmanschap et al., 1995)

These cost categories can be understood only by seeing how they are measured in practice. We can begin by noting that most indirect costs – items like collateral damage to materials, administrative overhead, excess staffing and increased turnover – are evaluated on an individual level, but rarely in economy-wide studies. (For an example of a costing tool at the level of an individual firm, see Oxenburgh and Marlow, 2005.) It is recognized that such cost elements may well be cumulatively significant, but it is difficult to find aggregate data on them. Thus direct costs, and especially absenteeism, are central to most of this literature. Indeed, in the great majority of studies, the number of days missed from work due to an injury or illness is regarded as the sole component of employer cost, and the value of lost output is assumed to be equal to the number of missed days times the worker's daily wage.

Nevertheless, in a number of studies an effort has been made to qualify or extend this approach. An excellent survey can be found in Zhang et al. (2011); here we will highlight a few pertinent themes. One issue is whether only a portion of lost workdays should be regarded as resulting in lost output, as argued in friction cost theory. An example of careful investigation is Jacob-Tackén et al. (2005), which used surveys of both supervisors and front-line workers to determine the portion of lost workdays that led to reduced productivity in the Dutch health care sector. They found that only 25-30 per cent of these absences could be tied to less output; in the majority it was possible for management to make temporary adjustments that compensated for the missing personnel. In accordance with the theory, the longer the absence the more difficult it was for the firm to sustain this adjustment. (The absences in question were temporary, and replacement did not arise.) This result, even though it is based on evidence from just a few workplaces, should make us wary of the assumption that it is enough to simply tally the number of days health-impaired workers are absent from their jobs.

On the other hand, it is also possible for the value of lost output to be significantly greater than the wages corresponding to the lost work time. The theoretical basis for this claim was established in Pauly et al. (2002), and empirical corroboration was presented in Nicholson et al. (2006). The argument is that three factors can potentially lead to an absenteeism cost multiplier great than one: how readily an injured or ill worker can be replaced, the extent of teamwork that relies on the contribution of the missing worker, and the degree to which the value of output is time-sensitive. That is, if specialization, training or labour market constraints make it difficult for the employer to find substitutes for the worker who has suffered a health incident,

if output is determined interactively between that worker and his or her teammates, and if the firm suffers an appreciable cost due to a delay in supplying output of the desired quality, then the value of lost production may well exceed the wage equivalent of the absenteeism episode.

To test this, Nicholson and his collaborators administered a survey to a sample of managers in a variety of industries, asking them in different ways to assess the hypothetical unplanned absence of one of their subordinates, in conjunction with their perceptions of the extent to which their units corresponded to the three factors affecting absenteeism multipliers. This enabled Nicholson et al. to estimate a formula for predicting the multiplier and to apply it to the industries in the sample. It is difficult to summarize their decomposition of the multiplier, since they estimated coefficients on each stepwise answer regarding the levels of replaceability, teamwork and time-sensitiveness (via an ordered probit), but two generalizations can be offered. First, difficulty in substitution had the largest effect of the three, followed by team production and time sensitivity. Second, when the multiplier was calibrated for each industry based on a hypothetical two-week absence, it ranged from 1.00 (fast food) to 1.93 (paralegal). Other examples include hotel room cleaners (1.10), retail sales (1.17), truck driver (1.28), welder on an auto assembly line (1.33) and carpenter in non-residential construction (1.51). Overall, the evidence presented by these authors gives us the opposite impression from the frictional cost studies: absenteeism tends to understate, rather than overstate, output costs to employers. Clearly, it is important for future work to bring these two perspectives together into an integrated framework.

In addition to absenteeism, a full accounting would include the cost of presenteeism as well. Logically, this would have to be based on subjective surveys of workers and managers, since the objective metric of days lost is not available. Researchers have employed several such instruments, and it is illuminating to look at some of the examples. For instance, Meerding et al. (2005) used two different surveys to estimate the degree of presenteeism associated with health-impaired workers in two physically demanding job categories. They found a high degree of correlation between the productivity losses indicated by the two methods, with a mean of about two hours per day applying across three of four sample-instrument pairs. (This pertains only to workers who also reported lost work time.)

Another synthetic approach was used by Goetzel et al. (2004), who applied data from five previous presenteeism studies, based on a variety of survey instruments, to ten leading health conditions at a national level. Based on differences in survey results, they classified presenteeism losses into low, average and high estimates and combined them with absenteeism data for the same impairments. Presenteeism costs were converted into hours lost equivalents and then valued at workers' wages, as were absenteeism costs. The results, presented as an average cost per case and broken out by health conditions, permit both absolute and relative measures of absenteeism and presenteeism, but perhaps the relative amounts are more persuasive since both are derived from the same wage assumptions. Using mid-level presenteeism estimates, the authors find that presenteeism accounts for about 50 per cent more of total costs than absenteeism, although the ratio varies from 1:4 to 9:1 across health conditions.

Finally, Pauly et al. (2008) applied the same methods to presenteeism that Nicholson et al. (2006) applied to absenteeism, generating multipliers for this less tangible form of cost. Naturally, they are universally less than one – even the most costly reduction in productivity under conditions of limited replaceability, teamwork and time-sensitivity is less damaging than outright absence – but they are appreciable nonetheless. Results are presented for both acute and chronic conditions, which tend to be similar. The mean multiplier (fraction of the worker's wage lost to presenteeism)

was 0.31 for acute impairments and 0.32 for chronic. Looking only at acute conditions, the multipliers varied from 0.125 (hotel maids and auto service technicians) to 0.25 (truck drivers, construction workers, waiters and waitresses) to 0.50 (carpenters and office clerks).

Drawing these and other studies together, it is difficult to disagree with the judgment of Zhang et al. (2011) that there is still a wide variety of presenteeism measurements depending on sample and methodology, but it is also striking that disparate methods all arrive at substantial costs. To date, such costs have not been incorporated in national measures of the cost of work-related injuries and diseases.

3.2 Worker costs.

By far the most salient cost to workers is the loss of quality of life, and even premature death, resulting from occupational injury and disease. Whether this is an economic cost, one that should be added to the financial costs borne by employers, is another matter.

One argument is that all costs, whatever their nature, are economic in the sense that there is a monetary equivalent that people would be willing to pay to avoid incurring them. In the case of catastrophic losses, including loss of life, the claim is that people would pay a sum of money to reduce their risk of an occurrence, and this permits extrapolation to a unit cost for a single episode. Thus, if I would pay \$100 to reduce my risk of losing an arm by 0.1 percent, this implies that the monetary cost of having an arm severed in an industrial accident (for me) is \$100,000. There are two difficulties with this argument, however. First, the monetary sum is strictly notional; there is no actual financial impact, and for many purposes it is this impact that we wish to isolate and measure.

In particular, this is the case for studies whose purpose is to motivate more investment in improving working conditions in the developing world: we do not need to be persuaded that those who suffer serious injuries and illnesses suffer on this account, but we wonder whether the costs of poor working conditions impinge on development. Treating subjective well-being and financial gains and losses as equivalent obscures this question. (It is telling that none of many studies of the economic cost of malaria and HIV/AIDS, which we will survey later in this paper, incorporate monetary equivalents for reductions in the quality or extent of life.) Second, there is considerable evidence that people in their negotiations with risk do not behave according to the “rational consumer of health” model on which cost attribution depends. (Dorman, 2005) This suggests that even if methods to construct monetary equivalents for health outcomes are internally valid (if the experimental methods produce values that are logical in the context of the experiment), they impute to individuals a consistency they do not adhere to in their daily life.

A different argument is that the worker’s subjective valuation of the risk of injury and disease really is a financial cost, one that must be paid by employers. The justification is that, in a perfectly competitive labour market in which there is no long term attachment between workers and firms, nor any resource- and time-consuming process of job search, nor any incentivizing purpose to the wage beyond assuring that workers show up at starting time, differences in the riskiness of work need to be offset by differences in pay. If two jobs are identical in every other respect, and workers are free-floating, fully informed agents maximizing their returns in the labour market, one that is more dangerous will have to pay more in order to attract a workforce. The difference in pay between the two jobs would be a perfect measure of the difference in their

desirability from the point of view of the workers who are in a position to consider them, and it would be an actual, payable cost borne by employers. According to this theory, employers have a financial incentive to make their workplaces safer in order to avoid paying this wage premium. Many economists claim to have measured this premium; for a widely-cited review, see Viscusi and Aldy (2003). On the other hand, disconfirming and anomalous results have also appeared, such as Dorman and Hagstrom (1998). Without going into detail regarding the issues that separate proponents and opponents of the wage compensation hypothesis, it is germane that the expense of paying a wage premium never appears in firm- and sector-level studies of occupational safety and health costs. It is true that some workers earn extra hazard pay for coping with exceptional risks on the job, but these are typically risks that are perceived as inherent, beyond the ability of employers to mitigate. One does not see workers agreeing to higher wages in return for the employer's unwillingness to take available safety precautions. (Dorman, 1996)

For the purposes of this paper, then, we will adopt a narrower definition of what constitutes the economic cost of an injury or illness. Pain and suffering will be acknowledged as centrally important costs, but they will not be treated as economic; only those that have tangible financial consequences, whether in money or in-kind services, will be subject to measurement.

