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Biswajit Mandal

Department of Economics University at Albany-SUNY, Albany, NY,  
USA and Visva-Bharati University, Santiniketan, India

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*Biswajit Mandal\**

Department of Economics  
University at Albany-SUNY, Albany, NY, USA  
and  
Visva-Bharati University, Santiniketan, India

## Address for Correspondence :

BISWAJIT MANDAL

Department of Economics & Politics

Visva-Bharati University

Santiniketan, India

731235

Telephone: (+91) 03463262751-56 Extn. 405

E-mail: [biswajiteco@gmail.com](mailto:biswajiteco@gmail.com) / [bmandal@albany.edu](mailto:bmandal@albany.edu)

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# **Trade Reform, Environment and Intermediation: Implication for Health Standard**

## **Abstract**

Health standard of a region or economy significantly depends on environmental quality. And informal sector has a striking role for overall environmental quality as sometimes producers prefer not to produce in the formal sector as formal production calls for stringent environmental and other governmental regulations. Under such circumstances the informal counterpart of the economy becomes heaven for those producers who do not want to abide by the rules. Extralegality of informal production, by definition, indicates the emergence of intermediation activity. In light of these concerns here I build a standard general equilibrium structure to capture these phenomena and to focus on the effects of trade reform. It has been shown in this paper that tariff reform may lead to greater usage of abatement technology under certain factor intensity assumption. However, interestingly, this can not unambiguously ensure a better environmental quality in broader sense.

Key words: Environment, International Trade; Intermediation; General Equilibrium.

JEL classification: O13, F1, D73, D5

## 1. INTRODUCTION

Broadly speaking general health standard and health related problems are intertwined with the environmental standard of a country in particular. And on the other hand the nexus between trade and environment related issues are in the forefront of economic research for quite a long time. Huge numbers of papers are produced concerning the world wide panic of environmental degradation that may arise due to non-usage of environmentally sound technology of production. Trade theorists more often than not look at such concerns from the perspective of globalization. A representative sample consists Anderson and Neary (1992), Barrett (1994), Beghin et al (1997), Conrad (1993), Copeland (1994), Hoel (1997), Markusen et al (1993), Motta and Thisse (1994), Neary (2005), Rauscher (1994, 1997), Ulph (1997), Ulph and Ulph (1996) et al. Surprisingly a relatively less attempt (Chaudhuri and Mukhopadhyaya, 2011; Biswas et al, 2012; Chung and Chung, 2012) has been made to analyze an important aspect of developing economy in particular and world economy in general, corruption which naturally co-exists with trade and environment related problems. Therefore trade and environmental issue must have some inference for health standard of an economy which is almost a neglected area of research.

A-priori manufacturing production and industrial activities are the principal sources of pollution in both developed (DCs) and less developed countries (LDCs). DCs, with higher per capital income, prefer to use different regulatory framework to reduce environmental pollution by curbing production units or processes that pay little attention to the growing concern of environment. However, the scenario of LDCs are a bit different. Although the regulatory framework, its enforcement and the resources allocated to comply with legislation are generally limited in LDCs. On top of that increasing competition in domestic markets due to liberalization in trade and services has forced firms to reduce costs by any means and to upgrade their technologies to become more competitive.

Conventionally the relationship between environmental protection and private costs is quite straight forward, environmental regulations in different forms can only be met by additional investments and higher operative costs. Consequently economic growth rate is expected to be lowered. Furthermore, taking into account the unequal application of environmental regulations in different countries, we observe that a trade-off between environmental preservation and private competitiveness may often arise.

In this context it is very important to note that many have taken the policy implication of the so-called 'environmental Kuznets curve' (EKC). Poor countries can and perhaps grow themselves out of environmental problems rather than tackling them with stricter regulation at least for the time being. Critics also mention that the now rich countries have become clean at least partly by exporting the dirty production of products to other, poorer countries. This implies that the current poor countries will not be able to replicate fully this experience. Nevertheless, how some environmental policies even in the LDCs can push some firms to an isolated "free" zone where nobody is bothered about environment is taken into account in this paper. So use and non-use of abatement technology in production in the LDCs exist simultaneously. We will come back to this issue later.

