The Environmental Implications of the Philippine Economic Structure: An Input-Output Analysis

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I. Introduction

The purpose of this paper is to look into the relationship between the Philippine economic structure and the environment using input-output (I-O) analysis. Specifically, we have the following objectives: (1) to describe how environmental variables are incorporated in the conventional I-O table; (2) to extract the 1994 environment-augmented I-O Table for the Philippines; (3) to augment the conventional I-O model by including import variables in the Leontief matrix; and (4) to determine how endogenizing imports will affect the impact of a change in final demand on gross output and, consequently, the environment, in the Philippines.

The role of the environment as a provider of raw materials and as a sink for wastes from production and consumption cannot be overemphasized. While in the past, the environment was largely taken for granted especially in developing countries, its scarcity and the drive towards sustainable development, as well as lessons learned from developed countries, have motivated economists and policymakers to assess the stock of their natural resources and quantify the burden imposed by economic activities, in what is now popularly known as the "Environmental and Natural Resource Accounting (ENRA)".

ENRA in the Philippines began in 1991 with the launching of the Environment and Natural Resource Accounting Project (ENRAP) spearheaded by the Department of Natural Resources and sponsored by the US Agency for International Development (USAID). The valuation project comprised of four phases: (1) forest accounts; (2) household waste disposal; (3) renewable and non-renewable resources; and (3) institutionalization and application of the project. The data gathered from the studies were used in extracting the environment-augmented IO table for the Philippines.

The National Statistics Coordination Board (NSCB) in 1994 also began developing the

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Philippine System of Integrated Environmental and Economic Accounting (PSEEA) framework which is patterned after the United Nation's System of Integrated Environmental and Economic Accounting (UNSEEA). Under this program, environmental accounts for five resources (fishery, forest, minerals, land and water) were compiled in 14 economic activities, four in agriculture, fisheries and forestry; seven in manufacturing and one each in mining, electricity generation and land transportation services.

Other than the "environmental scorekeeping" role of these projects, they also provide data used to simulate the environmental impact of economic development policies and help design long-term environmental strategies in the country. In this paper, we attempt to give a more accurate assessment of the environmental impacts of the economic policies by incorporating imports coefficients in the current I-O framework. We observe that (1) by importing the factors of production or inputs, the environmental impacts are "exported," and (2) the higher the import coefficients, the lesser will be the net environmental impact compared to that implied in the current I-O framework.

This paper is divided into 6 sections: In the next section, we describe the environment-augmented I-O constructed by ENRAP for 1988 and 1990, and briefly present some studies that use this framework in evaluating the impact of growth policies in the Philippines. In section III, we modify the current I-O framework by augmenting it with respect to imports. Section IV will briefly describe the data used in this study to extract the 1994 environment-augmented I-O Table for the Philippines. In section V, we show and analyze our results. Finally, section VI gives the summary and recommendations of this paper.

II. The ENRAP I-O Framework

II.1. The Conventional I-O Framework

The conventional general I-O model (equation 1) represents the economic structure of an economy, and shows the relationship between gross output and the total final demand components.[1]

$$[X]=[I-A]^{-1}[Y_D+E-M] \qquad (1)$$

where X is the column vector of gross output, A is the technical coefficient matrix, I is an identity matrix, Y_D is final domestic demand (consisting of private consumption expenditures, investments and government expenditures), M is imports and E is exports.

The second term on the right hand side of equation 1 is the final demand matrix whose components (domestic final demand and net foreign demand) are all exogenous to the system. $[I-A]^{-1}$ is known as the Leontief inverse matrix. The column sum of its elements is called the output multiplier for that sector, which is the total value of production in all sectors of the economy required to satisfy a unit increase in final demand for that sector's output. The impact of a policy which effects a change (Δ) in any of the final demand components can thus be computed using equation (2):

(2) $$[\Delta X]=[I-A]^{-1}\Delta[Y_D+E-M]$$

II.2. The Environment-Augmented I-O Framework (Mendoza, 1996)

ENRAP augmented the conventional general I-O framework represented in equation (1) to include the environmental inputs and outputs. It used estimated values for several environmental variables derived mainly from other ENRAP studies as follows:

1. Income from non-marketed, nature-based household activities

These are considered "unaccounted" output and are thus accounted for in the I-O table as additional output of the agricultural and forestry sectors. The output from upland agricultural activities, fuel wood gathering and charcoal making are added as pure labor income of the agricultural and forestry sectors and as increase in personal consumption expenditures.

2. Environmental waste disposal services (ES)

The cost of air and water disposal services are used as proxy for pollution, and are entered as negative inputs (additional rows). The values for ES are actually the pollution abatement costs that are incurred if pollution is to be reduced by 90%. The ES coefficients are then derived by dividing the actual ES values by the total cost of inputs (intermediate and value-added). Air pollution is estimated as the abatement cost for particulate matters (PM), sulfur oxide (Sox), nitrogen oxide (NOx), volatile oxygen compound (VOC) and carbon monoxide (CO). For water pollution, calculations are based on pollution control cost for Biological Oxygen Demand 5 (BOD_5), suspended solids (SS), total dissolved solids (TDS), oil (OIL), nitrogen (N) and phosphorus (P).

3. Environmental health and non-health damages (ED)

Environmental damages are considered negative output and are thus deducted from the total output of the respective sectors (additional column). The ED coefficients are then derived by dividing the actual ED values by the total amount of outputs (intermediate and value-added). The data used are based on the health effects and productivity loss due to pollution. Only health damages in the national capital region are used for air pollution damages, while for water pollution damages, both health and non-health damages nationwide are covered.

4. Natural resource depreciation (NR)

Natural resource depletion, considered a form of physical capital depreciation, is subtracted from the output of the agricultural and forestry sectors (additional row).[2] NR in the agricultural sector is measured as the quantity of upland soils eroded, while for the forestry sector, it is based on the change in stock of forest resources and quantity of upland (grassland and woodland) soils eroded. NR in the mining sector is represented by the amount of copper and gold extracted. Finally, the quantity of small pelagic catch is used for NR in fisheries.

5. The benefits received from recreational activities involving nature (direct natural services or DNS)

These include ENRAP estimates for benefits derived from the use of parks, bathing beaches, swimming pools and forests for amusement and recreation, and are estimated and included as additional output for the services sector.

6. "Net environmental benefits (NEB)"

NEB is included as an accounting balancing entry and computed as follows (equation 3):

$$NEB = |ES| - |ED| + DNS \tag{3}$$

This is called the "social cost of polluting" or the pollution abatement cost that is saved by actually polluting minus the resulting pollution damages (Mendoza, 1994).