There are, of course, many important economic consequences of work-related ill-health that accrue to workers and their households. Above all, they may suffer an uncompensated loss of income for the duration of their absence from work. Most workers in the industrialized world are insured under employment injury or workers compensation systems, but not all absences are compensated, nor do the payments necessarily reimburse workers for the full monetary cost of their absence. These lost earnings represent the starting point for measurement of economic costs borne by workers. (We will refer to "workers" as the party bearing this cost, although it may well be other household members who either share it or bear some portion of it in its entirety.) Under the category of lost earnings should be included not only unpaid absences from current employment, but also early withdrawal from the labour market.

A second direct financial cost arises when workers must pay for medical care and pharmaceuticals without being fully reimbursed by either the employer or employment injury insurance schemes. This assumes, moreover, that medical care is provided on a fee-for-service basis, which may not be the case. If workers have recourse to a publicly-funded system, such as the UK's National Health Service, medical expenses accrue to the wider community.

A related financial cost is the loss of assets due to diminished wages and unforeseen health care expenses. One should be careful, since this can result in double-counting, yet lost assets are a legitimate category. The reason is that, even in the wealthiest countries, most individuals, and certainly most workers, face credit constraints. If they suffer a temporary loss of income or incur large medical expenses, limitations on their ability to borrow can lead to the loss of a home, an automobile or other goods on which they rely for maintaining their standard of living. Morse et al. (1998) report, for instance, that Connecticut workers who had suffered work-related musculoskeletal disorders were two and a half times more likely to have lost their car and three and a half times more likely to have lost their home. In a careful analysis one would want to identify the portion of this asset loss that is additional to the income-and-expense shocks that these workers also experienced.

Other costs may be less tangible than these, but they are of economic significance all the same. Injured or ill workers are less able to engage in household production, tasks which have economic value not only in the sense that one could be imputed to them, but also in the possi-

bility that it may be necessary to pay someone else for this purpose. Thus, in the Connecticut study just mentioned, workers with musculoskeletal disorders found it much more difficult to manage their child care responsibilities. Even if lost production is compensated by other household members, however, there may be an economic cost. Other adults may have to reduce their labour market work, or perhaps some of their household responsibilities will go unmet. Children may be called on to do more in the household, reducing the time available for school work – certainly a serious economic outcome, although difficult to assess on an individual level and delayed in its impact. It will turn out that household costs will be expected to play a larger role in developing countries due to the lack of monetary and institutional support available to households impacted by work-related ill-health.

A final point of some significance is that good health constitutes an important source of human capital. To the extent they are long-lived, health impairments deplete this capital and reduce the economic prospects of the victim. Once again, the Connecticut study offers an entry point: workers with musculoskeletal disorders are less than half as likely to be promoted compared to their peers. The vast literature on disability establishes the health-economic prospects linkage more fully, although it does not distinguish between work- and nonwork-related impairments. Ideally, we would want to incorporate at least the loss of expected future earnings in any accounting of workers' OSH costs.

3.3 Costs to society.

Of course, costs to enterprises and workers are also social costs, but there are burdens that fall solely on the larger community beyond the employer's workplace and the worker's household. These are largely the costs of medical care and wage replacement that are not financed by either workers or firms. Since employment injury insurance is usually fully financed from employer contributions, it should not be included in this category. Payments that fit the definition of "social" include:

- additional subsidies for wage replacement and medical reimbursement out of non-employment injury insurance accounts;
- costs of administering the public OSH system, or at least those portions necessitated by the continuing occurrence of work-related health incidents;
- claims on insurance systems other than employment injury insurance; and
- the use of public health services not administered on a fee-for-service basis.

Note that there are both public and private elements to the category of social cost. If workers are reimbursed for some of their medical costs by private health insurances, the cost falls on all subscribers and represents a sort of social subsidy to the cost of OSH incidents. In most industrialized countries the social account is much smaller than the employer and worker accounts, although this does not apply when medical care is publicly provided.

3.4 The example of Great Britain.

Great Britain has the only national OSH accounting process designed to continually update estimates of aggregate economic cost. Under the aegis of the Health and Safety Executive,

the costs of workplace accidents have been tallied and reported periodically since 1994. In 2009 HSE commissioned a fundamental review of its costing methodology, which resulted in a number of improvements, including a spreadsheet model that permits annual updates. Here we will look at the methodology employed in their most recent update for the financial years 2006-07 through 2009-10. (UK Health and Safety Executive, 2011a)

The goal of the cost exercise is to put a price on workplace exposures within a given year that result in injury and common ill-health outcomes and to apportion it among the three parties – business, workers and government. That is, its time frame is based on the appearance of new cases (incidence) rather than the total number of cases among the population (prevalence); if a worker is newly injured or made ill due to occupational causes during the reference year, the case is recorded, but not if the case was initiated during a prior year.

Four categories of health outcomes are recognized in the HSE model depending on whether they take the form of injuries or illness and whether they are fatal or nonfatal:

- (a) Fatal accidents are taken from employer records. Employers are required by law to maintain them, and it is believed that accidents resulting in death are such high-profile events that the records are comprehensive. There is no secondary source for these incidents, such as public health surveillance systems.
- (b) Nonfatal accidents are not taken from employer records, since it is believed that only about half are properly reported. Instead, they are extrapolated from responses to a module in the national labour force survey, administered to a sample of just over 50,000 responding households. Three consecutive surveys are pooled to generate more observations for this extrapolation. Injury events are therefore self-reported, with a recall period of one year.
- (c) Nonfatal illnesses are also identified from the labour force survey; again three years are pooled. While this survey is believed to be an accurate source of information for estimating the incidence of common work-related illnesses, it does not capture less common, long latency conditions such as cancers and chronic obstructive pulmonary disease, since it is difficult for respondents to attribute them to occupational versus non-occupational exposures. Three-fourths of the nonfatal illnesses that are recorded take the form of either musculoskeletal disorders or stress.
- (d) Fatal diseases are currently not part of the system.

Employer costs are relatively modest under the HSE methodology. An extreme version of the frictional cost model is assumed: neither absence nor presenteeism is believed to cause any reduction in the firm's output. In this case, employers bear only direct costs. If they provide sick pay to workers even after they have been replaced, and if this pay is not reimbursed, it constitutes an OSH cost. Insurance premiums to indemnify OSH liability are another significant cost item. Employers pay an administrative cost per incident, which is assumed to be equal across all firms; they also bear an expense for taking measures to maintain output, such as reorganizing the work process and performing the additional recruitment and training necessitated by OSH-induced turnover. In practice, sick pay and insurance premiums account for nearly all the employer costs identified by HSE.

Worker costs are greater. The main reason for this is that the HSE borrows a methodology from road transport analysis which assigns monetary costs to the pain and hardship resulting from both fatal and nonfatal incidents. Aside from this, workers lose wage payments during their absence from work unless they receive sick pay from employers, or unless they are reim-

Table 1: Costs to Stakeholders of Hazardous Working Conditions in Great Britain, 2009–10
(in £billion)

Stakeholder	Point	Lower	Upper	Percent
Employer	3.1	3.0	3.1	22
Workers/households	7.6	6.8	8.4	55
Government	3.3	2.9	3.7	24
Society	13.9	12.7	15.1	100

Source: UK Health and Safety Executive (2011b)

Table 2: Major Components of the Cost of Hazardous Working Conditions in Great Britain, 2009-10
(in £billion)

	Point	Lower	Upper
Nonfinancial human costs	7.6	7.0	8.2
Lost production	4.6	3.9	5.2
Medical costs	0.8	0.8	0.8
Compensation for lost wages	0.7	–	–
Production disturbance	0.1	0.1	0.1
Administrative and legal overhead	0.1	0.1	0.1
Total	13.9	12.7	15.1

Source: UK Health and Safety Executive (2011b)

bursed by state-funded disability benefits. If they withdraw from the labour force altogether – an outcome that would be self-reported in the survey – their lost expected future earnings are calculated, net of state-funded compensation. Because most lost earnings will be reimbursed under the UK system, however, the nonfinancial costs of pain and hardship predominate.

