

## CHAPTER 33

### MODELING THE BEST USE OF INVESTMENTS FOR MINIMIZING RISKS OF MULTIPLE STRESSORS ON THE ENVIRONMENT

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**Abstract:** This chapter contains the assumption about a novel perspective on the relationship between foreign direct investment (FDI) and the stringency of environmental policies. We have created, by means of powerful econometric apparatus, possible models for equality of positive and negative influences of FDI on environmental security.

**Keywords:** foreign direct investments; environmental policies; ecological-economic model.

#### Introduction

Problems of preservation of the environment are mainly the topic for investigation for physicists, chemists, and biologists. But as one of the main parts of state safety and as a component of a nation's level of development, a country's environmental strategy should be developed also from the position of economic theory.

There are next to no publications concerning economic tools for the evaluation of the impact of environmental regulations in the world. This problem is nearly ignored in transition economies like Ukraine and other Commonwealth of Independent States (CIS) states.

#### Foreign Direct Investment and Environmental Policy: Theoretical Aspects

Attraction of FDI is becoming increasingly important for developing and transition economies. However, this is often based on the implicit assumption that greater inflows of FDI will bring certain benefits to the country's economy.

The character of environmental security problems today has changed. The emphasis today has shifted toward how to minimize the burden on environment caused by business activity. Moreover, many environment problems are global in scale, complexly interlaced.

There is a necessity in a well-grounded system of regulation of environment safety. Ecological standards nowadays are not only technical, but also economic, possibilities. At the same time there is a need in circumstances for reaching of economic optimum between productive efficiency, external costs, and ecological damages.

Developing effective environment policy for a sustainable future should imply the analysis of the environment and investing, especially foreign investing (eco-business trends, environment related industries, etc.). Gets comprehensible that further operating of an economy at condition of the absence goal-directed actions for account of the ecological factor in its structure, threatens arising the ecological blast in Ukraine, and other transition economy.

But to realize “pros and cons” of FDI as a source for minimizing risks of multiple stressors on the environment, one should realize global tendencies in investment and macroecological-economic aspects.

The circumstances of shortage of internal capital resources in transition countries force these countries mostly to rely on foreign investments to address environment issues. Spillovers due to foreign corporate presence include technology diffusion and development of less “pollute” productions.

Investments (by means of their impact on economic growth) in a recipient-state and transfer of new ecologically safe technologies must stimulate improvements in environmental security. However “the reverse of the medal” is often in fact the “pollution haven.” This means that investing companies move operations to transition countries to take advantage of less stringent environmental regulations than in other developed countries. In addition, all countries may purposely undervalue their environment in order to attract new investment. Either way this can lead to excessive levels of pollution and environmental degradation.

The topic of this research is to determine the equilibrium of “benefits” and “costs” of foreign capital interference in issues of environmental security regulation in recipient-states (transition economies). The answer to the problem shares most risk-related methodologies, IT tools, and data sources, so they can be dealt with a synergistically coordinated way.

### **Ecological-Economic Models**

In this research, modeling of foreign direct investment (FDI) effects on the ecology effective economy divided on two stages:

1. Creating of dynamic and optimization models
2. Creating of multifactor cross-section regression models.

As to dynamic and optimization models, there are two main directions in building of ecological-economic models:

1. With account of ecological factor in economic-mathematical models
2. With account of anthropogenic impact in models of ecosystems.

Models of the first type have a traditional structure of economic-mathematical models; include additional variables and connections that characterize ecological subsystem.

At the basis of second type models is a model of mathematical ecology, and anthropogenic activity is considered as exogenous impact on ecosystem.

The classic representatives of both types of ecological-economic models are Leontiev-Ford model and Mono-Irusalimskiy model correspondently.

The character of ecological-economical models is *controllability* – the presence of vacant exogenic variables that one can define oneself. As usual, combinations of values of defined variables are combined in scenarios of regulations of ecological-economic systems.

For receiving the adequate and reliable results of ecological-economic modeling, we attempt to describe system “environment-economy” – to make a model of ecological-economic production function of maximization of output.

