Towards a Reformation of the Theory of Safe Working Conditions - A Preliminary Model

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Note to Conference Participants:

This is a preliminary draft. I welcome comments, critiques and suggestions on any aspect of this paper. I hope to generate discussion as to how this model can be empirically tested.

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Workplace injuries and illnesses have always been characteristic of industrial economies, with some industries much more susceptible to injury and illness than others. According to the most recent data from the International Labor Organization, there were 358,000 fatal occupational accidents annually; 337 million non-fatal occupational accidents and 1.95 million fatal work-related diseases (ILO 2008).

While recent data for both the EU and US show declines in workplace accidents, we believe that current financial crisis has significantly affected the trajectory of capitalist development of both developed and developing countries; with significant affects on global labor markets. While much focus is devoted to employment and unemployment, an often neglected facet is safe working conditions.

In order to formulate effective policy responses the causation process must be effectively modeled. This paper argues that the current model of achieving safe working conditions, based on firm optimization is inadequate and misleading. This paper will offer a reformulated modeling process which in turn can lead to more effective policy solutions. The first section of this paper will critique the existing model. The second section will construct a new more realistic model. And the third section will offer concluding comments and suggestions.

The Traditional Theory of Safe Working Conditions

Previous models assume that achieving safe working conditions is an extension of the firm's optimization goal of maximizing profits. The firm is assumed to maximize profits, while minimizing the expected cost of an accident λ which can be expressed as a function of firm size (L) and the level of safety expenditures (S) (Oi 1972],

$$\lambda = f(S,L)$$

The expected cost of an accident is defined as the probability its occurrence multiplied by total costs, which include the direct costs such as payments to injured workers, replacement of damaged machinery, firm closure; and indirect costs such as loss of morale, lower productivity, etc. The expected cost is entered into the firm's objective function and the firm is assumed to maximize profits. .

It is assumed that the more the firm spends on safety the less the probability of an accident; and that the more output the firm produces the greater the risk. That is, the "real risk is the level of physical danger of accidental injury or occupational disease that comes from workers producing output" (Butler and Park 2005: 1). Thus,

$$d\lambda/dS < 0$$

$$d\lambda/dL > 0$$

This model assumes that the safety decision is made by the firm and is the main stakeholder in determining safe conditions. If a labor union exists, it is assumed to constrain the firm to act differently; and likewise government regulation is assumed to constrain the firm to act differently than it would otherwise.

This conceptualization implicitly assumes that other stakeholders have a secondary role only to constrain management, which remains the preponderant stakeholder in safe working conditions. But this conceptualization is misleading for the following reasons,

1. Just because a union exists does not mean it automatically desires (or achieves) safe working conditions; nor that it automatically opposes or supports the firm. This assertion rests on two assumptions. First, safe working conditions are a public good (Freeman and Medoff 1984: 8) and hence the production of safe working conditions without market intervention is sub-optimal (Olson 1965: 67,76; Hirsh and Addison 1986: 24). And since a labor union provides employees with a collective voice that can be used to achieve a public good (Freeman and Medoff 1984: 11) a labor union will automatically desire safe working conditions. This assumption is incorporated into econometric testing via a simple binary variable indicating 1 if the firm is unionized and 0 otherwise. But evidence does not support this assertion (Reardon 1996). Econometric testing and its underlying economic model ignores that a labor union is a political institution; thus, whether it supports safer working conditions is a function of the specific economic conditions in which it operates and the specific jobs held by the most senior members.

2. Other stakeholders can have a legitimate interest in safe working conditions separate from their intention to influence and constrain the firm. Of course within each stakeholder there are various groups, each with different interests. It is then a question of which rights of which stakeholders are articulated and effectuated.

3. The existence of asymmetric information, i.e., some stakeholders have more knowledge than others, is a palpable problem in more dangerous workplaces, such as coal mines, "the costs of defining what risks are involved in various mines are often very high; therefore knowledge may also be asymmetrically distributed between the parties" (Vant 2005: 217) It is a mistake therefore to assume that management possess perfect knowledge and is capable of minimizing the probability of an accident when the information could very be decentralized and available to more decentralized stakeholders. In fact, the more dangerous the workplace, the less reliable the standard optimization model.

It is thus more realistic to simultaneously model all potential stakeholders including joint interactions, in the context of asymmetric information, which will be done do in the next section. .

A More Realistic Model of Safe Working Conditions

With multiple stakeholders recognized, with their own genuine interests in determining safe working conditions, how should the decision-making process be modeled? It should be emphasized that "the aim of formal theories is to give us an understanding of a relational structure that exists somewhere in the world" (Diesing 1971: 108). Although every model is an abstract simplification, "one's choice of characterization determines the kind of theory that will result, and a change of characterization sometimes leads to new theoretical developments" (Diesing 1971: 49). Thus the modeling process is crucial.