The government's share in total cost is on a par with that of employers. The UK has a comprehensive insurance program that provides replacement income to workers unable to continue working due to occupational injury or illness, as well as a publicly-funded National Health Service. Thus all medical services delivered to victims of occupational injuries and illnesses are expensed to the public except for a small portion picked up by private parties. In addition, the HSE methodology also estimates the tax revenues lost to the government due to health-related absence from work. Note that lost earnings due to absences or withdrawals from the labour force in the wake of OSH events are regarded in this methodology as social costs, since it is assumed that reduced labour supply constitutes reduced labour utilization at the macro-economic level. This is not an employer cost (wages and productivity are assumed to cancel out); rather it is split between workers and government, based on the proportion of lost wages that are publicly compensated. This item appears in Table 2 as Lost Production.

Another feature of the HSE methodology is that it incorporates the statistical uncertainty associated with extrapolating incidence estimates from a sample to the entire population. (Their confidence intervals for stakeholder totals incorporate the interactions between the uncertainties attached to these incidence estimates as they interact with other variables like the amount of lost wages. They do not reflect uncertainties about non-incidence variables, model assumptions or

potential measurement error.) Table 1 shows the point estimates and lower and upper confidence intervals for each stakeholder and society as a whole for the most recent year tabulated, 2009-10.

For the calendar year 2010, the UK GDP was £1,455 billion (current). This means total cost to society according to Table 1 was in the range of 0.9 – 1.0 per cent of GDP. It is important to bear in mind, however, that these costs do not include fatal diseases or most latent occupational diseases.

Table 2 breaks down the social cost for 2009-10 into its major components, again including a point estimate and lower and upper confidence intervals. Here it is clear that two components play the largest role: nonfinancial costs (pain and hardship) and lost output due to the removal of workers from the labour force.

Note that compensation is taken from administrative records and is therefore not subject to sampling uncertainty. A more detailed exposition of the UK approach can be found at: www.hse.gov.uk/statistics/cost.htm.

3.5 The example of the US.

J. Paul Leigh has recently published a major update to his earlier study of OSH-related costs in the United States. (Leigh, 2011) New data sources permitted a more precise methodology, and these methods were applied to data for the calendar year 2007.

Rather than use household survey data, Leigh bases his estimate of nonfatal occupational injury and illness rates primarily on records kept by employers and reported to the Occupational Safety and Health Administration (OSHA), but he adjusts the numbers upward to account for undercounting documented in previous research. He does use some survey data, however, to augment employer records with data for employees of small businesses, the self-employed and others not covered by OSHA record-keeping. Injury information from government employees comes from a separate compensation system set up solely for them. Basing his incidence estimates on administrative records in this fashion has the disadvantage, which he recognizes, that many nonfatal illnesses are excluded because of time lags and difficulties in attribution.

For fatal injuries, Leigh relies on the Bureau of Labor Statistics' Census of Fatal Occupational Injuries, which is generally viewed as comprehensive. Fatal diseases, however, are more difficult to identify. Leigh's approach relies on published work to identify the fraction of these diseases that can be attributed to occupational causes, so he can then translate general disease costs into those that are specifically work-related.

On the cost side, Leigh distinguishes between what he labels direct costs – medical expenses – and indirect costs. The latter consist of lost earnings and other employee compensation, as well as the lost value of home production. Note that his treatment of lost earnings is the same as that of the UK HSE: it is assumed that a worker absent from work is generating lost output somewhere in the economy, and the value of that missing output is equal to what the worker would have been paid. As with HSE, no further allowance is made for multiplier effects of unanticipated absences or for possible costs of presenteeism, but employer overhead estimates encompassing items like added recruitment and training are included.

Since injury and nonfatal illness records contain occupation and industry information on the affected workers, Leigh can apply the appropriate average wages to his cost calculation.

Table 3: Estimated Costs of Occupational Injuries and Diseases in the US, 2007, by Cost Item
(in billions of \$US)

Medical costs	67.0
Lost employee wages and benefits	139.0
Lost home production	43.5
Total	249.6

Source: Leigh (2011)

Table 4: Estimated Costs of Occupational Injuries and Diseases in the US, 2007, by Event Type

Type of event	Total cost (billions \$US)	Number of cases (thousands)	Unit cost \$US
Injury, nonfatal	185.8	8,559	21,713
Injury, fatal	6.0	5.7	1,058,865
Disease, nonfatal	12.3	462.7	26,496
Disease, fatal	45.6	53.4	852,278

Source: Leigh (2011)

Medical costs can similarly be estimated on the basis of the injury or illness severity and type. Overhead costs for employers and the public workers' compensation system have also been estimated on a per-case basis in prior studies and Leigh transfers them to this calculation. More detail is provided in estimations of the indirect costs of fatal injuries, since an earlier study, on which Leigh relies, provides estimates that include household production and future survival probabilities had a fatality not taken place. A somewhat different approach is taken to fatal diseases, however. Leigh begins with prior estimates of the total medical cost of diseases with possible occupational etiology, and he prorates them according to published estimates of their attributable fractions (the proportion attributable to occupational exposures). For wage estimates, he applies the attributable fractions to average wages earned by victims of the corresponding fatal diseases, disaggregated by age and gender. This is clearly less accurate than one would like, but other disaggregations that would be preferable, like education or occupation, are not available. All calculations involving future costs are represented by their present value using a 3 per cent discount rate.

Leigh's results for 2007 are given in Tables 3 and 4. Table three breaks them out by type of expense, Table 4 by type of injury or disease.

Lost earnings are the biggest single contributor to economic cost, but the value of lost household production is surprisingly large, equivalent to almost 2/3 of medical expenses. The sum of all three items comes to 1.8 per cent of US GDP for the year. Table 4 reports the relative roles played by incidence and economic burden in establishing these costs. Nonfatal injuries are by far the most numerous, and they play the largest role in total cost, but their unit cost is relatively low. Nonfatal diseases have a unit cost that is only somewhat greater. The unit costs of fatal injuries and diseases, however, are vastly greater, and they play a minor role in total cost only because of much lower incidence rates. Note that the 10:1 rule-of-thumb for fatal diseases to fatal injuries is corroborated in this study, but nonfatal injuries outnumber nonfatal diseases by

a ratio of nearly 20:1. In part, this is because of the relative abundance of more minor accidents compared to fatal ones, in contrast to the smaller proportion of nonfatal to fatal diseases. It likely also reflects the incomplete identification of diseases in the employer records that Leigh uses as his basis for nonfatal incidence data.

4. Research on the Economic Costs of Work-Related Injuries and Illnesses in Developing Countries

4.1 Two cases

To orient ourselves in the rather different world of low- and middle-income countries, we can begin by reviewing two recent attempts to place monetary values on the costs of occupational injuries at the national level. First, consider the case of Mauritius, as analyzed in Shalini (2009). The number of accidents was taken from reports filed with two government agencies, the National Pension Fund and the Occupational Safety and Health Inspectorate, during the fiscal year 2002-03. In all, 3,634 accidents were registered, of which 14 were fatal. Since the country's labour force was about 537,000 in 2003, this signifies an accident rate of approximately 0.7 per cent – less than a tenth of the accident rate found by Leigh et al. (2000) for the US in 1993 (9.9 percent). Nonfatal accidents were sorted into five categories depending on how many days of work were missed, and the midpoint of each category was assigned to all cases in the category to arrive at a total. The cost per absence was taken as the average daily wage in the one-digit industry in which the accident occurred. The same wage was used to calculate the cost of early withdrawal from the labour force or premature death. Finally, average costs for treatment of road accidents were used to estimate the medical expenses of occupational injuries, and to this was added a fixed unit cost of investigation by OSH authorities (assumed to be five days of wages for investigators plus 100 rupees). Summing up all costs, Shalini came to a total of 84 million rupees – \$3 million for 2003 – or 0.05 per cent of the country's GDP.