7. The model is closed with respect to the household sector.

In the conventional IO, only the total output induced by the first-round change in any final demand components is considered. During the production of the induced output, however, income is generated and again spent by households on consumption of goods, which in turn again generates income and then spent as PCE. The full-round (total) impact can thus be estimated by closing the model with respect to households or by "endogenizing households" inside the A-matrix. Thus, the PCE from labor income (Labor PCE), showing the money flows from consumers (as purchases of goods of the n sectors) is added as the (n +1)th column (H_c column). Labor income, showing the money flows to consumers is moved inside the A-matrix as the (n + 1) th row (H_r row)[3]. The (n + 1, n + 1) th element is therefore the household purchase of labor services, which we will assume here to be equal to zero.[4] In this framework, we now have a "consumption" sector in addition to the conventional n production sectors.

The environment-augmented A-matrix will then be a partitioned matrix as shown in equation (4).

$$(4) \qquad \left[\frac{X}{X_{n+1}}\right]=\left[\begin{array}{c|c} I-A & -H_c \\ \hline -H_r & 1 \end{array}\right]^{-1}\left[\frac{Y_D^*+E-M}{Y_{n+1}^*}\right]$$

The last column in the environment-augmented Leontief inverse matrix will then be the expected increase in consumption due to a one peso increase in final demand arising from the increase in labor income. The gross outputs derived in this "closed with respect to household" model are higher than in the conventional IO analysis because it includes the additional output necessary to satisfy the expected increase in consumer spending arising from household income.

In analyzing the total environmental impact of PCE, the IO that is closed with respect to household model is justifiable since it accounts not only for the value of environmental variables arising from the first-round PCE but also from its succeeding rounds as income earned from the first round is put back to the system in the form of labor income.

II.3. The Environmental Impact of Economic Policies

An economic policy that results in a change in the value of final demand will affect the gross output per sector through the output multiplier. In the same manner, we can also determine the impact on the environment, V, by multiplying the environmental impact coefficients by the total change in gross output (as solved using equation 2). The formula is shown as equation (5), where ν is the vector of environmental coefficients classified per sector.

$$(5) \qquad [V]=\nu\times[I-A]^{-1}\Delta\,[Y_D+E-M]$$

For the model closed with respect to household, the impact on the environment is computed using equation (6).

$$(6)\qquad \left[\frac{V}{V_{n+1}}\right] = \nu \times \left[\begin{array}{c|c} I-A & -H_c \\ \hline -H_r & 1 \end{array}\right]^{-1} \left[\frac{\Delta\,(Y_D^{*}+E-M)}{\Delta\,Y_{n+1}^{*}}\right]$$

where the elements of $\nu \times [I-A]^{-1}$ or $\nu \times \left[\begin{array}{c|c} I-A & -H_c \\ \hline -H_r & 1 \end{array}\right]^{-1}$ are called the environmental impact multipliers.

We can now decompose the environmental impact of an increase in final demand for a sector's output as follows:

(1) First-round direct or initial environmental impact of the change in final demand for that sector's output. This is measured by simply multiplying the initial increase in demand by the environmental coefficients, v.

(2) First round, indirect or induced impact due to the use of output from other sectors as input to the said sector's production. This is termed as the sectoral interlinkage effect. The first- round, total (direct and indirect) impact can thus be computed by multiplying the environmental impact multipliers (see equation 5 above) with the initial change in final demand.

(3) Full-round impact that includes the additional effect arising from the endogenization of the household. The labor income generated by the additional production due to the initial increase in final demand will be partially used for personal consumption expenditures (PCE), and therefore will again induce production in all sectors. The full-round impact in the closed model therefore considers all the changes in gross output and the environmental variables, and is similar in concept to the Keynesian multiplier effect (see equation 6).

Using the model above, four studies in the case of the Philippines have been conducted. In the first study (Mendoza, 1996), environmental variables were incorporated in the 1988 11-sector I-O transactions table and then simulation was done for the impact of five policy scenarios, namely, (1) trade policy targets, (2) trade agro-industrial plan, (3) domestic pump-priming, (4) NIC targets with different growth rates for sectors' final demand, and (5) uniform growth in final demand, both in the case when household consumption expenditures are exogenous, and when they are endogenized. Simulation results showed that for all scenarios, the amount of air pollution damages is very high compared to the amount of natural resource depletion or water pollution damages. Moreover, out of the 5 scenarios simulated, domestic pump-priming programs generated the highest rate of increase in air pollution. The role of household as emitter of air and water pollution cannot be ignored since it was found out that it accounts for 43% of total air pollution and 33% of water pollution for the year 1988. Also, endogenizing the household sector resulted in at least twice as much of the impact when it was considered as an exogenous final demand sector.

Orbeta, Cortez and Calara (1997) applied ENRAP's I-O framework on a regional level using the 1988 Region XI intraregional industry-by-industry transactions table and the national coefficients for the environmental variables. They simulated the impacts of (1) export-oriented agro-industrial policies; (2) local pump priming program; (3) over-all economic growth target; and (4) over-all regional growth targets, and found essentially similar findings as Mendoza (1996). In addition, the high value-added and environmental multipliers for resource-based agro-industrial sectors in this region suggest that the regional government can prioritize programs for the development of these sectors, provided that they complement them with natural resource conservation and rehabilitation policies.

Two studies by Orbeta (1999a and 1999b) studied the impact of changes in the tariff structure of the Philippines from the period 1991-2000 using the 1990 I-O transactions table disaggregated into 40x40 and 34x34 sectors, respectively. Tariff reductions will have varied effects on the environment. First, higher tariff for natural-resource-intensive sectors and highly-polluting sectors will reduce environmental burden in the country. On the other hand, if tariffs are lowered for inputs generating high pollution like crude oil, then, the intensified use of these inputs due to their lower prices will raise air pollution levels in the country.

In both studies, the impact was calculated as the product of the exogenous change in gross output due to tariff reduction[5] and the multiplier for each environmental variable. It was found out that the reduction in tariffs will lower depletion for upland soils but at the same time hasten the depletion of forests and mineral resources. It will also increase emission of residuals, especially of air pollutants, which is mainly attributed to the increase in consumption of crude oil and oil products of industries brought about by the reduction in tariffs on imported oil products.

