The Incorporation of Reciprocal Effects, Environmental and Economic Ones, in Process of Commercial Decisions

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Abstract—These days, the study the deal of pollution emission in diverse industries, is recognized urgency in many countries. Hence, this study evaluates impacts of foreign trade on energy use, air pollutants emission and provision of economic objective. Input-output table is applied to the Iran economy to propose approaches that can reach simultaneously to both economic and environmental purposes while policy of final import substitution are developed. The results show, ten sectors (electricity, mining, petrol, mineral and non-metal, transport, chemical, metal, water, natural gas, and communications), Don't have efficiency in simultaneity achievement to both economic and environmental purposes. because electricity sector have great effects either direct or indirect via other sectors on air pollution, usage of pure substitudes like renewable energies and changing the production method can reduce pollutant emission, meanwhile it has no negative effects for access to economic aims.

***Index Terms*—Policy of Import Substitution,Air pollutants, Input-Output Table, Iran.**

I. Introduction

As all goods and services produced in an economy are directly or indirectly related to types of fuels , foreign trade can be a main factor in shaping the industrial structure of country and thereupon nonrenewable energy use, fossil fules and air pollutants emission. Discussion regarding the impacts of commerce policies on environmental damage such as pollution air is not new. It reached the top concerns on the international agenda in the 70's due to the energy supply crises and it was revived in the 90's by environmental concerns. Recent studies have been increased focus on the application of input-output analyses to study simultaneously diverse consequents from multiple aspects (economic and environmental dimentions) in all economic sectors [1].

Particularly, some studies have addressed the role of international trade in determining environmental damage. The main concern of these international trade studies has been oriented to evaluate how foreign commerce affects the domestic demand for energy and how it impacts the environment.

First research about the relationship between air pollutant and economic policies has been started with using input – output tables from 1970. In this year, Leontief has studied the relation between air pollutant and the economic input - output structures, for 70 sectors in the interval of 1958-1970 [2].

Peter Eder & Michael Narodoslawsky (1999) presented a method to analyse the ecological sustainability of a regional economy.In this study, Author distinguishes responsibility for direct and indirect environmental pressures. Also the implications of various principles of regional responsibility are discussed [3].

Sangwon Suh (2004), aims to link the functional flow-based, micro-level LCA system to its embedding, commodity-based, meso- or macro-level economic systemrepresented by input–output accounts, resulting in a comprehensive ecological–economic model within a consistent and flexible mathematical framework. For this purpose, the LCA computational structure is reformulated into a functional flow by process framework and reintroduced in the context of the input–output tradition. It is argued that the model presented here overcomes the problem of incompleteness of the system and enables various analytical tools developed for LCA or input–output analysis (IOA) to be utilised for further analysis. [4].

Also Kerkhof et al (2009) examined the relations between various household consumption and its environmental impact by combined household expenditure data with an environmental input-output model, in the Netherlands [5].

In the present study, effort has been given to use the economical- environmental input - output technique to intervention strategies to environmental considerations during of development of final import substitution. Therefore the amount of the five types of air pollutants gas (CO_2, SPM, CH, NOX, SO_2) in the eighteen economic sector and incorporated input- output tables have been used.

II. Research Methodology

In this paper, the conceptual framework for economic-environment model is a common input-output model. The starting point of input-output model is trade off table that is a professional form of national account including the inter industries and marginal demands tradeoffs. The economic sector of model has standard input--output notation and can be written as:

$$X\text{-}AX=D \tag{1}$$

That X is. total output, , less intermediate output, *AX*, equals net output, D, or final demand. Alternatively, total output may be expressed as a function of final demand.

$$X = (I - A)^{-1} D \tag{2}$$

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Multiplication of the inverse matrix by the final demand vector will determine the level of gross output for each industry.

A more exhaustive model for environmental impact evaluation requires the inclusion of the environmental sector which takes into account flows of nonmarket materials into and out of the economic sector. Environmental I-O model includes extra block. This block shows sum of air pollutant emission in diverse economic sectors and is written as:

$$q = r'x \tag{3}$$

That $q = (Q_i)$ is a vector of air pollutants emission in producer sectors.

Also $r = (\frac{Q_i}{X_i})$ is a vector of coefficients of amount of air pollutants in different sectors.