A second attempt to provide a national estimate was presented by Carlos-Rivera et al. (2009) for Mexico, using data from 2005. The scope of the study was more restrictive, however: it looked only at occupational injuries that resulted in treatment at medical centers operated by the Mexican Institute of Social Security, and only medical costs themselves, and no other costs to workers, employers or society were tallied. Even so, as we will see, the exercise required further assumptions in order for it to be generalized to the workforce as a whole.

Since medical costs are not recorded on a case-by-case basis, and since work-related injuries and diseases constitute only a portion of the caseload of the Social Security Institute facilities, it was necessary to provide an estimation procedure. The first step was to exclude all occupational diseases, since too few are recognized as such and treated in these clinics. The second was to classify all occupational cases according to the type and severity of injury sustained. Each injury category was then reviewed by a panel of Institute personnel, who proposed a standard set of procedures and resources that would likely be applied across severity levels. These medical services were priced on the basis of Institute reports, resulting in an average cost per case for each diagnostic group and severity. (This description leaves out detail regarding the extent to which researchers attempted to associate cases with treatments along multiple

diagnostic dimensions.) These methods resulted in an injury rate of 2.9 per cent (again, far less than the corresponding US rate) and an average cost per case of just over \$2,000. A total cost for the entire economy can be extrapolated, but only if one assumes that the 70 per cent of Mexican workers not covered under the Social Security system have injuries at the same rate, of the same type, and receive treatment of equal cost as those in the covered population.

Both studies are commendable in that they try to shed light on a subject that receives almost no attention. That said, both demonstrate some of the difficulties in doing this work in a developing country context:

- Both are restricted to occupational injuries, since occupational illness data are almost completely lacking.
- Both are based on data derived only from the formal sector; national estimates require extrapolation under the assumption that accident risks and economic costs are the same for informal jobs.
- Both rely on the doubtful assumption that all injuries in the formal sector are properly reported. They generate injury rates substantially below that of the United States, but it is likely that this reflects an incomplete count, not safer working conditions.
- Both have to impute costs, whether stemming from employee absences or medical treatment, since actual costs are not present in the data. The imputations rely on assumptions that cannot be verified.
- Both avoid the problem of estimating indirect costs, whether for workers or employers.

The purpose at this point is not to diminish the efforts of the researchers who published these articles: they are taking on an important task and using the resources available to them. Rather, they suggest that it is difficult to achieve the sort of OSH cost accounting that industrialized countries have performed with the data available in the developing world. In the remainder of this section we will explore the difficulties and their practical implications in more detail.

4.2 The incidence of work-related injuries and diseases

Data regarding occupational injuries and illnesses are far less available in developing countries, and where records do exist they are generally unreliable. A critical problem is underreporting. This is widely recognized by researchers who have attempted to estimate occupational injuries at a global level, such as Concha-Barrientos et al. (2005), who believe that it is responsible for more than 100,000 “missing” fatalities. Examples can be found in several countries. Schierhout et al. (1997) compared official OSH records to mortuary and police reports in ten rural districts in South Africa and found that only 15 per cent of the work-related deaths were properly registered. An equally disturbing pattern in Nicaragua is described by Corriols et al. (2008): a national survey of over 3,000 respondents uncovered 22 cases of acute pesticide poisoning requiring medical treatment, yet only one of these episodes was reported to the official pesticide injury registry. Similarly, Noe et al. (2004) examined the records of a single emergency facility in Managua during the period 1 August, 2001 – 31 July, 2002, identifying 27 fatal work-related injuries, when ILO’s LABORSTA database (compiled from country submissions) shows only 32 fatalities in 2001 and 29 in 2002 for all of Nicaragua. Thus, even when data sources are available, they need to be cross-checked independently against other sources of epidemiological information.

Of course, for many countries and many types of work-related impairments, no data of any sort are collected. For occupational diseases in particular, public health surveillance systems are the primary resource, but these tend to be inadequate. According to Ferlay et al. (2008), only 8 per cent of Asians and 11 per cent of Africans are covered by population-based cancer registries. If the number is restricted to registries whose results are deemed to be professionally publishable, these figures fall to 4 per cent in Asia and 1 per cent in Africa. One important reason for this is the lack of medical personnel with training in occupational health. (London, 2011)

Because data from developing countries are often unavailable or unreliable, it is common practice to extrapolate epidemiological results from developed countries. Not surprisingly, this is nearly always the case with occupational diseases; thus the attributable fraction of diseases derived from studies in a few higher-income countries (especially Finland) is simply applied to the rest of the world. (Hämäläinen et al., 2007; Driscoll et al., 2005a; Nelson, 2005; Piedrahita, 2006) Even in the case of occupational accidents, where some formal sector data are usually reported, North-to-South extrapolation frequently occurs. A prominent example is Hämäläinen (2006). They had estimates of fatal accident rates for developing countries (derived in many cases from rates in other developing countries), but not reliable nonfatal rates. Their solution was to apply the ratios of fatal to nonfatal accidents in a set of industrialized countries as a range of possible corresponding ratios in the developing world. The reason for highlighting this practice is not to criticize the researchers, who are doing the best they can with the data at their disposal, but to identify a critical weakness with existing imputations of national and global burdens of work-related injuries and illnesses. They are accurate only to the extent that working conditions in more- and less-developed regions are comparable – but are they?

There are two general reasons for supposing that they are not. The first is that the distribution of occupations and employment systems is dramatically different in ways that place workers in less-developed countries at greater risk. The most striking difference, of course, is the much-larger role played by informal sector employment. While this varies greatly from country to country, in general one can say that the majority of workers lack the coverage of OSH regulation and employment injury insurance schemes associated with formal sector enterprises. Adding them to other excluded populations, such as public employees in some countries, LaDou (2003) estimates that only about one in ten workers is within the reach of OSH laws. We know that employment characteristics associated with informality, such as more sporadic work and attenuated attachment to enterprises, are predictors of more adverse OSH outcomes in developed countries. (Quinlan et al., 2001) The evidence is spottier in the developing world, but generally supports the same conclusion.

In the previously cited Noe et al. (2004) study of an emergency department in Nicaragua, for example, about 30 per cent of all occupational accidents occurred in the home, suggesting that home-based production is hardly the refuge from risk it is sometimes believed, or hoped, to be. Pick et al. (2002) reports on a sample of over 400 street vendors in South Africa; more than half described symptoms of work-related injury or illness, and about a third had received treatment. Santana and Loomis (2003) describe a survey administered to over 2,900 working adults in Salvador, Brazil, where the self-reported industrial accident rate is 20 per cent higher among informal workers than those in formal jobs.

Another closely related aspect of developing country economies is the greater role for small enterprises. It is well-known that workers in the small business sector of industrialized countries are at greater risk of work-related injuries than those at bigger firms (Sørensen et al.,

2007), but is the same true for developing countries? As usual, we do not have the data that would enable us to answer with confidence, but case studies point in this direction. Wesseling et al. (2002) claim that working conditions at small and micro-enterprises in Costa Rica are worse than those with more employees, and Kheni and Dainty (2008) found that few small construction firms in Ghana were proactive in addressing safety risks. Rongo et al. (2004) conducted walk-throughs and surveyed workers at 60 small workshops in Dar es Salaam, witnessing hazardous conditions first-hand. Workers at every worksite reported at least one serious hazard, and nearly every individual in every type of workshop described work-related health impairments. In general, we should not be surprised that these problems are so severe: one of the main constraints that prevents small employers from improving working conditions is lack of financial resources, and this is likely to be even more constraining in poorer economies.

As for industrial composition, the biggest single difference between developing and industrialized countries has to do with the large share of agricultural employment in the former. Even in the industrialized countries, where the role of direct physical labour has declined, agriculture remains distinctly hazardous and contributes more than its share to the economic burden of work-related injuries and illnesses. (McCurdy et al., forthcoming; Leigh et al., 2001) Case studies in developing countries reaffirm this heightened degree of risk. Lu (2011), for instance, found that almost 30 per cent of her sample of Filipina farmers was suffering from a work-related disease, while Mock et al. (2005) found that the occupational injury rate in rural areas of Ghana was four times the urban rate in a sample of over 21,000 individuals.