The framework used in these studies bears the limitations inherent in I-O modeling in general, and to environmental impact analysis, in particular. We can see that the technology coefficients, or the peso amount of each input required to produce a peso amount of a sector's output, are fixed, implying constant returns to scale and therefore ignoring economies of scale. Prices are also constant so that any increase in demand will not induce technical substitution. Similarly, the environmental impact multipliers are also represented as constant values for the entire simulation period. In reality, however, this is generally not the case, and simulation results, especially those encompassing several years must be interpreted with care. Furthermore, household consumption was considered to depend only on labor income, although other sources, such as international remittances from overseas contract workers, may contribute considerably to private consumption expenditures.

Finally, imports in the model above are considered to be fixed and unaffected by the change in final demand. However, the total amount of imports will increase as production increases, depending on the import content of a sector's output. In this study, therefore, we attempt to augment the model above in terms of imports, and, in so doing, we will be able to look at the domestic environmental impact of production within the I-O framework.

III. Imports and the Environment-Augmented I-O Model

In equations (1) and (4), imports are an exogenous reduction in final demand. In reality, however, they are highly dependent on other final demand components as well as on the production structure represented by the Leontief inverse matrix. For simplicity, we will use equation (1) as the starting point, augment it with respect to imports and then we determine the impact on the environment, V_M, as shown in equation (7).

$$(7) \qquad V_M = \nu \times [I-(I-\overline{M})A]^{-1}[(I-\overline{M})\Delta Y_D + E]$$

where M is a diagonal matrix whose elements in the diagonal are the import coefficients, and where the second term on the right hand side of equation (7) is now the import-augmented Leontief inverse matrix whose coefficients are now the gross domestic output multipliers.[6] We assume here that the amount of exports is independent of imports.[7] In equation (7), the domestic environmental impact multipliers are now represented by $\nu \times [I-(I-\overline{M})A]^{-1}$.

The domestic environmental impact multiplier for a sector is now interpreted as the amount of environmental burden on "domestic" air, water or natural resources arising from an additional unit of final demand for each of the sectors of the economy. Its magnitude will be especially relevant if we want to separately evaluate the impact on the "domestic" environment and on imports of any government policies that favor expansion of output in selected sectors. For example, if the government undertakes a campaign that will raise investments and production in a highly pollutive sector, its domestic environmental impact will be minimal if this sector is, at the same time, a highly import-dependent sector.

Moreover, by comparing our results with the model with exogenous imports, we can determine if a considerable level of environmental burden is embodied in our "imports", or if we "export" a considerable amount of environmental damage and natural resource depreciation.

IV. Description of Data

The initial task of this paper is to extract the 1994 environment-augmented I-O Table for the Philippines, which was done by using the conventional I-O Table and the environmental coefficients from ENRAP. The extracted environment-augmented I-O Table for the Philippines for 1994 is shown as Appendix A.

For the I-O Table, we use the I-O Use Table for the Philippines (1994) (in thousand pesos and in current producers' prices). It has data for 11 sectors and four primary inputs: compensation of employees, depreciation, indirect taxes less subsidies and other value-added. The final demand components are private consumption expenditures (PCE), government consumption expenditures (GCE), gross fixed capital formation (GFCF), current stocks (CS), and imports (IMP) and exports (EXP).

Perhaps the greatest barrier in evaluating the environmental impact of economic activities is in the extraction of the coefficients for the environmental variables mentioned above. For our purpose, we will use the only available, estimated national coefficients derived from various studies under the Philippine Environment and Natural Resource Accounting Project (ENRAP) for 1988, 1990 or 1992 (see Orbeta, Cortez and Calara, 1997)[8] The coefficients of these environmental variables are presented as Appendix B.

V. Presentation and Analysis of Results

V.1. The Environmental Burden Imposed by the Production Sectors and Households

Table 1 shows the impact of the economic structure on the environment in the

Table 1. Environmental Impact per Sector, Philippines (1994)

Impact Variable	Sector 1	2	3	4	5	6	7	8	9	10	11	HH(CE)
Residuals	(in metric tons)											
PM	0	0	1,004	88,503	266,292	0	0	0	119,832	26,347	126,885	2,641,301
Sox	0	5,308	502	26,049	98,108	0	0	0	5,287	13,948	11,535	28,099
Nox	3,816	10,615	1,255	20,713	84,092	0	0	0	12,336	23,247	23,070	202,312
VOC	3,816	3,538	1,088	17,261	70,077	0	0	64	12,336	38,745	57,675	5,844,582
CO	11,449	9,730	6,609	102,312	406,445	0	0	0	70,490	114,686	126,885	17,921,510
BOD_5	2,201,936	0	708,851	0	217,238	0	0	0	0	0	3,079,842	6,496,477
SS	231,172,736	0	140,679,477	52,635,676	217,238	0	0	0	0	0	2,387,743	2,939,150
TDS	0	0	0	0	2,011,204	0	0	0	0	0	0	0
Oil	0	0	0	0	21,023	0	0	0	0	0	103,815	0
N	1,209,729	0	545,296	0	0	0	0	0	0	0	80,745	517,021
P	15,265	0	8,617	0	0	0	0	0	0	0	23,070	207,932
	(in thousand pesos)											
NR Depn	(774,685)	(6,975,877)	(313,390)	(186,735)	0	0	0	0	0	0	0	0
Air Damages	0	0	(837)	(76,263)	(231,253)	(200,479)	(29,953)	0	(102,210)	(23,247)	(103,815)	(2,270,395)
Water Damages	(396,883)	0	(128,000)	0	(42,046)	(5,569)	0	0	0	0	(553,680)	(1,174,536)
Nature Services	0	0	0	0	0	0	0	0	0	0	5,617,540	0
ES(air)	(53,427)	(118,535)	(30,620)	(480,803)	(2,221,435)	(1,136,049)	(57,411)	(129)	(366,546)	(443,246)	(669,029)	(4,765,582)
ES(water)	(5,987,586)	0	(3,457,751)	(5,421,586)	(315,346)	(111,377)	0	0	0	0	(6,736,434)	(20,085,129)
NEB	5,644,130	118,535	3,359,535	5,826,126	2,263,481	1,041,379	27,457	129	264,336	419,999	12,365,509	21,405,780
	(in million pesos)											
Gross Output	381,618	88,459	8,366	31,384	700,768	556,887	83,204	6,433	176,224	154,981	1,153,499	561,979

Notes:
1. Residuals are measured in metric tons per thousand pesos of the sector's modified total domestic output.
2. Air emission residuals: PM, Sox, Nox, VOC and CO
3. Water effluent emission residuals: BOD_5, SS, TDS, OIL, N, P
4. Natural resource depreciation (NR depn) , air pollution damages (air damages), water pollution damages (water damages), nature services, and environmental waste disposable services (ES(air) and ES(water)) and gross output are expressed in thousand pesos.
5. Computed by multiplying total output in 1994 by the environmental impact coefficients found in Appendix B.