Before we move to the brief description of the structure and basic results let me just put forth the interconnectedness of environment and health in a very simple way. Environmental pollution' encompasses the terms environment and pollution. Environment is the complete range of external conditions under which an organism lives. On the other hand, pollution means to make or render an undesirable change in the characteristics of the land, air or water that harmfully effect human life or other species. In addition to this, over the last three decades there has been increasing global concern over the public health impacts caused by environmental pollution, in particular, the global burden of disease. The World Health Organization (WHO)

estimates that about a quarter of the diseases that mankind faces today occur due to prolonged exposure to environmental pollution. Most of these environment-related diseases are however not easily detected and may be acquired during childhood from the environment where they are raised and manifested later in adulthood. So the detrimental long-run effects of utilization of non-environment friendly technology in production on health in general are quite explicit.

As we mentioned before, sometimes stringent environmental regulation induces firms to go beyond the formal setup or sector and to continue production in the informal sector<sup>1</sup> where environmental strictures are not so binding or non-existent. Since informal production itself is not permitted by law, it becomes a happy hunting ground for extortionists who actually negotiate between producers and bureaucratic officials or government representatives. In exchange of this service they demand pecuniary benefit which by definition is DUP activities (Bhagwati, 1982) in nature. This paper focuses on such concerns in light of a reformatory trade policies in a general equilibrium theoretical model. And subsequently try to look at the possible ill effects on health, if any, of a reformatory trade policy. The basic results that I derive here:

- (a) tariff reform may lead to greater usage of abatement technology under certain factor intensity assumption;
- (b) a tariff cut can not unambiguously ensure a better environmental quality and health standard, per se, in broader sense.

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<sup>1</sup>Informal sector is an important ingredient of the contemporary world economy particularly in the developing regions as this segment occupies a formidable chunk of the unskilled labor force. This sector covers primarily the non-agricultural employment of unskilled labor. It accounts for 50-80% of total employment in South Asia, 30-50% in South East Asia, 40-50% in Africa, 55% in Latin America and Caribbean, 24% in Southern Europe, 10% in Western Europe, 18% in Canada and 8% in USA (ILO, 2002) . Yet, informal sector's jobs are not considered as respectable ones. The main derogatory feature of informal sector is its extra-legality or illegality by law since it does not conform to government regulations. These units do not abide by labor regulations of the government, and do not pay taxes. In fact a large part of it would have vanished if they had to confront government regulations. The paucity of legal protection makes the informal sector an easy pray for extortion and corruption. It has been reported in Ethiopia that the urban informal sector of this rural country is comprised of almost one million people and is vastly distorted with extortion. While Morocco experiences an annual loss of \$ 3.6 billion because of lack of transparency related extortion/corruption/bribe (Drakard, 2009).

The rest of the paper is arranged as follows. Section 2 builds the basic model and talks about the solution mechanism. Effects of tariff reform are discussed in Section 3. Section 4 concludes the paper.