Some activities stand out as far more prevalent in developing countries; among them is scavenging and recycling. Of course, there is also an active recycling and landfill industry in the industrialized world, but this too tends to impose greater than average risks on its workforce. (Kitsantas et al., 2000) The situation is far worse in poorer countries where scavenging is widespread, and where enterprises compete to be repositories of imported electronic waste on the basis of low wages and minimal OSH oversight. This is brought out in a comparison of Switzerland and India: Switzerland has sustained an e-waste processing industry, but only with difficulty due to its insistence on upholding OSH regulations. India is rapidly expanding its e-waste imports, but working conditions in that sector are substandard by any definition. (Bandyopadhyay, 2010) Other case studies have found extremely unhealthy conditions in recycling operations in Hong Kong and Bangladesh. (Chan and Leung, 2011; Hossain et al., 2008) Below this level are the informal scavenging and recycling activities in developing country garbage dumps, where serious health problems are ubiquitous. (Gutberlet and Baeder, 2008)

Another difference that points to greater risk in developing countries is the greater reliance on child labour. It is difficult to generalize about the degree of health and safety risk faced by child workers, but a large body of research has documented exposures in a wide variety of contexts. (Dorman, 2008; International Programme on the Elimination of Child Labour, 2011) One way to characterize the overall situation is to note that children face greater than average accident rates but also lower than average severity rates – while performing work that is typically less onerous or intrinsically hazardous than adults. In other words, if adult work were identical to child work, the replacement of adults by children would tend to increase the likelihood of injury. Thus the greater employment of children in developing countries should be considered a further reason to suspect that the lack of OSH data conceals increased risk.

Even where there are no “special” factors that point to greater risk, however, it can safely be said that working conditions tend to be worse in developing countries. The popular press is filled

with reports about fires, mine disasters, sweatshop conditions and other dramatic instances of OSH failure, and the scholarly literature concurs. (Barten et al., 2008; Ahasan and Partanen, 2001) A number of detailed case studies have been published documenting shortcomings in particular localities and sectors. (Ahasan et al., 1999; Velázquez et al., 2008; Iroakpo Ido, 2008; Wong et al., 2011; Malik et al., 2010; Kayumba et al., 2009) In some cases researchers were able to demonstrate that work in the same sector was more dangerous in developing compared to developed countries. (Hermanus, 2007; Michelo et al., 2009; Barss et al., 2009) Even in the most advanced sectors of industry employing state-of-the-art technology, weaker regulation, diminished union presence and less OSH awareness result in greater risks being faced by developing country workers. (Brown and O'Rourke, 2007)

In summary, it is difficult to disagree with Giuffrida et al. (2002) who, although describing the situation in Latin America could be referring to any region in the developing world:

In sum, occupational health risks are likely to be higher in Latin America and the Caribbean than in the industrialized countries for a variety of reasons related to socioeconomic and political differences. First, workers are more likely to be in informal jobs and small businesses, which tend to have poorer work safety records. Secondly, labour unions have not been effective in pursuing workplace safety. Thirdly, workers work longer and are more likely to be in economic activities that are disproportionately likely to be hazardous, such as agriculture, fishing, construction, transportation and mining. Fourthly, women and children face particular risks when they are employed due to differences in training, physical vulnerability and sexual harassment. Finally, governments have fewer resources for prevention, research and enforcement of occupational safety standards. (p. 237)

4.3 Economic costs.

As little as we know about the rates of occupational injuries and illnesses in developing countries, we know even less about their economic costs. The few studies that have been conducted thus far draw on fragmentary evidence and require enormous assumptions to permit simplification and extrapolation; we saw two of these at the beginning of this section. Because the research literature on this topic is so slim, we would be forced to speculate about the probable differences that would enter into developing country cost calculations – if we could perform them.

The only data we have regarding employer costs come not from the employers themselves but from social insurances they pay into. This contrasts with developed countries, where vigorous debates continue about the relevance of frictional costs and the size of absenteeism and presenteeism multipliers. To a large extent, this reflects the resources available not only to firms but also researchers in poorer countries. In addition, the greater importance of small and informal enterprises in the developing world suggests that the records that would illuminate the size and nature of employer costs are seldom kept. The situation is particularly obscure in the realm of home-based production, where not only are records nonexistent, but even definitions of the costs themselves are uncertain.

The situation is hardly better on the worker's side. Indeed, what little we know comes from more general studies on injury and disease and not from specifically work-related impairments. Some of this will be discussed in the following section, where the focus shifts to the role of OSH in the development process, but a few points need to be made here because they suggest specific shortcomings in the available data.

First, the economic burden of health care costs is likely to fall more heavily on workers and their families in developing countries, although there is enormous variation in this respect. Baeza and Packard (2006) have constructed a chart which is worth reproducing here:



Overall there is a tendency for the out-of-pocket portion of cost to rise as national income is less, but the dispersion also increases: among the poorest countries are those in which patients bear the least cost and also the most. This is directly relevant because of the substantial role of medical expenses in establishing the incidence of economic costs, but also because the extent to which workers and their families are responsible for paying for their own care will also influence how much care they seek. It is likely that the combination of low household income and high responsibility for shouldering these expenses will lead to less formal care provision than we would otherwise see.

In addition, millions of working households, particularly in rural areas, have limited access to formal medical facilities. In analyzing data from Yemen, moreover, Cho (2011) finds that workers in the informal sector (where working conditions are likely to be more hazardous) have less access to medical treatment. Thus, use of medical care may diverge significantly from the need for care.

One result may well be the greater reliance on home care, delivered by family members on an unpaid basis. It is well known, of course, that unpaid care plays a large role even in relatively wealthy countries; in the United States, for instance, the American Association of Retired Persons (AARP) estimates that the cost of this care for adults with disabilities amounted to \$450 billion in 2009, or about 3.2 per cent of GDP. They arrive at this figure by using survey data on the amount of time spent, converted to dollars according to a formula based on the

applicable legal minimum wage and the going rate for home health aides. (Feinberg et al., 2011) This suggests a baseline for thinking about the presumably larger role of unpaid care in developing countries.

Comparable evidence that would enable us to place a monetary value on unpaid care in low and middle income countries, especially related to work-related impairments, does not exist. Occasional studies have been done of home-based care for specific diseases, however, and they provide a rough sense of the magnitudes involved. One study of the social cost of malaria in India found that a malaria sufferer who was also the main earner of a household lost an average of 8.4 working days over the course of ten months, but during that same time other family members lost 5.3 days as well. In other words, from the perspective of household costs, the absenteeism multiplier was 1.6. (Jayawardene, 1993) According to Mendoza (2010), family members in Cairo assume complete responsibility for the care of the autistic – they receive no institutional assistance – and the average time spent is substantially greater than that found in a comparable study of Swedish families with autism. In a review of the literature on the extent of unpaid care for individuals infected with HIV/AIDS in southern Africa, Akintola (2008) describes the toll taken on subsistence agriculture by the diversion of caregivers, most of them women, from production. Akintola also cites a survey from South Africa that finds that 40 per cent of primary caregivers have to miss work or school in order to care for family members.

Indeed, it may be that disruptions to education, rather than lost income from work, constitutes the most far-reaching impact of unpaid care. Akintola describes numerous studies that provide qualitative evidence for this phenomenon, although little is known about how extensive it is. Of course, to the indirect cost of work-related health impairments due to caregivers missing schooling must be added the direct impact on education when the injured worker is himself or herself a student. Mashreky et al. (2010), in a survey of Bangladeshis to identify those who had experienced an electrical injury, found that over 80 per cent of those who suffered an injury and were students were forced to be absent. The mean length of absence was nearly ten days, and the absence of 6 per cent of the sampled students could be measured in months. The general point to bear in mind is that when children are affected directly, through their work activity, or indirectly, as caregivers or replacement laborers, the impact on education needs to be taken into account along with the reduction in household income. Without question, reduced educational attainment is an economic cost, and it is valued in this manner in studies devoted to the economics of education.

Finally, the topic would not be complete without some mention of the potential economic costs of work-related injuries and illnesses that are not borne by employers or workers, but by society at large. In industrialized countries this is primarily the result of social insurance programs that indemnify enterprises and their employees, and which are funded out of general revenues. Such programmes also exist in developing countries, although they tend to be restricted to the formal sector, and their resources are fewer. Ironically, this component of total cost, while likely to be small in the developing country context, is also the most readily calculated, since public programs usually maintain records of their revenues and expenses. The difficulty, however, may be that of identifying the work-related component of their services if they provide health benefits for other reasons as well.