Source: Author's Calculations

Data Sources: For environmental coefficients, Orbeta, Cortez and Calara (1997); and for thePhilippine I-O Table (1994), National Statistics Coordination Board, Philippines.

Philippines in 1994. The values are derived by multiplying gross output (Appendix A) by the environmental coefficients (equation 5). The total impact on air residuals (PM, Sox, Nox, VOC and CO) and water residuals (BOD_5, SS, TDS, Oil, N, P) are expressed in metric tons, while natural resource depreciation, air and water damages (ED-air and ED-water), nature services (NS), environmental waste disposal services (ES-air, ES-water) and net environmental benefit (NEB) are expressed in thousand pesos.

First, for air pollution, the manufacturing I and II sectors are the highest emitters of particulate matters (PM), volatile oxygen compound (VOC) and carbon monoxide (CO). This can be attributed mostly to the high value of gross output from these sectors (700,768 and 556,887 million pesos respectively, see Appendix A), and partly from their relatively high environmental coefficients (see Appendix B). The construction sector also has high total emission levels of PM mainly because of high emission coefficients. Other than the manufacturing and construction sectors, mining and quarrying, transportation, and other services sectors emit very large amounts of CO due to high emission coefficients. CO is emitted by motor vehicle exhaust, other non-road engines and vehicles (such as construction equipment and boats) as well as industrial processes (such as metals processing and chemical manufacturing), residential wood burning, and natural sources such as forest fires.

For water pollutants, the agricultural sector emits considerable amounts of most of the residuals measured, such as biological oxygen demand 5 (BOD_5), suspended solids (SS), and nitrogen (N). BOD_5 is a measure of oxygen depletion in water bodies that is crucial for fishes to survive and anaerobic microorganisms to flourish, while suspended solids make water bodies become shallow, and encourage the increase of anaerobic microorganisms. Anaerobic microorganisms produce toxic and smelly ammonia, amines and sulfides, as well as flammable methane (swamp gas). The agricultural sector also emits high amount of nitrogen, which causes undesirable growth of aquatic weeds, thus making the water bodies unsuitable for swimming and boating. Moreover the intensive use of pesticides, herbicides and fertilizers also contributes considerably to water pollution. The large amount of water pollution in the agricultural sector can be attributed both to the relative size of this sector and to the relatively high pollution coefficients. Other sectors that greatly contribute to water pollution are (1) forestry (especially SS and N), (2) mining and quarrying sector (for SS), (3) manufacturing sectors and (4) other services sector (for BOD_5 and oil). Our findings reiterate the need for water sewage system or filtering plants in these highly pollutive sectors.

With regards to natural resource depletion, the fisheries sector imposes the heaviest burden, compared with other natural-resource intensive sectors like agriculture, forestry and mining and quarrying. From our estimates, the amount of water resources decreased by 6,975 million pesos, which is at least 9 times the amount of depreciation of other natural resources. This problem is partly attributed to the problem of clear property rights in fishing grounds relative to property rights for forests and quarries.

Air damages, which refer to the health and non-health impact of air pollution, are very considerable in the two manufacturing sectors. On the other hand, for health and non-health damages arising from poor water quality, about three-fourths originated from the agriculture, mining and quarrying, and other services sectors. From these observations, we suggest the implementation of institutional regulations that will require factories to employ technology which emit less air residuals that cause health and non-health damages, or take necessary and additional procedures that will purify air and water disposed by factories. It must be noted that at present, such regulations are either lacking or not successfully implemented in the country.

The total cost of environmental waste services (ES) for air, which is the abatement cost of 90% of air pollution, is very high in the two manufacturing sectors, again mainly because of the high amount of their gross output and high impact coefficients (−0.00317 and −0.00204 respectively). On the other hand, the natural-resource intensive sectors (agriculture, forestry and mining and quarrying) as well as the other services sector have high abatement costs for water pollution (ES-water). For natural-resource intensive sectors, abatement costs for water pollution per thousand pesos of output are more expensive than for air pollution; while the reverse is generally true for the rest of the sectors. This suggests that effective environmental management should prioritize water pollution control in natural-resources and the other services sectors, while air pollution control must be the focus in the rest of the sectors, particularly in the two manufacturing sectors.

Finally, the net environmental benefit (NEB), which is one, although incomplete, measure of the net social cost of polluting, and an indicator of the "wisdom" of imposing pollution reduction measures, is positive for all sectors, which suggests that it will be more expensive to spend for abatement cost of pollution rather than the estimated cost of health and non-health damages it will inflict. This finding, however, must be taken cautiously because a possible reason for this result is the limitation in the scope of health and non-health damages that can be quantified.

It is also important to look at the magnitude of air and water pollution as well as natural resource depletion imposed by households, which are shown in the last column of Table 1. Compared to all production sectors, the households emit very high amounts of particulate matters (PM), nitrogen oxide (NOx), volatile oxygen compound (VOC), carbon monoxide (CO), biological oxygen demand5 (BOD_5), and phosphorus (P). Health and non-health damages arising from air and water pollution (ED-air and ED-water) as well as the cost of services required to eliminate 90% of air and water wastes (ES-air and ES-water) are also significantly higher than any production sector. These results can be explained by the large share of PCE to final demand, and therefore, to gross output, as well as their high emission (impact) coefficients. Therefore, any successful national drive towards environmental protection would require the involvement of these consumers, either by encouraging them to reduce air and water residual emission intensities through education, and by implementing measures that will prevent air and water residuals from households from polluting water bodies and the atmosphere, such as the construction of water sewage filtering treatment system especially in well-populated areas. Moreover, further studies on the consumption and pollution emission patterns/behavior of households are relevant if we are to effectively implement environmental programs on the national level.

In summary, our results show that light and heavy manufacturing sectors are the main contributors to air pollution, while the agricultural and other services sectors impose the greatest burden to water resources. These can be attributed to the following three factors.

(1) High share of the outputs of these sectors to total output (see Appendix A);

(2) High linkage of these sectors and the other sectors (see Carlos, 2000); and

(3) High environmental coefficients (see Appendix B).