## 2. THE MODEL

There are three goods  $X$ ,  $Y$  and  $Z$  produced in the neo-classical framework using four factors such as skilled labor ( $S$ ), unskilled labor ( $L$ ) and two types of capital ( $K$  and  $T$ ).  $K$  is perfectly mobile across  $X$  and  $Y$  but  $T$  is specific to  $Z$ .  $X$  and  $Y$  are produced in the formal set up whereas  $Z$  is produced in the informal set up<sup>2</sup>. The point to be noted very carefully is that the moment producers shift from formal to informal sector they are denied the formal capital/credit represented by  $K$ . They bank on informal credit,  $T$ . In addition both  $X$  and  $Y$  require another intermediate input as abatement technology which is not needed in  $Z$ . That is the way we bring in informality and environment together. Furthermore,  $S$  is specific to  $X$  and gets  $W_s$  as wage.  $L$  is mobile between  $Y$  and  $Z$ . Unskilled labors ( $L$ ) are unionized in  $Y$ . They get  $\bar{W}$  as their wage.  $K$  gets identical return  $r$  across  $X$  and  $Y$  while  $T$  gets  $R$  in  $Z$ . Who are not fortunate enough to work in  $Y$ , have to go out of the formal segment. Producers of  $Z$  need to comply with some institutional and political menace as it is an extra-legal, if not illegal, activity. To combat such menace producers obtain service of intermediaries who actually watch out for institutional perils. Their marginal productivities in terms of the volume of goods are zero though they get positive return for their work<sup>3</sup>. However, without such an arrangement production of  $Z$  could not have taken place. We call sector  $Z$  as informal productive sector. Therefore, in a nutshell production can take place anywhere between formal and informal segments. Production in informal sector requires less costly labor as  $\bar{W} > W$  but possible return to capital is higher as informal units are not entitled to get

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<sup>2</sup> For details about the way we define informal sector see Marjit and Kar (2011).

<sup>3</sup> We can coin this sort of intermediations as directly unproductive profit-seeking activities (Bhagwati, 1982). This is the concept of corruption and/or related extortion that we are going to use in our model.

loans from legal or government recognized sources. On top of that they need to, however, rely on intermediation activity as informal production does not abide by environmental regulation. This is reflected by the non-existence of abatement cost and existence of cost of intermediation or extortion in form of  $\alpha$  in tandem.  $\alpha$  resembles an ice-berg kind of cost. Therefore the amount lost from Z is entirely spent for employing intermediators who actually negotiates with administrators for the survival of environment non-friendly sector Z. Intermediation is done only by unskilled labor. Let  $L_N$  be the people and N be the sector representing intermediation/extortion. The return to extortionists,  $W$  is identical with competitive informal wage,  $W$ . Perfect labor mobility between Z and N ensures this equality.

We have a small open economy with competitive markets for production as well as for extortions related intermediation or corruption. Competitive corruption market implies that the lost output due to intermediation is fully exhausted in paying out extortionists. Moreover, we have the standard neo-classical assumptions of constant returns to scale and diminishing return to factors. The following set of equations describes the model and the interpretations of symbols are usual and well used in trade models (Jones, 1965, 1971)<sup>4</sup>. Further, Y is the importable commodity and subject to a tariff  $t$ <sup>5</sup>.

Competitive commodity market guarantees the following equalities:

$$W_S a_{SX} + r a_{KX} + \mu a_{CX} = P_x \quad (1)$$

$$\bar{W} a_{LY} + r a_{KY} + \mu a_{CY} = P_Y(1 + t) \quad (2)$$

$$W a_{LZ} + R a_{TZ} = P_Z(1 - \alpha) \quad (3)$$

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<sup>4</sup> The symbols that would be used extensively in this paper are:  $P_j \Rightarrow$  price of the  $j^{\text{th}}$  commodity ( $j = X, Y, Z$ );  $W_S \Rightarrow$  skilled wage;  $\bar{W} \Rightarrow$  unskilled formal wage;  $W \Rightarrow$  unskilled informal wage;  $r \Rightarrow$  rate of return to  $K$ ;  $R \Rightarrow$  rate of return to  $T$ ;  $a_{ij} \Rightarrow$  production requirement of the  $i^{\text{th}}$  factor in one unit of  $j^{\text{th}}$  commodity ( $i = S, L, K, T$  and  $j = X, Y, Z$ );  $S \Rightarrow$  total supply of skilled labor;  $L \Rightarrow$  total supply of unskilled labor;  $L_N \Rightarrow$  number of unskilled labor employed in extortion;  $K \Rightarrow$  total supply of capital,  $T \Rightarrow$  total supply of capital, T.