With substitution x from equation (2):

$$q = r\,(I - A)^{-1}\,D \tag{4}$$

With expansion of equation that is related to inverse of Leontief matrix:

$$(I - A)^{-1} = I + A + A^2 + A^3 + \ldots\ldots\ldots\ldots \tag{5}$$

It will be:

$$q = r\,D + r\,(A + A^2 + A^3 + \ldots..)D \tag{6}$$

where $r\,D$, describes impacts of direct demand for different goods that is related economic production in each industry [6]. In next part, we use Leontief balance relation to study the impacts of development of final import substitution on economic (value added, employment) and environmental variables (pollution). This relation is for total of economy (18 sectors):

$$X = (I - A)^{-1}(D + E\_M) = R^{-1}(D + E\_M)$$
$$X = AX + D + E\_M \rightarrow \tag{7}$$

where, E , M shows amount of export and import, respectively. Also $(I - A)^{-1} = R^{-1}$ is inverse of Leontief matrix that shows intermediate exchange among economic sectors. With due attention to constant return to scale hypothesis total effects (direct and indirect effects) for value added, employment and pollution due to import substitution is written as:

$$\Delta V = v.R^{-1}\Delta M \quad \Delta P = p.R^{-1}\Delta M \;,\quad \Delta L = l.R^{-1}\Delta M \tag{8}$$

where $R^{-1}\Delta M$, shows the share of total effects [direct and indirect] due to final import substitution on production changing. ΔV , ΔL & ΔP are matrix of value added, employment and pollution changes, respectively due to cited policy. Also v , l & p are matrix of coefficients for value added, employment and pollution per economic sector [7]. If we put diagonal elements of matrix A intead of R^{-1} in 3 previouse equations. It can be written as

$$\Delta L_1 = l.diag(A).\Delta M \quad \Delta P_1 = p.diag(A).\Delta M \;,$$
$$\Delta V_1 = v.diag(A).\Delta M \tag{9}$$

3 new equation shows direct changes for variables (value added, employment and pollution) in each economic sector when it is independent from other sectors. On the other hand, above relations describes internal power of each sector for changing of studied variables due to development of final import substitution. If we subtract calculations in equations (number: 9) from calculations in equations (number: 8), we can obtain indirect effects of cited policy on studied variables. The effects are because of intermediate relations among diverse economic sector.

Also we use Input-output tables for 2001 year that was published by statistic center of Iran. Because this table is published per ten year and we didn't access to new I-O table while doing this research.

III. Results, Discussion & Suggestions

TABLE I: The Effect of Development of Final Import Substitution (One Rials Milliard) on the Pollution Emission (Tons)

Sector	Direct Effect	Rank	Indirect Effect	Rank	Total Effect	Rank
Agriculture	138	8	97	17	235	17
Mining industry	2968	2	60	18	3028	2
Food Industry	68	11	221	11	289	14
Wood & Paper	103	10	302	9	405	12
Textile Industry	121	9	272	10	393	13
Petrol Industry	1233	3	510	5	1743	3
Chemical Industry	271	7	366	8	637	9
Mineral & non metal industry	885	5	697	3	1582	4
Electronic Industry	17	18	398	7	415	11
Metal industry	5471	6	527	4	1068	6
Electricity's	7114	1	136	14	7250	1
Water	41	15	916	1	957	7
Natural Gas	37	16	245	12	282	15
building	33	17	471	6	504	10
Commerce	49	13	202	13	251	16
Transportation	973	4	109	16	1082	5
Communication	51	12	867	2	918	8
Services	48	14	124	15	172	18

Source: Input-output Table and Author Calculations

As it was stated in the introduction, with regards to antithesis of economic and environmental objectives in the most cases, the main concern of policy makers is that to explore ways for provision both economic and environmental objectives, simultaneously. Hence, in order to recognition efficient and inefficient sectors in simultaneous accomplishment diverse objectives, we studied exchanges between economic goals and environmental damages among sectors. We should consider

the sum of direct and indirect changes (total changes) to reach real ranking among economic sectors. Because, strong indirect impacts come over weak direct impacts in some sectors and hence, those sectors are put in high grade due to total impacts.