Our results imply that (1) as these sectors continue to make up for a large part of the economy, (2) as the government promotes growth biased towards sectors that are highly interlinked with these sectors, and (3) as the environmental coefficients remain high, then the environmental burden arising from these sectors will remain high. To further explain these observations, we derive in V.2. the output and environmental impact multipliers, which will help us evaluate especially the environmental impact of economic policies that will selectively raise final demand for different sectors.

V.2. The Output Multipliers

Table 2 shows the sectoral output multipliers in the models with exogenous imports (Model A) and endogenous imports (Model B), derived as the column sum of $[I\text{-}A]^{-1}$ and $[I\text{-}(I\text{-}M)A]^{-1}$ for Models A and B respectively. The sectoral multiplier in Model A gives us the total value of GROSS OUTPUT required by the entire economy (all sectors and including imports) due to the change in final demand in that sector. For example, a peso worth of additional final expenditure on agriculture will yield a 1.5650 increase in GROSS OUTPUT.[9] On the other hand, the values in model B will give us the effect of a peso increase in final demand on DOMESTIC OUTPUT for the 11 sectors. The output multipliers for Model A range from 1.5325 to 2.6865, while for Model B, the range is from 1.2485 to 1.9077. The difference obviously arises from the "leakage" of output in the form of imports and therefore of environmental burden to the producers of output imported by the Philippines.

Table 2. Output Multipliers in the Philippines (1994)

	Sectors	Model A $\{(I\text{-}A)^{-1}\}$ Exogenous Imports	Model B $\{(I\text{-}(I\text{-}M)A)^{-1}\}$ Endogenous Imports	Difference Model A- Model B	Share of Imports (%)	Share of Domestic Goods (%)
1	Agriculture	1.5650	1.3548	0.2102	0.0224	0.9777
2	Fishery	1.6453	1.3779	0.2675	0.0024	0.9977
3	Forestry	1.5210	1.2485	0.2726	0.0030	0.9970
4	Mining and Quarrying	2.0190	1.4910	0.5280	0.7294	0.2706
5	Manufacturing 1	2.2569	1.9077	0.3492	0.1699	0.8301
6	Manufacturing 2	2.6865	1.6209	1.0656	0.5174	0.4826
7	Electricity and Gas	2.1847	1.4469	0.7378	0.0000	1.0000
8	Waterworks	1.5325	1.2870	0.2454	0.0000	1.0000
9	Construction	2.0886	1.4803	0.6083	0.0258	0.9742
10	Transportation Service	2.3092	1.5814	0.7278	0.0343	0.9657
11	Other Services	1.6630	1.4310	0.2320	0.0450	0.9550

Notes:
1. In Model A, the output multiplier can be interpreted as the increase in TOTAL output arising from a one unit increase in final demand.
2. In Model B, the output multiplier can be interpreted as the increase in DOMESTIC output arising from a one unit increase in final demand.
Source: Author's computation from the Philippine I-O Table (1994).

For model A, the manufacturing 2 sector (heavy industries) generated the highest multiplier (2.6865) followed by the transportation services (2.3092), manufacturing 1 (light industries), electricity and gas (2.1847), and construction (2.00886). This suggests that policies which will raise the final demand for these sectors will require very large amount of gross output compared to those intended for the resource-intensive sectors (agriculture, fishery and forestry). This becomes one of the basis for manufacturing-led economic growth strategies or industrialization.

However, Model A does not consider the amount of imports that will be required for the production of the additional unit of final demand. If the share of imported inputs is high, then, the impact on the domestic economy will be low. Compared to the values in Model A, the values obtained in model B are significantly low especially for the heavy manufacturing industries (manufacturing II). The difference can be explained by the high import content of output in these sectors (see last two columns of Table 2). This suggests that manufacturing -led growth strategies will have serious implications on the economy by draining it of foreign reserves used to pay for the required imports.

From the third column of Table 2, we can also see that the multipliers decreased by at least 0.5 points when we use model B for the following sectors: transportation services, electricity and gas, construction and mining and quarrying. In the case of the first three sectors, although their import contents are not that high (and even zero), additional demand in these sectors require inputs from other sectors that are import-intensive (for example, the manufacturing sectors).

Another observation from this study is that the difference between the output multipliers using model A and model B is not so wide for natural-resource intensive sectors (except mining and quarrying) because, compared to most of the sectors, their import contents are minimal and they have weak linkage with other sectors.

V.3. The Environmental Impact Multipliers

The environmental impact multiplier is useful in projecting the impact of an additional unit of final demand for a sector's output on the domestic environment.

The values in Table 3 are the domestic environmental impact multipliers, computed from $\nu \times [I-(I-\overline{M})A]^{-1}$, and are interpreted as the effect of a change in a thousand peso final demand from each of the sectors of the economy. For example, the value 0.00007 for particulate matters (PM), sector 1 (agriculture), is the amount (in metric tons) of particulate matters induced by an additional thousand peso of final demand in sector 1. Note that although the environmental coefficient for PM in sector 1 (agriculture) (refer to Appendix A.2.) is 0.00000, the additional final demand in this sector will affect other sectors through its interlinkage with other sectors. As production is induced in these related sectors by the additional final demand in agriculture, PM is emitted. In other words, although production in agriculture will not generate PM per se, a thousand peso change in final demand from this sector will result in the use and production of inputs from all the other sectors, and in the process, "indirectly" generates PM for the amount of 0.00007 metric tons/thousand pesos.

We focus our analysis on how decisions on which sector an additional final demand is used will affect the different types of air and water pollution residuals, natural resource, pollution damages as well as the cost of waste disposal services. Evidently, the environmental effect will be varied due to the difference in the values of the environmental coefficients (v), the strength of interlinkage among the sectors (A), and the import contents (M) in these sectors.

First, for air residuals, we can see that an additional final demand of one thousand pesos in the mining and quarrying sector (instead of being used in the other sectors) will emit the highest levels of PM, Sox, VOC and CO, even though this sector is highly import-dependent. For water residuals, the manufacturing 1 sector emits very high levels of all water residuals. Therefore, any policy that will raise the final demand for output produced by this sector instead of those by the other sectors will result in more serious water pollution. Another sector in which the change in final demand will greatly aggravate water pollution is the other services sector, which includes retail and wholesale trade, real estate, business services, education, restaurants and hotels, recreation and cultural services and personal and household services. If, as income increases due to economic development, a larger portion of it is used for manufacturing or other services sectors, then, we can predict that water pollution will worsen, and therefore, will greatly necessitate the implementation of measures that will alleviate it, such as the construction of water sewage/ filtering systems and regulations on water waste disposal (like the ISO scheme) for these sectors.