<sup>5</sup> One can effortlessly disagree to argue that Y should not be the importable commodity for any developing economy as it uses unskilled workers. But we do not find any harm in assuming this. Here skilled good (X) is exportable. In order to avoid the possibility of complete specialization we have taken the remaining good (Y) as importable. Introduction of any other commodity as importable, instead of Y, would not matter much to the basic results of the paper.



$\mu$  is the per unit price or cost of abatement technology or cleansing act.  $a_{cX}$  and  $a_{cY}$  represent how much unit of abatement technology is required to produce one unit of environment friendly X and Y respectively.  $\mu, a_{cX}$  and  $a_{cY}$  are given and constant. Note that,  $\alpha \in [0,1]$ ; a low  $\alpha$  will mean lower fee of extortion and conversely.

We have mentioned earlier that N people are paid out of the amount lost from the value of Z. And in a competitive set up the value of output lost in Z must be identical to the payment made for extortionists. Thus,

$$\alpha \cdot P_Z \cdot Z = WL_N \quad (4)$$

Full employment of all the factors ensures the following:

$$a_{SX} \cdot X = S \quad (5)$$

$$a_{KX} \cdot X + a_{KY} \cdot Y = K \quad (6)$$

$$a_{TZ} \cdot Z = T \quad (7)$$

$$a_{LY} \cdot Y + a_{LZ} \cdot Z = L - L_N \quad (8)$$

We further know that  $a_{cX} \cdot X = C_X$  and  $a_{cY} \cdot Y = C_Y$ .  $C_X$  and  $C_Y$  represent total amount of abatement technology used in X and Y respectively, and C means abatement technology together. So

$$\mu(a_{cX} \cdot X + a_{cY} \cdot Y) = \mu(C_X + C_Y) = \mu C \quad (9)$$

Subsequently health standard (H) is a function of environmental quality and thus in turn depends on Z which does not abide by environmental regulations. Therefore

$$H = f(Z); f'(Z) < 0 \quad (10)$$

This completes the structure of the model. Now let us solve for the unknown variables. Note that  $\{t, \alpha, \bar{W}, K, T, L, S\}$  are exogenously given and we need to solve for  $\{W_S, W, r, R, X, Y, Z, L_N \text{ and } C\}$  from equation (1) - (9). We have nine equations and nine unknown variables. Thus the system is solvable.

### 3. EFFECTS OF TARIFF REFORM

There is no wonder that restrictive trade policies are gradually becoming an issue of past. Following WTO negotiation an era of reform has set in and the entire developing

world in some form or the other has responded to such transformation. Therefore to start with the analysis of trade reform we assume that the government has initiated the liberalization strategy and accordingly opted for a tariff cut in the importable sector. Following Jones (1965, 1971) and using the Heckscher-Ohlin nugget structure (developed in Jones and Marjit 2009) drawing from Gruen and Corden (1970) we can easily derive the values of X and Y consequent upon tariff cut.

$$\hat{X} = (-)\sigma_X \frac{\theta_{KX}}{\theta_{SX}} \frac{t}{\theta_{KY}} \hat{t} > 0 \quad (\text{as } t \text{ falls}) \quad (11)$$

$$\hat{Y} = \sigma_X \frac{\theta_{KX}}{\theta_{SX}} \frac{\lambda_{KX}}{\lambda_{KY}} \frac{t}{\theta_{KY}} \hat{t} < 0 \quad (12)$$

$$\text{Using (9) } \hat{C} = \sigma_X \frac{\theta_{KX}}{\theta_{SX}} \frac{t}{\theta_{KY}} \hat{t} \left( \lambda_{CY} \frac{\lambda_{KX}}{\lambda_{KY}} - \lambda_{CX} \right) \quad (13)$$

Two opposing forces are working for the change in C. As t falls X increases and thus demand for and /or use of C rises. Whereas, a reduction Y acts in opposite direction.