With due attention to TABLE I, Survey of amount of air pollutants emission shows, we will have the most environmental damage in electricity, mining, petrol, mineral and non-metal, transportation, metal and water sectors, respectively, when the policy of import substitution is developed. Electricity sector emit air pollutants 2.5 times more than mining sector. Also it emit air pollutants 4, 4.5 and 7 times more than petrol, mineral and transportation sectors In Iran, Electricity is produced via thermal powerhouse (vapor, gas, synthetic cycle and diesel systems) and water powerhouse. In water powerhouse, pollution emission for per kilowatt of produced electricity is much less than other types of powerhouses, on the other hand, the share of water powerhouse in electricity production is very low in Iran. In Iran, cited factors and cheap accessible fuels of fossil are the most important reason for high pollution emission in electricity industry.

TABLE II: THE EFFECT OF DEVELOPMENT OF FINAL IMPORT SUBSTITUTION (ONE RIALS MILLIARD) ON PER CAPITA POLLUTION /VALUE ADDED & PER CAPITA POLLUTION /EMPLOYMENT

Sector	Pollution /Value Added [Tons/Milliard Rials]	Rank	Pollution /Employment [Tons/person]	Rank
Agriculture	247.37	17	6.2	17
Mining industry	3086.7	2	302.8	2
Food Industry	1027.4	7	9	14
Wood & Paper	794	12	10.6	13
Textile Industry	813	11	7.7	15
Petrol Industry	2542.7	3	102.5	3
Chemical Industry	856.2	10	30.3	10
Mineral & non metal industry	1715.9	4	83.3	4
Electronic Industry	509.9	14	15.4	11
Metal industry	1229	5	50.9	7
Electricity's	7413.1	1	517.9	1
Water	1022.4	8	73.6	6
Natural Gas	296.5	15	40.3	8
building	552	13	11.2	12
Commerce	260.4	16	7.6	16
Transportation	1133	6	37.3	9
Communication	965.3	9	76.5	5
Services	185	18	5	18

Source: Input-output Table and Author Calculations

In TABLE II, we calculated per capita of pollution emission/value added and per capita of pollution/employment. In TABLE II, we calculated excess of value added (percent) and employment growth [percent] to pollution emission growth (percent) affected by policy of import substitution.

Results shows, electricity, petrol, mineral and non-metal industries are the most inefficient sectors in simultaneous provision of both economic and environmental objectives, respectively, In cited sectors and in water, communication, metal, transportation and chemical industries, economic benefits is lower than environmental damages due to studied policy. Services, agriculture, commerce, textile, food, wood and paper industries are the most efficient sectors for simultaneity achievement to twofold objectives. In cited sectors, positive economic impacts are more than negative environmental impacts after developing of import substitution.

As the long-term growth and development without provision of environmental issues will not be generated, change the methods of production and intermediate consumption can be an effective approach for abatement of air pollutants emission in process of trade policies.For instance, electricity sector and petroleum products emit the most deal of air pollutants and have the highest share of indirect pollutant emission in another sectors, too.Hence, Using the more convenient and cleaner fuels (natural gas, new and renewable energies such as hydrogen gas) instead of previous fuels is profitable approach for abatement of air pollutants emission. Also change thermal powerhouses to other types of powerhouse (water, wind, solar and nuclear energy) for electricity production, reduce efficiently air pollutants emission either direct or indirect in economic sectors. It is noticeable that suggested methods not only abate effectively air pollutants emission, but also don't make problem for achievement to economic purposes.

TABLE III: THE EFFECT OF DEVELOPMENT OF FINAL IMPORT SUBSTITUTION (ONE RIALS MILLIARD) ON EXCESS OF VALUE ADDED AND EMPLOYMENT GROWTH TO POLLUTION EMISSION GROWTH (PERCENT)

Sector	Excess of value Added Growth to Pollution Growth	Excess of Value Employment to Pollution Growth
Agriculture	0.136	0.174
Mining industry	-0.602	-0.681
Food Industry	0.145	0.170
Wood & Paper	0.081	0.128
Textile Industry	0.071	0.232
Petrol Industry	-0.317	-0.418
Chemical Industry	-0.029	-0.051
Mineral & non metal industry	-0.214	-0.0319
Electronic Industry	0.078	0.065
Metal industry	-0.221	-0.054
Electricity's	-2.2	-2.3
Water	-0.091	-0.211
Natural Gas	-0.107	0.039
building	0.051	0.147
Commerce	0.148	0.163
Transportation	-0.121	-0.154
Communication	-0.039	-0.162
Services	0.141	0.192

Source: Input-output Table and Author Calculations

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