Comparing the multipliers for air and water residuals in agriculture, generally, water pollution is a more severe problem than air pollution in this sector. This is a result of rampant use of fertilizers and pesticides to increase farm production, and from the lack of facilities in farms that will filter the chemicals and prevent them from flowing into water bodies. This is a great concern for the Philippines in which large areas are still used for the cultivation of agricultural products. Moreover, we can also predict that an agro-industrial growth strategy will highly pollute the country's water resources, unless the necessary water-pollution reducing policies are simultaneously implemented.

For natural resource depreciation, the impact multipliers in fishery and forestry sectors are obviously very large. For health damages caused by air pollution, additional demand in

Table 3. Environmental Impact Multipliers in the Model with Endogenized Imports, Philippines (1994)

Impact Variable	Sector 1	2	3	4	5	6	7	8	9	10	11	Total
Residuals	(in metric tons)											
PM	0.00007	0.00009	0.00019	0.00299	0.00054	0.00071	0.00059	0.00010	0.00084	0.00034	0.00021	0.00667
Sox	0.00010	0.00021	0.00013	0.00127	0.00044	0.00049	0.00644	0.00061	0.00017	0.00027	0.00025	0.01038
Nox	0.00005	0.00018	0.00018	0.00077	0.00022	0.00024	0.00114	0.00012	0.00013	0.00022	0.00008	0.00334
VOC	0.00003	0.00007	0.00016	0.00059	0.00015	0.00016	0.00007	0.00003	0.00012	0.00030	0.00009	0.00177
CO	0.00013	0.00024	0.00091	0.00345	0.00083	0.00090	0.00026	0.00008	0.00062	0.00097	0.00025	0.00863
BOD_5	0.00678	0.00039	0.08590	0.00070	0.00391	0.00071	0.00040	0.00027	0.00058	0.00074	0.00338	0.10377
SS	0.70101	0.03354	17.01444	1.74169	0.44885	0.09919	0.03672	0.01169	0.03938	0.03115	0.03414	20.19180
TDS	0.00019	0.00023	0.00003	0.00012	0.00354	0.00028	0.00009	0.00004	0.00015	0.00014	0.00016	0.00498
Oil	0.00001	0.00001	0.00001	0.00002	0.00005	0.00003	0.00001	0.00001	0.00002	0.00002	0.00011	0.00028
N	0.00364	0.00014	0.06594	0.00023	0.00203	0.00016	0.00008	0.00004	0.00011	0.00010	0.00022	0.07268
P	0.00005	0.00000	0.00104	0.00001	0.00003	0.00001	0.00000	0.00000	0.00000	0.00001	0.00003	0.00118
NR Depn	(0.00249)	(0.08584)	(0.03795)	(0.00623)	(0.00387)	(0.00048)	(0.00015)	(0.00008)	(0.00027)	(0.00034)	(0.00058)	(0.13829)
Air Damages	(0.00006)	(0.00008)	(0.00016)	(0.00257)	(0.00047)	(0.00061)	(0.00050)	(0.00008)	(0.00072)	(0.00030)	(0.00018)	(0.00573)
Water Damages	(0.00122)	(0.00007)	(0.01551)	(0.00013)	(0.00071)	(0.00013)	(0.00007)	(0.00005)	(0.00010)	(0.00013)	(0.00061)	(0.01874)
Nature Services	0.00030	0.00028	0.00032	0.00069	0.00057	0.00070	0.00050	0.00040	0.00074	0.00106	0.00573	0.01127
ES(air)	(0.00062)	(0.00204)	(0.00416)	(0.01616)	(0.00443)	(0.00359)	(0.00148)	(0.00040)	(0.00302)	(0.00383)	(0.00122)	(0.04095)
ES(water)	(0.01875)	(0.00153)	(0.41893)	(0.17601)	(0.01284)	(0.00864)	(0.00244)	(0.00108)	(0.00329)	(0.00299)	(0.00796)	(0.65447)
NEB	0.01839	0.00370	0.40775	0.19016	0.01667	0.01220	0.00385	0.00174	0.00622	0.00746	0.01411	0.68224

Note: Computed by multiplying the environmental coefficients matrix, v, by the Leontief inverse.

Source: Author's calculations.

mining and quarrying seem to have the greatest impact, followed by the construction sector. An additional final demand in the forestry and agriculture sectors will produce relatively significant health and non-health damages due to water pollution. Generally, damages arising from water pollution are higher than those from air pollution, but this may be the result of insufficient data that can measure these damages, especially non-health damages brought about by air pollution.

Finally, we can also evaluate the cost of eliminating air and water pollution (with an abatement cost of 90%) if an additional final demand is spent on each sector, and this is represented by the impact multipliers for ES-air and ES-water. The mining and quarrying sector require higher cost of eliminating air pollution, because it emits considerable amount of air residuals. It is followed by manufacturing 1 sector, which, other than having relatively high air residual multipliers, is also highly linked with the other sectors. Also, the cost of eliminating water pollution per additional thousand pesos of final demand is very high for the forestry sector.

VI. Summary and Policy Implications

The main aim of this paper is to assess the environmental impact of the economic structure of the Philippines. First, we extracted the environment-augmented I-O Table for 1994 for the entire Philippines. Second, using the environmental impact coefficients derived in Mendoza (1996) and Orbeta (1999a and 1999b), we estimated the total environmental impact of gross output for 1994. We also identified the sectors that emit the greatest amount of environmental variables using the environment-augmented I-O Table we extracted above. The environmental impact depends on the relative size of this sector in the entire economy, the strength of the interlinkage between this sector and all the other sectors of the economy, and the emission levels/cost/damage per one thousand pesos of output (or the environmental coefficients). From our results, we have seen that the manufacturing sectors emit the highest levels of air and water residuals.

Third, we proposed an import-augmented, environment-augmented I-O model and used it to estimate the environmental impact of domestic production. We have seen that the output multipliers are greatly reduced if we exclude the increase in imports arising from additional final demand for each of the sectors.

Finally, we analyzed the output multipliers and the environmental impact multipliers, which represent the impact of additional final demand on gross output and the environment respectirely, and estimated the impact of having endogenous imports on the domestic output and domestic environment. This exercise is especially important if we want to know how an economic policy to be implemented will affect the environment, or if we want to decide on which sector may be chosen to lead an environment-friendly (sustainable) economic development, bearing in mind the existing trade-off between output and its environmental burden.