To sum up this section: there is far less data available on both the incidence and costs of occupational injuries and illnesses in developing countries than in the developed ones. This

has understandably led researchers to try to plug the information gaps with assumptions and extrapolations taken from countries where data are ample. Nevertheless, it is likely that this approach will understate the incidence of work-related impairments, and it is doubtful it will reflect the rather different set of factors that govern the economic costs of such events. This should provide a *prima facie* case for undertaking burden of injury and disease studies in low and middle income countries, even though the task is sure to be challenging.

5. OSH in the Context of Development

While it had long been recognized that lack of development was responsible for poor health outcomes in low-income countries, it was not until the 1990s or so that the reverse process – the impact of health on development – became a key topic for research and policy. One important milestone was the 1993 World Development Report, *Investing in Health*, which contained a section laying out the economic case for prioritizing health investments. Over the course of the decade, studies began to appear assessing the effects of specific high-profile diseases, like malaria, tuberculosis and HIV/AIDS, on development. Some were microeconomic, using survey and surveillance data, accompanied by economic theory, to estimate impacts at the household and community level. Others relied on data sets in which entire countries were units of observation, using time series and cross-sectional methods to isolate the effects of disease prevalence on growth. This literature was summarized in the report of the Commission on Macroeconomics and Health, *Macroeconomics and Health: Investing in Health for Economic Development*, which played a powerful role in putting health at the center of development policy. (Commission on Macroeconomics and Health, 2001) Diseases that plague the developing world, in particular sub-Saharan Africa, gained heightened attention, funding for treatment and prevention multiplied, and several health metrics were incorporated into the Millennium Development Goals.

Since this time, there has been somewhat of a backlash among professional researchers against the view that health is a major contributor to development, and also a backlash against the backlash. Some, like Acemoglu and Johnson (2007) and Ashraf et al. (2008), while agreeing with the humanitarian case for investing in health, denied that this would tend to raise incomes in poorer regions. Others, like Bloom et al. (2009) and Bleakly (2008), found fault with the methods of the skeptics. It is worth pointing out, however, that this debate has centered on the interpretation of cross-national data and has not reversed the view that, at national and community levels, poor health stemming from carefully studied diseases is a severe impediment to the development of those affected.

To some extent, these debates have been altered by a change in thinking about poverty and development that has also taken place within the past decade or so. Under the aegis of the “Washington Consensus”, influential organizations had promoted the notion that accelerated economic growth was the critical factor in reducing poverty; thus attention should be centered on national-level measures like GDP per capita. This view suffered from multiple reverses post-2000, however. While the main blows were struck in the wake of the East Asian financial crisis of 1997-98, it also became apparent that, for many countries, the relationship between aggregate economic growth and poverty reduction was problematic. The World Bank, for instance, began to shift its rhetoric and policy toward what it called “pro-poor growth”, which could no longer be taken as synonymous with growth itself.

In this intellectual and policy environment, the role of health took on a new meaning. One was the direct linkage between health status and household income. This can be drawn from survey data that include, as many do, questions on health and disability. Not surprisingly, the

evidence strongly supports the view that health impairment is an important contributor to lower incomes. (For a recent global “snapshot”, see Mitra et al. (2011).) There is also fragmentary evidence that children who live in households with disabled adults are less likely to attend school. (Cuong and Mont, 2011)

However, the main line of research at the present time concerns movements into poverty, and the role of health shocks in propelling them. The general framework could be expressed as follows: large numbers of households in developing countries are vulnerable to poverty. They have few assets, little access to credit, and their current income puts them uncomfortably close to the poverty line. If they experience a negative shock, it could be sufficient to put them into the ranks of the poor, from which it may not be possible to find a way out. Since poverty can often entrap its victims, the best policy would be one that either reduces the likelihood of shocks or bolsters the forces, like credit, that can mitigate them. If sudden health impairments constitute a significant fraction of these shocks, and if they have large, negative effects on income, investment in health should be seen as a means for reducing poverty.

The evidence supports this set of suppositions. Heltberg and Lund (2009) report the results of a survey in Pakistan focused specifically on shocks and coping mechanisms available to low-income people; they found

Conditional on a shock, almost one third of respondents faced shortage of food as a consequence of the shock; 7 per cent of households withdrew their children from school; 9 per cent put their children to paid work; 1 per cent sold major assets; 4 per cent went into bonded labour; and only 12.5 per cent had fully recovered from the shock. (p. 13)

Also, over half of the shocks reported by respondents were health-related. Wagstaff and Lindelow (2010) present the results of a survey in Laos that was also centered on the impact of shocks; they found that health shocks in particular impose a range of negative effects on households, with effects on the poor more likely to be permanent than those on the better off. Mohanan (2011) drew on records of bus accidents in rural districts of Karnataka, India. Some of the riders suffered injuries and others didn't, so this provided a natural experiment to see what the effects of injuries were on poverty and indebtedness. (The nature of the injuries suggests they might be a reasonable proxy for those resulting from work-related causes.) He found that injured riders did not cut back on consumption due to medical costs; rather, they borrowed almost the entire amount and almost half remained in debt a year later. Mounting debt burdens is one of the main channels by which household vulnerability to poverty is increased.

These case studies are suggestive, but they do not directly address the role of work-related morbidity and mortality in susceptibility to poverty. As we saw from the evidence of impacts on workers in industrialized countries, such as those documented in the Connecticut study (Morse et al., 1998), there is every reason to expect that OSH conditions play an important role in the propagation of poverty in poor countries as well. It is only that the research needed to demonstrate this has not been performed.

One way to place OSH in the context of health and development is to compare estimates of the human impacts of work-related injuries and illnesses to those of other, high-profile health problems. To do this we need a common metric. A useful standard of measurement has been created by the World Health Organization, the Disability Adjusted Life Year (DALY); it is described in the first *Global Burden of Disease* and has been elaborated in subsequent publications. (Murray

and Lopez, 1996; Murray and Acharya, 1997; Fox-Rushby and Hanson, 2001) The central idea is that weights can be constructed for various disabilities that express a year's impairment as a fraction of a year lost altogether due to premature death. A slight impairment would be closer to zero; an extremely debilitating impairment would have a weight closer to one. This makes it possible to sum up the DALY's attributable to different injuries and diseases, incorporating the number of years over which disabilities persist, and including both morbidity and mortality impacts.

The methodology is not without critics and faces a competing approach favored by many economists, the Quality Adjusted Life Year (QALY). (Anand and Hanson, 1997; Murray and Lopez, 1997; Nygaard, 2000; Reidpath et al., 2003; Robberstad, 2005; Mont, 2007) Without going into the issues that divide health policy researchers, it should be enough to say that one should bear in mind the limitations of any single approach for indexing the social and economic costs of ill-health, or even the enterprise of constructing any such index. Nevertheless, the DALY metric enables us to get a rough sense of the impact of work-related factors compared to others that have attracted public attention.

The problem is complicated by the decision of WHO to not attempt a calculation of the OSH-related burden in their most recent update based on data from 2004. This means we have to rely on the estimates they produced for 1990 and published in 1996. (Murray and Lopez, 1996) According to this earlier study, approximately 2.7 per cent of all DALYs throughout the world, the sum of preventable morbidity and mortality, could be attributed to work-related causes. Driscoll et al. (2005b) examine the assumptions that entered into this calculation and came to the conclusion that the true fraction of global DALYs is at least twice as great. Even conservatively, then, we could suspect that poor working conditions account for something like 5 per cent of the global burden of preventable injury and disease. Is that a big number or a small one? It helps to have comparisons. Turning to the most recent version of the global burden of disease report (World Health Organization, 2008), we find that the three "headline" diseases, HIV/AIDS, tuberculosis and malaria, account for 3.8 per cent, 2.2 per cent, and 2.2 per cent, respectively, of the global total. Thus, based on the DALY metric as our standard for social impact, work-related morbidity and mortality are far more substantial. (One should also bear in mind that some portion of each of these three diseases can be attributed to work-related factors as well.)

This raises a deep question which lies at the heart of the effort this paper is intended to serve: how can it be that the interest and resources of the world community have been so effectively mobilized against these three diseases – and justifiably so – while the arguably greater threat posed by hazardous working conditions is routinely ignored, or even denigrated as a "luxury" that only the wealthiest countries need be concerned with? Is it because workplace risks are heterogenous and difficult to see whole, while diseases are more visible as single, dramatic attacks on health and well-being? Is it because occupational factors point to the world of work, and developing countries are often seen as having more willing workers than they need? (But health impairments derived from work impose costs on all aspects of life, including work, as do impairments attributable to headline diseases.) Or is it because of the prejudice some have that workplace risks are "voluntarily" accepted by workers and therefore less cause for concern? (But the same argument could be made that HIV/AIDS is voluntary because individuals "choose" to have sex, and it would not lessen the public health imperative.)