So the general model of one-sector ecological-economic production

$$\begin{aligned}
 & f(x) \rightarrow \max \\
 & \phi(x) \leq a \\
 \text{function we propose like this: } & \Psi(x) \leq b \\
 & x \text{ from } T_x
 \end{aligned}$$

where  $f(x)$  is the income from sale of products’ vector  $x$ ;  $\phi(x)$ ,  $\psi(x)$  are the vectors of costs of economic  $a$  and ecological  $b$  resources; ecological resource  $b$  is the actual damage (in money equivalent) to society as a result of pollution of firms or additional costs for compensation for such damages.

According the same scheme – two-sector ecological-economic production function in the case of liner dependence of income, costs of economic and ecological resources from intensity of production is like

$$\begin{aligned}
 & p_0 m x \rightarrow \max \\
 & A_1 x + A_2 y \leq a \\
 \text{this: } & B_1 x - B_2 y \leq b \\
 & 0 \leq x \leq 1 \\
 & 0 \leq y \leq 1
 \end{aligned}$$

So we have the task of parametric linear programming (under terms of perfect competition), where:

$p_0$  – a price of output

$m$  – a vector-row of main production capacity

$x$  – a vector-column of an intensity of main production technology

$y$  – a vector-column of an intensity of technology in auxiliary process  
(destruction of pollutants)

$a$  – a vector-column of available economic resources

$A_1 \geq 0$  – a matrix of standards of resource expenses in main production

$A_2 \geq 0$  – a matrix of standards of resource expenses in auxiliary process

$b$  – a vector-column of limits on emissions (ecological resource)

$B_1 \geq 0$  – a matrix of standards of emissions of pollutants in main production

$B_2 \geq 0$  – a matrix of standards of destruction of pollutants in auxiliary process.

### Empirical Analysis

Generally, statistical studies (Keller, 2002; Kharlamova, 2005; Mabey and McNally 1992), show that the effect of FDI on environment cannot be clearly identified and there is a need in a mathematically based modeling of situations. So this research makes an attempt to show the possibility of the creation of new ecological-economic models that give a possibility to optimize production at the presence of ecological restrictions; for further creation of ecological and economic regulation policies.

Dependence of ecological pollution level from FDI inward in Ukraine is described on Fig. 1, where variable FDI – FDI in Ukraine (\$mln. USA)

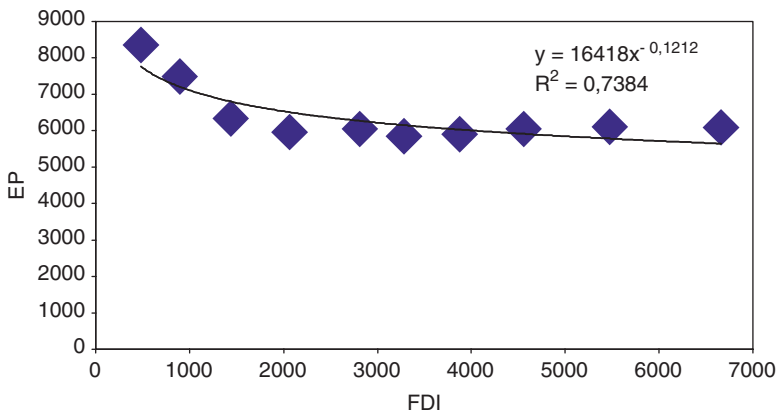


Fig. 1. Dependence of ecological pollution level from FDI inward in Ukraine in 1995–2004.

(1995–2004), variable EP – harmful emissions in environment of Ukraine (thous. t.) (1995–2004).

This research used panel data from 20 countries (taking in account CIS transition states): USA, Canada, Japan, Ukraine, Russia, Belarus, Moldova Rep., France, Germany, UK, Bulgaria, Czech Rep., Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Rep., and Slovenia. The cross-country data support the estimation of multifactor regression models with fixed effects for evaluating FDI-environment mutual influence in the time period 1995–2004:

$$\text{REGS}_{it} = \alpha_i + \beta X + \varepsilon_{it}$$

where

$\text{REGS}_{it}$  – variable estimating the volume of ecological regulation in a state-recipient  $i$  in  $t$  year

$\alpha_i$  – constant time fixed effect

$X$  – a vector of independent variables

$\varepsilon_{it}$  – error of estimation.