Some of the vital policy implications we have drawn from this study are as follows: (1) Air pollution level is higher than water pollution level in the Philippines, and thus, the reduction of air pollution is a more urgent problem that government policies must deal with; (2) Among the sectors, the manufacturing sectors (light and heavy industries) are the largest emitters of air residuals. As the shares of these sectors in the total economy increases, total emission will also increase, thus the need for stricter environmental policies based on incentives, like charging firm polluters based on the amount of their emissions. (3) The 4 primary sectors (agricultural, fisheries, forestry and mining and quarrying) impose heavy load on the environment, in the form of natural resource depreciation and water pollution. In these sectors, the imposition of quantitative restrictions may be more feasible and effective than policies based on incentives like collection of logging or fishing fees. For the agricultural sector, collection of fees for water pollution due to the use of pesticides may be difficult to implement unless it is imputed in the price of pesticides. (4) The household sector is a potential big source of air and water pollution. Therefore, policies geared towards the reduction of household's solid wastes and air and water pollution emissions in well-populated areas, and natural resource depreciation in the provinces must be prioritized by the government. In this regard, garbage segregation and environmental education must be implemented in schools and local communities.

Appendix A. The Environment-Augmented I-O Table of the Philippines (1994)

(in million pesos)

	Sectors	1	2	3	4	5	6	7	8	9	10	11	Labor PCE (Household)	Total Intermediate Demand Original	Total Intermediate Demand with Labor PCE
1	Agriculture	38,997	0	7	0	187,209	4,296	0	0	0	128	11,429	47,085	242,067	289,152
2	Fishery	0	6,393	0	0	17,223	28	0	0	0	172	4,190	18,825	28,007	46,832
3	Forestry	0	0	67	70	7,586	181	46	0	19	0	0	853	7,969	8,822
4	Mining and Quarrying	5	23	0	133	182	61,610	166	0	3,292	0	73	704	65,485	66,189
5	Manufacturing 1	20,434	5,335	5	627	140,993	17,431	100	31	5,343	3,330	48,179	196,795	241,808	438,603
6	Manufacturing 2	24,240	7,019	663	6,538	31,867	235,423	29,475	525	45,042	51,629	62,350	50,158	494,771	544,929
7	Electricity and Gas	2,753	956	16	1,665	17,177	11,216	4,045	577	755	1,169	28,926	5,800	69,256	75,056
8	Waterworks	108	21	0	4	430	12	0	0	87	285	3,268	932	4,215	5,147
9	Construction	160	419	8	841	710	561	286	1	1,845	338	14,208	1,707	19,377	21,084
10	Transportation Services	5,527	1,729	339	838	14,071	11,617	184	28	6,496	4,436	44,604	18,959	89,870	108,829
11	Other Services	14,065	2,487	234	3,018	42,836	49,952	5,333	371	18,850	25,395	159,975	220,161	322,517	542,678
CE	Compensation of Employees	99,280	15,634	2,670	5,507	61,228	46,189	6,835	1,421	28,248	27,212	267,755	0	561,979	561,979
TII	Total Intermediate Inputs	106,289	24,382	1,340	13,735	460,284	392,328	39,635	1,533	81,728	86,882	377,203	561,979	1,585,340	2,147,319
CE	Compensation of Employees	95,001	15,634	754	5,507	61,228	46,189	6,835	1,421	28,248	27,212	267,755		555,784	555,784
	Nature-Based HH Prod'n	4,279	0	1,916	0	0	0	0	0	0	0	0		6,195	6,195
Dep	Depreciation	19,273	7,079	351	3,297	18,314	16,800	11,669	1,188	10,392	14,083	51,091		153,537	153,537
IT-S	Indirect Taxes less Subsidies	6,989	2,179	596	889	20,792	14,872	2,070	3	3,074	3,392	40,547		95,402	95,402
OS	Operating Surplus	149,788	39,186	3,409	7,956	140,149	86,697	22,995	2,288	52,782	23,412	416,904		945,565	945,565
TPI	Total Primary Inputs	275,329	64,078	5,110	17,649	240,484	164,558	43,569	4,899	94,496	68,099	776,296		1,756,483	1,756,483
TI	Total Inputs	381,618	88,459	6,449	31,384	700,768	556,887	83,204	6,433	176,224	154,981	1,153,499	561,979	3,341,823	3,903,802
NR	Natural Resource Depreciation	-775	-6,976	-313	-187	0	0	0	0	0	0	0	0	-8,251	-8,251
ES(air)	Environmental Waste (Air)	-53	-119	-31	-481	-2,221	-1,136	-57	0	-367	-443	-669	-4,766	-5,577	-10,343
ES(water)	Environmental Waste (Water)	-5,988	0	-3,458	-5,422	-315	-111	0	0	0	0	-6,736	-20,085	-22,030	-42,115
NEB	Net Environmental Benefit	5,644	119	3,360	5,826	2,263	1,041	27	0	264	420	12,366	21,406	31,331	52,736
TEI	Total Environmental Input	-1,172	-6,976	-442	-263	-273	-206	-30	0	-102	-23	4,960	-3,445	-4,527	-7,972
Adj. TI	Adjusted Total Input	380,447	81,483	6,007	31,121	700,494	556,681	83,174	6,433	176,122	154,957	1,158,459	558,534	3,335,379	3,895,830