Let us initially assume only two stakeholders $\mathbf{g_1}$ and $\mathbf{g_2}$. This assumption will greatly simplify the analysis, and will be relaxed later in the paper. Let $\mathbf{Y_1}$ be a random variable equal to 1 if a 'yes' decision is made pertaining to safe working conditions by stakeholder $\mathbf{g_1}$ and equal to 0 if a no decision is made. Let $\mathbf{Y_2}$ be a random variable equal to 1 if a 'yes' decision is made pertaining to safe working conditions by stakeholder $\mathbf{g_2}$ and equal to 0 if a 'no' decision is made.

The traditional model assumes that a tradeoff exists between output and safety expenditures (Butler and Park 2005: 4). While this might be true in the very short- term it is not in the long-term, since many safety expenditures are long-term investments. But rather than assume a trade-off, it is more realistic to incorporate a threshold level, which in turn is determined by the specific institutional and economic context in which the firm operates. Each stakeholder $\mathbf{g_k}$ has a threshold $\mathbf{K^*}$ above which it makes a yes decision to safe working conditions (votes yes) and below votes no. For some stakeholders it is conceivable that the threshold level might never be reached and for other reached at low levels of output. Of crucial interest is what determines the threshold and determines movement up or down.

In constructing this model we jettison a general theoretical predictability, characteristic of the optimizing model, thus potentially decreasing the attractiveness to some; but at the same time, the model and the decision-making process become much more realistic. Thus, determining the variables necessary for each decision and each decision maker becomes crucial. We will return to this important point in the next section.

With two stakeholders, four possible scenarios emerge: (1) both vote no to safe working conditions; (2) both vote yes to safe working conditions; (3) stakeholder $\mathbf{g_1}$ votes yes while stakeholder $\mathbf{g_2}$ votes no; and (4) stakeholder $\mathbf{g_1}$ votes no while $\mathbf{g_2}$ votes yes. The four scenarios are depicted in Table 1,

Table 1

Joint (y_1, y_2)	1st No $y_1=0$	1st Yes $y_1=1$	Marginal for y_2
2nd No $y_2=0$	P_1 0 0	P_2 1 0	$y_2=0$ $P_1 + P_2$
2nd Yes $y_2=1$	P_3	P_4	$y_2=1$ $p_3 + p_4$
Marginal for y_1	$y_1=0$ $P_1 + P_3$	$y_1=1$ $P_2 + P_4$	

In scenarios two and three, a negative interaction occurs; that is, safe working conditions is not jointly accepted; whereas in scenarios 1 and 4 a positive interaction occurs- both either accept safe working conditions. What compels both stakeholders to desire safe working conditions and what would entice each to desire opposite states? Convincing evidence suggests that safe working conditions is positively related to joint employee/management involvement (Butler and Park 2005). While readers might depict some similarity with game theory, the main difference is that the will and hence the outcome of each stakeholder are known based on their behavior, past and present.

Of interest is what determines the probability $\mathbf{P_k}$. With **G** decisionmakeers, the number of probabilities is determined as

$$K = 1 + \sum_{g=1}^{G} 2^{(g-1)}$$

Each probability $\mathbf{P_k}$ is generated as follows,

$$\mathbf{P_k} = \frac{e^{\sum_{g=1}^{G} X'_g \mathbf{B}_{gk} \mathbf{y}_{gk}}}{\sum_{k=1}^{K} e^{\sum_{g=1}^{G} X'_g \beta_{gk} y_{gk}}}$$

Where $\mathbf{y_{gk}}$ =0 if the $\mathbf{g_{th}}$ stakeholder says ‘no’ while $\mathbf{y_{gk}}$ =1 if the gth stakeholder says yes. And $\mathbf{X_g}$ is a row vector of explanatory variables specific to the $\mathbf{g_{th}}$ decision maker and $\mathbf{B_{gk}}$ is the vector of coefficients for the $\mathbf{g_{th}}$ decision maker’s explanatory variables in contributing to the $\mathbf{k_{th}}$ joint probability.

Thus, safe working conditions becomes a random variable expressed as a function of the probability that the $\mathbf{g_{th}}$ stakeholder says 'yes' to safe working conditions,

$$\mathbf{SW = f(P_k) + \varepsilon_k}$$

It is assumed that the error term is generated by the Poisson distribution.

Pertaining to the $\mathbf{P_k}$ of the kth stakeholder, it is the variables in the **Xg** matrix that are of crucial interest. And must be decided on the basis of the industry and economic context. While this will disappoint some who assume one overlying theory can explain everything, such modeling is more realistic, although ascertaining the relevant variables in the **Xg** matrix will be more cumbersome. Step one is to ascertain all stakeholders. Obvious ones are the firm, employees, government, customers, suppliers and the community. Step two involves deciding the joint effects that each has on the other. Step three involves ascertaining the variables that affect the joint probability as well as attaining the threshold.

In empirical investigations using the traditional optimization method, constraints are entered as binary variables and regressed on some format of injury rates; in addition variables controlling for firm size are also included. (Reardon 1995). I believe that this model more accurately captures the inherent dynamics in achieving safe working conditions.

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