Whatever the reason, it is important to marshal the evidence that can show the magnitude of the social cost of work-related injury and illness in developing countries, as well as the channels through which they impede economic growth and render their victims vulnerable to poverty.

6. A Framework for Future Study

6.1. Objectives

To summarize the argument to this point, let's catalogue the kinds of data we would like to have in order to raise the profile of OSH in development policy:

- credible estimates of the incidence rates of occupational injuries and, if possible, illnesses, disaggregated according to major industry and occupational categories,
- plausible estimates of the costs to employers of occupational injuries and illnesses, taking into account relevant absenteeism and presenteeism multipliers,
- credible estimates of the direct costs to households of occupational injuries and illnesses, including medical expenses and lost income,
- plausible estimates of the indirect costs to households, including lost household production, lost market work from unpaid caregivers and detrimental effects on education,
- credible estimates of the role of unanticipated occupational morbidity and, if possible, mortality shocks in the propagation of poverty, and
- credible estimates of the costs socialized by government programs not funded by contributions tied to injury or illness events.

Together, these would largely replicate the data available to researchers on these topics in developed countries and would permit analytical exercises designed to assess the impact of poor working conditions on prospects for development. Because of the importance given to combating poverty in particular, the data should answer the questions we ought to be asking about poverty and OSH. Two caveats should be noted. First, the above list identifies the data we would like to have, but not all of it may be feasible. In particular, as we will see, the occupational fatalities components require data collection methods that may be beyond the resource constraints of a typical study. Second, the wording of this list reflects the fact that two standards of data reliability are proposed. Credible estimates approximate true magnitudes with sufficiently small margins of error deducible from statistical theory. Plausible estimates, on the other hand, while not possessing a quantitative confidence interval, indicate a range of possible outcomes observers will find reasonable. In other words, the error that separates estimate from reality under the first standard derives from the (known) statistical properties of sampling, data collection and analysis. The error under the second is formally unknown, but can be tolerated if the procedures employed are acceptable and end-users are willing to accept greater imprecision. The reason for the difference is that some data can be gathered using methods that adhere to classical sampling and population inference, and some can't. Rather than just ignore the issues furthest from our data collection lamppost, it is important to make the best effort possible under the circumstances.

6.2 Household survey

Given our inability to construct comprehensive population estimates from the fragmentary records of formal institutions like employers, insurances, hospitals and the OSH inspectorate, we will have to rely on a survey instrument to gather most of the data we seek in developing countries. This raises questions regarding sampling, survey content and procedure.

a. Sampling frame. The proper sampling unit is the individual worker, although, as we will see, it will be necessary to gather information regarding workers' households as well. Since workers are accessible primarily via their households, the sample will cluster within households (multiple individual workers) and between them (neighborhoods). If the survey is free-standing, it should be stratified for the most effort-efficient coverage of industries and occupations of concern. Sample size should be sufficient to adequately populate all industry-occupation cells of interest; that is, the minimum sample size depends on the diversity of OSH contexts facing the labour force. The ideal, however, would be to create a module that could be attached to an already-existing labour force survey (LFS) or demographic and health survey (DHS), since this would greatly reduce incremental costs and simplify the process of administering the instrument.

Income stratification would not need to be employed insofar as industry-occupation location is largely determinate of economic condition. This may not be the case in rural areas, however, where farmers, even if specialized in the same crops or stock, may be stratified by income and productive assets. If that proves to be true, explicit stratification by income or assets (e.g. land-holding) may be required.

Of course, if the survey is free-standing, sampling will be organized geographically. This means that there should be a prior mapping of industries and occupations at the most detailed spatial unit available. The underlying assumption is that employments will adhere to a geographic distribution; normally, this will be true. Such a mapping is not required if the instrument is a LFS or DHS module, although it would be advisable in order to assess the adequacy of the existing sample.

One additional consideration concerns the adequate representation of migrants, who tend to occupy the most dangerous jobs and whose health and safety outcomes tend to be worse even in the same jobs. (Schenker, 2010) It is sometimes the case that vulnerable migrants are concentrated in particular districts; so it is important to be sure they are incorporated in the sample.

Some procedure is needed to identify individual respondents within households. Two possibilities exist. First, interviewers may try to speak with each household member who is engaged in productive work. Second, they may select just one working individual from each household, provided the method for selecting this person is random. The problem with the first approach is that it accentuates the clustering problem: the various individual observations collected in the same household are not fully independent. (Indeed, unless an individual can be interviewed in isolation from the others, there will likely be a clustering of response bias as well as of household-level data.) The advantage is that it maximizes the number of (semi-) independent observations that can be obtained from a given amount of data collection effort. The main problem with the second approach is that, in the absence of a reliable household enumeration, there is no truly randomizing technique available for picking the one individual respondent.

Since the unit of observation is the working individual, it is necessary to have a definition of who fits this description. Clearly, paid employment does, whatever the relationship between

employer and employee. Also, the production of marketed goods qualifies, even if the worker is unpaid; this describes the majority of self-employment. Finally, we should include unpaid production of marketable output according to the criteria of the System of National Accounts (SNA). This is essential for two reasons. First, without its inclusion we would lose a large portion of subsistence work, particularly in agriculture. Second, in many societies there is a gendered division of labour, such that women are disproportionately engaged in unpaid household work that nonetheless lies within the SNA boundary. To fail to extend our sample to them would result in an unacceptable level of gender bias.

If the instrument is adopted as a LFS or other survey module, it might seem that these questions of definition and detailed sampling method are rendered moot, and in a sense they are. Nevertheless, they apply with force to the other objectives LFS's are intended to serve and should therefore be taken into account as the survey's sample frame is refined over time.

b. Content. The survey (module) should gather as much of the data indicated above under "objectives" in the most economical manner possible. The minimal list of variables needed would include the following:

- the individual's industry and occupation
- the individual's age and sex
- the category of enterprise (size, formal/informal, self-employment) in which the individual's work currently takes place
- the length of the individual's employment at the current enterprise
- the individual's previous employment history (there can be flexibility regarding the detail the respondent is called on to provide)
- the individual's education
- the individual's relevant demographic status (ethnicity, caste, migrant, etc.)
- the individual's current health status
- work-related health-altering events during the individual's previous year
- lost household income attributable to work-related morbidity
- household medical expenses within the past year associated with the respondent's work-related morbidity
- compensation from insurances or public programs for medical expenses reported above
- unpaid care provided within the household during the past year for work related morbidity – in time units, in diminished market work and in educational impacts
- loss of productive household assets due to lost income or increased expenses reported above
- increase in household indebtedness due to the above shocks to income and expenses

A few of these require further comment:

- The purpose of including a variable for type of employment is to facilitate matching individual self-reported health events with reference cases of employer costs, which will be discussed below.

- Employment history can be simplified by having the respondent identify broad categories of job types and employment durations. The purpose is to estimate and assign attributable fractions of illness to occupational etiology, as will be described below.
- Basing injury and some portion of illness rates on retrospective self-reports raises questions about validity, particularly with respect to a recall period of a full year. It should be remembered that the UK Health and Safety Executive uses this same method for its periodic economic burden estimates, and it also uses a one-year recall. Their results have been validated internally. It is also common for general purpose health surveys in developing countries to use one-year recall periods.
- Many of the items enumerated above are conditional on a positive answer to a branching question. For instance, detailed questions about the burden of unpaid household care need to be asked only if the respondent indicates that unpaid care has been provided. It may also be possible to make questions on employment history conditional on the report of a current disease state. The general point is that the length of the interview will typically be much shorter than the above enumeration of variables might suggest. Moreover, with electronic interviewing aides, it is possible to tailor questions designed to uncover physical impairments and their occupational etiology to specific activities workers report engaging in.
- The definition of “work-related” needs to be clarified at the outset. To some extent, this can reflect the laws and practices of the country in question, as in the case of accidents occurring during the commute to and from work. The problem is more complex for home-based production, where the line between work and non-work activities is inherently blurred. In addition, the exposures attributable to the work environment are difficult to disentangle from those due to general living conditions. (Barten et al., 2008) It is probably unrealistic to suppose that a precise delineation constructed by the researcher can inform the self-reports of respondents, however, and the language employed to make this distinction can best be refined in the process of piloting the instrument.
- Identifying the work-relatedness of diseases requires an etiological method. The starting point should be the exposure-response relationships established in the literature on occupational illness in industrialized countries. This establishes two kinds of information, the occupation-industry locations which, via documented exposures, are linked to health outcomes, and the attributable fractions of those outcomes that can be identified as work-related. Nevertheless, as we have seen, the work methods and other contextual aspects of developing country employment likely result in exposures that are different from, and probably greater than, those in the countries from which existing data are drawn. With a large enough sample – one that sufficiently populates the industry-occupation cells of interest – it should be possible to estimate the difference in the relationship between work-related exposures and health outcomes, so as to calculate attributable fractions specific to the population under study. In other words, the methods used to compute attributable fractions in countries like the United States and Finland can also be used with the data from this survey.