Like in the work of Cole et al. (2004), a dependent variable –  $\text{REGS}_{it}$  – we received by multiplying the lead content in gasoline variable by  $-1$ . Thus, an increase in REGS represents an increase in the stringency of regulations (i.e., a decrease in lead content) in all models.

As factor variables were choused:

FDI – FDI inflows (thous. US\$)

CORRUPT – the level of government corruption (data of annual International Country Risk Guide)

FDICORRUPT – variable determining effect of interaction FDI and government corruption. Assumption: estimated coefficient  $\beta^*$ FDI expected to be positive, while coefficient of FDICORRUPT expected to be negative

GDP – GDP of a state-recipient (thous. US\$)

URBANPOPsh – a share of urban population of a state-recipient (%). Foreword: urban population of a state mostly suffer from industrial pollution. The most negative ecological effect from “pollute” FDI inward is in the very urbanized states

MANUFsh – a share of industrial workers in the whole amount of workers in a state-recipient (%)

GDPgr – GDP growth rate (as a variable of an economy growth rate) (%)

EAP – present economically active population of a state-recipient, as a variable that descript a scale of a state-recipient.

The source of statistical data: the National Committee of Statistics of Ukraine, the Global Corruption Report (2003, 2004), the Little Green Data

Book (2003, 2004), the World Bank Reports (2003, 2004), Lovei (1998), World Investment Reports (2003, 2004).

Results indicate:

- FDI can have a positive impact on the strength of environmental regulations for all analyzed states
- The variable of the connection effect of FDI inward with the parameter of corruption level in the recipient-country is significant and negative in models for all states. It has been observed that if the degree of corruptibility is sufficiently high (low), FDI leads to less (more) stringent environmental policy, and FDI thus contributes (mitigates) to the creation of a pollution haven
- Variable of interrelation effect FDICORRUPT is significant and negative in all models, that confirms assumption about dependence of a FDI effect on the environment from corruption in a government of a state-recipient
- Variables GDPgr and GDP make positive impact on dependent variable and are significant in all models
- Variables EAP, URBANPOPsh, and MANUFsh detected as negative impacted on dependent variable and significant in all models
- Variable CORRUPT is statistically nonsignificant in model for CEE states
- Models are statistically appropriate for further forecasts
- Sensitivity analysis shows that variables URBANPOPsh and MANUFsh ARE NOT important parameters in the models
- As to Ukraine: correlation analysis FDI and REGS<sub>it</sub> shows inverse negative relationship of FDI inward and environment pollution.

The building of the “FDI-environment improvement” model for macrodata of transition economies was based on the classic “predator-sacrifice” model. The model showed that investments with innovation contributing to more than half of the production of firms of main productive economic industries of a recipient-state leads to decreasing of harmful emissions of these firms at not less than 20%.

## Conclusions

Undoubtedly, economic tools can greater and more effectively affect environmental security in the state at macro- as at microlevels. However, FDI is unlikely unless investors have a reasonable understanding of the environment in which they will be operating.

Overall, every aspect of host countries' economic and governance practices affects the environment climate. On the answer "What may host countries do about it?" the answer should be:

The following policy action toward macroeconomic stability and ecological predictability should be priority:

- Pursue sound macroeconomic policies geared to sustained high economic growth and environment standards, attraction of "not pollute" and economically effective FDI inward.
- Strengthen domestic business climate in order to make domestic financial resources available to supplement and complement foreign investment for improving environment security.

Moreover, the combination of governmental policies and the national system of economic transfer toward the integration of the environment and sustainability could be considered as a conceptual State strategy. Authorities need to consider the following challenge: enshrine the principle of discrimination for "pollute" FDI in national legislation and implement procedures to enforce it through all levels of government and public administration.

There is a necessity in conduction of such incentives:

- To strengthen encouraging laws for investors who improve environment conditions of their business activity in any sector of economy of state-recipient FDI (especially, in tourism and forestry)
- To reform current and planned investment contracts in such a way to avoid "race to bottom" in environment legislation and in usage of natural resources
- To form the structure of international regulation and coordination for guarantees of positive impact of FDI on a stable economic and ecological development.

Any of these regulation advices does not need the creation of great and grave organization structure. But all advices can strengthen the connection between FDI inward and the level of environment safety in the state-recipient with further economic growth possibilities.

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