Hence

$$\hat{C} > 0 \text{ iff } \left( \lambda_{CY} \frac{\lambda_{KX}}{\lambda_{KY}} - \lambda_{CX} \right) < 0 \left. \begin{array}{l} \text{or, } \frac{a_{CX}}{a_{KX}} > \frac{a_{CY}}{a_{KY}} \text{ or, } \frac{a_{KX}}{a_{KY}} < \frac{a_{CX}}{a_{CY}} \end{array} \right\} \quad (14)$$

Therefore, if X uses the abatement technology more intensively than Y, a policy of tariff reform leads to more usage of abatement technology in the economy. It can not, however, ensure a better environmental situation in the country. Because the moment Y falls, it relinquishes some unskilled labor and capital. Capital goes to X and raises the production. Labor goes to Z and N simultaneously. Thus if Z goes up, this will pollute the environment further. But, if entire labor force gets employed in N, then the extent of pollution in the economy will remain unchanged. In what follows we propose that:

**PROPOSITIN I:** *If  $\frac{a_{CX}}{a_{KX}} > \frac{a_{CY}}{a_{KY}}$ , tariff reform leads to greater usage of abatement technology.*

Proof: See discussion above

Now let us move to the condition under which Z may rise, fall or remain constant. This would help us commenting on the overall quality of the environment and quality of health due to reform. Change in the production of either X and Y can not influence the quality of environment as both are produced by using environmentally sound technology. Whether environmental effect is bad or good that naturally depends only on Z. And that consequently determines H.

Manipulating the system of equations a bit we get

$$\hat{Z} = S_X \hat{X} + S_Y \hat{Y} + S_Y^t (\hat{Y} + \hat{t}) \quad (15)$$

$$\hat{Z} > 0 \text{ iff } S_X > \frac{S_Y^t}{\sigma_X} \frac{\theta_{SX}}{\theta_{KX}} \frac{\theta_{KY}}{t} + (S_Y + S_Y^t) \frac{\lambda_{KX}}{\lambda_{KY}}$$

$$\text{where, } S_X = \frac{\beta \cdot X}{(1-\beta) \cdot P_Z \cdot Z} \text{ and } S_Y = \frac{\beta \cdot Y}{(1-\beta) \cdot P_Z \cdot Z} \text{ and } S_Y^t = \frac{t \beta \cdot Y}{(1-\beta) \cdot P_Z \cdot Z}.$$

It is apparent from (15) that if the share of expenditure coming from X is sufficiently large, environmental quality of the economy would be worse off. The economic underpinning is as follows: since X expands and Y shrinks, the change in demand for Z is uncertain. Along with it as t falls the effective price of Y also falls indicating a less income from Y that can be spent on Z. Negative demand effect on Z is two-pronged: one for less production of Y and other for less price of Y. Hence equilibrium supply of Z will increase if and only if the share of X is sufficiently large to outweigh the negative demand effect generated from Y. Hence the following proposition is immediate.

**PROPOSITIN II:** Overall environmental quality and health standard will be degraded if

$$S_X > \frac{S_Y^t}{\sigma_X} \frac{\theta_{SX}}{\theta_{KX}} \frac{\theta_{KY}}{t} + (S_Y + S_Y^t) \frac{\lambda_{KX}}{\lambda_{KY}}.$$

Proof: See discussion above

#### 4. CONCLUSION

In this paper I have developed a general equilibrium model of trade where both formal and informal sector exist in tandem. Tight environmental guidelines lead to the

emergence of informal sector which crucially hinges upon the intermediation done by extortionists. These people, essentially, make the informal production possible. It has been shown here that a policy of tariff cut may induce greater usage of abatement technology. However, the environmental quality and the health standard of the country may be worsened under a certain condition.

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