Since occupational mortality is a low-frequency event, the sample size will not be sufficient to generate estimates of the mortality rate for the population as a whole, much less subpopulations like workers in particular industries or occupations. We will return to the issue of fatalities shortly.

6.3 Enterprise costs

One of the great challenges of research like this is producing plausible estimates of employer costs. There are really two big problems: cost studies at the enterprise level have hardly been undertaken at all in developing country contexts, and linking these (nonexistent) results to individual health events requires the creation of a matching procedure.

a. Reference cases. In the absence of relevant pre-existing records at a cross-section of employers, the only practicable approach is to perform hypothetical cost analyses for a selection of characteristic enterprises. This will have to be a hands-on, interactive process.

First, researchers need to identify a set of enterprises that are willing to open their doors – and books, if they have them – and which, collectively, span as much of the heterogeneity of employers as possible. This requires prior consultation with locally-based health professionals, who may have a rough sense of what enterprise characteristics are consequential for different kinds of health outcomes (this looks ahead to the matching problem to be discussed shortly). It also requires consultation with local informants knowledgeable about the range of enterprises and types of work processes they employ. Of course, it is important that owners and staff of these enterprises not only consent to being studied, but are actively eager to assist and participate.

Second, researchers need to model the work process in selected enterprises, as well as market conditions that influence the cost and revenue consequences of potential work disruptions. This type of analysis is regularly employed by developed country health and safety consultants, such as Oxenburgh; it has not been used in developing countries primarily because firms, and particularly small and micro firms, cannot afford it. (Oxenburgh and Marlow, 2005)

Third, researchers should conduct interviews of enterprise managers or staff along the lines of those used to estimate the multipliers for absenteeism and presenteeism described in section III of this paper.

Finally, the “objective” and “subjective” data can be brought together to create a full cost profile, one that translates various worker health events into their cost consequences for employers. Over the full set of these reference cases one would have a matrix where, for instance, the columns represent different types of enterprises and the rows different health events, and each matrix element would be a cost estimate, expressed as a multiple of the wage unit.

b. Matching household survey data to reference cases. Based on the information workers provide regarding their employment situation – industry and enterprise type – and the health events they or their deceased household members underwent during the past year, it is possible to situate the individual-level event in the above matrix. Of course, with a relatively small number of reference cases – at best, one to each main enterprise “type” – the cost attribution can hardly be regarded as precise. Nevertheless, it can serve to shed light on a problem that would otherwise go unmeasured and unrecognized, and aggregate estimates of employer costs can be evaluated according to their sensitivity to measurement parameters.

6.4 Socially externalized costs

These are perhaps the only costs that can be determined from pre-existing data, such as the records of hospitals and public insurances. It can be anticipated that they will be small relative

to the developed country average, and very small relative to countries like the United Kingdom in which nearly all medical services are publicly provided.

6.5 Getting to grips with fatalities

As discussed above, the household survey will not be sufficient to derive a usable estimate of the incidence of fatal occupational injuries and illnesses. It can, if desired, generate a plausible range of potential household costs. (The difference stems from the much greater power required to identify fatality rates that are only slightly greater than zero, in comparison to costs, which are much larger.) This cost estimate can be a freestanding contribution of the study, or it can be combined with epidemiological estimates derived from other sources to generate a component of total economic cost. To estimate the unit cost of fatalities, questions can be inserted into the survey to extend the cost items, like medical expenses and lost income and household production, to cases in which another member of the respondent's household had died during the reference period.

One possible method for deriving incidence rates would be to take a random sample of deaths, provided the country in question possesses a sufficiently comprehensive death registry with sufficient occupational information on the deceased. Since the proportion of deaths attributable to occupational causes will be much higher (by several orders of magnitude) than the proportion of workers who were alive during a given period but then succumbed to an occupational fatality – the data sought by a household survey – the sample size can be correspondingly smaller. Procedures for such a deaths sample will not be discussed here; the preceding literature review has cited several studies which incorporated this method, and there is no reason to alter their approach.

A second way to generate fatality estimates to link to household costs would be to employ the sort of rich-to-poor country extrapolation that was criticized earlier in this document; one could argue that it is better than nothing. Specifically, the incidence rates of various nonfatal occupational injuries and illnesses gathered from the household survey could generate estimates of occupational fatalities by applying to them corresponding nonfatal-to-fatal ratios derived from developed country data. Similarly, one can apply developed country attributable fractions to occupation (and therefore exposure)-adjusted developing country aggregate fatality data. One strong argument for expending the resources needed to scrutinize a sample of deaths, if one can be constructed, is that this would establish a developing reference country, whose attributable fractions or fatal-to-nonfatal ratios could be the basis for other developing country extrapolations.

6.6 Sequencing the study

Generally speaking, the household survey and the enterprise reference cases constitute two independent sub-projects; neither depends much on the other, except when the data analysis phase takes place at the end. Thus both should commence as soon as the initiative is started and proceed at their own pace. (The same judgments apply to the deaths sample, if that optional component is incorporated.) Since the sequencing of work on the reference cases has already been described, attention will be focused at this point on the survey.

The first step is to gather the background data on demographics, health risks and related topics that will inform the construction of the survey questionnaire and, if necessary, the sampling

frame. No single model will be appropriate for all countries, giving their different industry mixes, demographic circumstances and health challenges. This is especially the case if the survey is free-standing, and the sample design must be derived from an accurate mapping of work environments onto geographic clusters.

Once a tentative instrument has been drawn up, it should be piloted in a few communities that span a range of demographic and economic circumstances. Focus groups can be employed to explore in qualitative detail how the survey can be improved to uncover the data it is aimed at providing, and response patterns can be assessed for their consistency and appropriate calibration. (They should not generate results that don't fit with respondents' overall economic and health conditions.)

Survey implementation should be undertaken over as brief a time frame as possible, so that the reference years of the respondents are approximately the same. This is especially important where seasonal factors may apply, as in agriculture, or where rapidly evolving economic or social factors may influence results. Of course, shorter time frames are more expensive to adhere to, so compromise is unavoidable.

Data recording, cleaning and analysis should also take place as soon as possible, especially in light of the benefits to sharing results with the most-affected communities (see below). The longer the delay, the less ownership the communities will be able to claim. Initial presentations do not have to be based on the more sophisticated methods that researchers will subsequently publish.

6.7 Benefits from the data collection process

A major purpose of this framework paper has been to clarify and document the goals that research into the economic costs of work-related injuries and illnesses can serve for developing countries. It can fill in the gaps in our knowledge of OSH epidemiology, raise awareness for the urgency of addressing OSH issues even – and especially – where economic resources are scarce, and begin to mainstream OSH within coordinated approaches to tackling the problems of poverty and development. Nevertheless, as outlined above, research can also provide direct benefits to communities being studied.

Perhaps the main benefit will be to enterprises that have no prior experience of analyzing the impact of OSH on their economic performance. The specific enterprises that are selected to comprise the set of reference cases will benefit directly, but many others will benefit indirectly by being able to apply the insights of this work to their own circumstances. This side contribution of the research can be enhanced by making plans, right from the beginning, to publicize the findings of the enterprise cost studies.

Similarly, researchers should make every effort to reach out to the populations being sampled and enlist them as partners in the larger project. Workers' and employers' organizations can offer venues for presenting and discussing the results of the research; in fact, it would be illuminating to present the findings to local community groups, instigating a two-way dialogue that would raise awareness of OSH issues while educating researchers on the needs and perceptions of the people they are studying. It is because the threats to health and safety are so diverse, but also so enmeshed in daily life, that this dialogue is essential.

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