	Sectors	PCE original	Household Production	PCE (modified)	PCE (new)	GCE	GFCF	CS	EXP	IMP	TFD (modified)	TO original	TO (modified)	Environmental Adjustment	Output Adjusted for Environment	
1	Agriculture	101,524	4,279	105,803	58,718	0	22,889	2,469	16,636	-8,246	139,551	377,339	381,618	-1,172	380,447	1
2	Fishery	42,301	0	42,301	23,476	0	346	0	17,971	-166	60,453	88,459	88,459	-6,976	81,483	2
3	Forestry	0	1,916	1,916	1,063	0	0	-1,500	0	-19	397	6,449	8,366	-442	7,924	3
4	Mining and Quarrying	1,581	0	1,581	877	0	0	380	13,133	-49,195	-34,100	31,384	31,384	-263	31,121	4
5	Manufacturing 1	442,213	0	442,213	245,418	0	886	4,412	128,550	-117,102	458,960	700,768	700,768	-273	700,494	5
6	Manufacturing 2	112,708	0	112,708	62,550	0	180,582	2,025	175,607	-408,805	62,116	556,887	556,887	-206	556,681	6
7	Electricity and Gas	13,034	0	13,034	7,234	0	0	0	915	0	13,948	83,204	83,204	-30	83,174	7
8	Waterworks	2,095	0	2,095	1,163	0	0	0	123	0	2,218	6,433	6,433	0	6,433	8
9	Construction	3,835	0	3,835	2,128	0	156,203	0	1,431	-4,622	156,847	176,224	176,224	-102	176,122	9
10	Transportation Services	42,603	0	42,603	23,644	0	3,402	0	23,769	-4,663	65,111	154,981	154,981	-23	154,957	10
11	Other Services	494,718	0	494,718	274,557	182,776	43,031	0	157,365	-46,908	830,982	1,153,499	1,153,499	4,960	1,158,459	11
CE	Compensation of Employees				0								561,979	-3,445	558,534	CE
TII	Total Intermediate Inputs	1,256,613	6,195	1,262,808	700,829	182,776	407,339	7,786	535,500	-639,726	1,756,483	3,335,628	3,341,823	-7,972	3,333,851	TII
CE	Compensation of Employees	0	0	0	0	0	0	0	0	0	555,784		1,111,568			CE
	Nature-Based HH Prod'n	0	0	0	0	0	0	0	0	0	6,195		12,390			
Dep	Depreciation	0	0	0	0	0	0	0	0	0	153,537		307,074			Dep
IT-S	Indirect Taxes less Subsidies	0	0	0	0	0	0	0	0	85674	95,402		190,804			IT-S
OS	Operating Surplus	0	0	0	0	0	0	0	0	0	945,565		1,891,131			OS
TPI	Total Primary Inputs	0	0	0	0	0	0	0	0	85,674	1,756,483		3,512,967			TPI
TI	Total Inputs	1,256,613	6,195	1,262,808	700,829	182,776	407,339	7,786	535,500	-554,052	3,512,967					TI

Notes:

1. Income from Non-Marketed, Nature-Based Household Activities was computed as follows.

	Value
Aggregate Labor Income	555,784
Aggregate PCE	1,256,613
Proportionality Constant	44.23

2. PCE from labor was computed as follows.

Non-marketed Nature Based HH	
Agricultural sector	4278.82
Forestry sector	1916.26
Total	6195.08

3. For details on the extraction of the environment-augmented I-O Table, see Carlos, Goce-Dakila and Fukui (2002)

Appendix B. Summary Coefficients of Environmental Variables in the Philippines

B.1. Environmental Adjustment Coefficients

SECTOR	OUTPUT COEFFICIENT (per thousand pesos)						
	NR Depn	Air Damages	Water Damages	Nature Services	ES (AIR)	ES(WATER)	NEB
1	-0.00203	0.00000	-0.00104	0.00000	-0.00014	-0.01569	0.01479
2	-0.07886	0.00000	0.00000	0.00000	-0.00134	0.00000	0.00134
3	-0.03746	-0.00010	-0.01530	0.00000	-0.00366	-0.41331	0.40157
4	-0.00595	-0.00243	0.00000	0.00000	-0.01532	-0.17275	0.18564
5	0.00000	-0.00033	-0.00006	0.00000	-0.00317	-0.00045	0.00323
6	0.00000	-0.00036	-0.00001	0.00000	-0.00204	-0.00020	0.00187
7	0.00000	-0.00036	0.00000	0.00000	-0.00069	0.00000	0.00033
8	0.00000	0.00000	0.00000	0.00000	-0.00002	0.00000	0.00002
9	0.00000	-0.00058	0.00000	0.00000	-0.00208	0.00000	0.00150
10	0.00000	-0.00015	0.00000	0.00000	-0.00286	0.00000	0.00271
11	0.00000	-0.00009	-0.00048	0.00487	-0.00058	-0.00584	0.01072
CE (HH)	0.00000	-0.00404	-0.00209	0.00000	-0.00848	-0.03574	0.03809

B.2. Air and Water Effluent Emission Residuals

SECTOR	AIR EMISSION RESIDUAL COEFFICIENT (mt/'000 pesos)					WATER EFFLUENT RESIDUAL COEFFICIENT (mt/'000 pesos)					
	PM	SOx	NOx	VOC	CO	BOD_5	SS	TDS	OIL	N	P
1	0.00000	0.00000	0.00001	0.00001	0.00003	0.00577	0.60577	0.00000	0.00000	0.00317	0.00004
2	0.00000	0.00006	0.00012	0.00004	0.00011	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
3	0.00012	0.00006	0.00015	0.00013	0.00079	0.08473	16.81562	0.00000	0.00000	0.06518	0.00103
4	0.00282	0.00083	0.00066	0.00055	0.00326	0.00000	1.67715	0.00000	0.00000	0.00000	0.00000
5	0.00038	0.00014	0.00012	0.00010	0.00058	0.00031	0.00031	0.00287	0.00003	0.00000	0.00000
6	0.00042	0.00018	0.00013	0.00009	0.00054	0.00005	0.00007	0.00011	0.00001	0.00000	0.00000
7	0.00042	0.00603	0.00104	0.00003	0.00007	0.00000	0.00496	0.00002	0.00000	0.00000	0.00000
8	0.00000	0.00000	0.00000	0.00001	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
9	0.00068	0.00003	0.00007	0.00007	0.00040	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
10	0.00017	0.00009	0.00015	0.00025	0.00074	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
11	0.00011	0.00001	0.00002	0.00005	0.00011	0.00267	0.00207	0.00000	0.00009	0.00007	0.00002
CE (HH)	0.00470	0.00005	0.00036	0.01040	0.03189	0.01156	0.00523	0.00000	0.00000	0.00092	0.00037

Source: Orbeta, Cortez and Calara (1997).

Notes

1 For details about its derivation, refer to Miller and Blair (1985) and Miyazawa (1995). Although the I-O framework has its limitations of constant returns to scale and fixed technical coefficients, it is a popular method of measuring the impact of government policies on gross output and returns to value-added components on the sectoral level. Here, we can identify the sectors which are highly favored or disfavored by any economic policy in terms of output, employment generation, environment, etc.

2 Market-valuated NRs are included in the impact analysis as natural resource depreciation.

3 It must be noted that labor income is not the only source of change in PCE in the Philippines. International remittances can also be a considerable source of increase in PCE.

4 This is due to lack of data and/or its inclusion in the other services sector.

5 The values for the change in gross output were derived from a CGE analysis on tariff reduction program by Cororaton (1998) (see Orbeta, 1999b).

6 For simplicity, we assume that exports have no import components.

7 The analysis will be more complete if import contents of exports are also included.

8 For a summary of the sources of these data, see Carlos (2001).

9 It must be noted that our results will not include the additional output induced by an increase in household consumption arising from additional income generated by an initial unit increase in final demand.

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