18258

ENVIRONMENT
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PAPER NO. 41

TOWARD ENVIRONMENTALLY AND SOCIALLY SUSTAINABLE DEVELOPMENT

ENVIRONMENTAL ECONOMICS SERIES

Accounting for Natural Resources in Ecuador:

Contrasting Methodologies, Conflicting Results

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September 1996

Environmentally Sustainable Development

The World Bank

ESD

Pollution and Environmental
Economics Division

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Acknowledgments

This paper is a summary of a doctoral dissertation presented to the Johns Hopkins University in 1995. John Boland of Johns Hopkins University, Douglas Southgate of Ohio State University, Herman Daly of University of Maryland, as well as Kirk Hamilton, Claudia Sadoff, John Dixon and Andrew Steer of the World Bank provided advice and support throughout preparation of the report. Dan Morrow, Stefano Pagiola, and Aru Kunte of the World Bank also provided useful comments in finalizing this paper.

The report benefited from consultations with Augusto de la Torre, Managing Director of the Central Bank of Ecuador and his staff, the Ecuadorian Ministry of Finance, the Instituto Ecuatoriano Forestal y Areas Naturales y de Vida Silvestre (INEFAN), officials from PETROECUADOR and Dirección Nacional de Hidrocarburos, Neptali Bonifaz and the staff of Instituto de Estrategias Agropecuarias (IDEA) and Paul Simons of the U.S. State Department.

1 Introduction

When natural capital is depleted without the simultaneous investment of a portion of revenues into other assets, future generations are left with fewer resources to produce goods and services. This premise is based upon the writings of Sir John Hicks, Nobel laureate in Economics, who noted

> The purpose of income calculations in practical affairs is to give people an indication of the amount which they can consume without impoverishing themselves. Following out this idea, it would seem that we ought to define a man's income as the maximum value which he can consume during a week, and still expect to be as well off at the end of the week as he was at the beginning. Thus when a person saves he plans to be better off in the future; when he lives beyond his income he plans to be worse off [Hicks 1946].

Income may be considered the highest level of consumption attainable in a given period which does not reduce consumption in future periods. The same holds true at the national level: Hicksian income is the maximum value a nation can consume in the present without impoverishing itself in the future.

Income is a function of capital assets. A *capital asset* is any stock of value that has the potential to generate a stream of income to the owner. Stocks of fixed capital, including machines, factories, buildings and infrastructure generate flows of goods and services as the assets are used in the production process. Similarly, stocks of natural capital, including petroleum deposits that yield the flow of crude oil or forests that yield the flow of cut timber, provide important economic benefits to their owners. This study examines natural capital depletion in Ecuador from 1971 to 1990, corresponding with an oil boom in the 1970s followed by economic stagnation in the 1980s. Two natural resource accounting (NRA) methodologies are utilized to measure the economic value of natural capital depletion in the petroleum sector. The Depreciation Method, developed by Robert Repetto of World Resources Institute, adjusts national income to reflect the change in economic value of natural capital which occurs during each accounting period. The User Cost Method, proposed by Salah El Serafy of the World Bank, splits the revenue from the sale of an exhaustible resource into a capital element, or "user cost", and a value-added element, representing true income. (See Box 1.)

The paper is set out in four parts. Section 2 examines Ecuador's macroeconomic performance from 1971 to 1990. Section 3 calculates the value of natural capital depletion in Ecuador's petroleum sector. Section 4 incorporates the economic value of natural capital depletion into the nation's

macroeconomic accounts and offers indicators of environmentally sustainable development. Section 5 addresses policy implications related to the depletion of Ecuador's oil reserves.

Calculating Hicksian income from 1971 to 1990, the study indicates that the value of natural capital depletion derived using the Depreciation Method equals $7.8 billion (1987 US dollars), equal to 4.3% of GDP over the two decades. The User Cost Method indicates that the capital element of oil revenues over the two decades equals $16.2 billion, equal to 8.9% of GDP over the two decades (1987 US dollars).

Box 1: Accounting for Natural Resources - Two Contrasting Methodologies

Despite widespread agreement of the need to address natural capital depletion within the System of National Accounts, there is no consensus regarding means to accomplish this task. Two of the leading NRA methodologies approach this issue in strikingly dissimilar manners.

Depreciation Method

The *Depreciation Method* utilizes economic techniques similar to those used to value the decline in productivity of fixed capital in valuing natural capital depreciation. Standard calculations of national income impute and subtract fixed capital depreciation from gross domestic product (GDP) to arrive at net domestic product (NDP); similarly, the economic value of natural capital depletion is subtracted from NDP in estimating environmentally adjusted net domestic product (ENDP).

In order to calculate natural capital depreciation, physical accounts must be created. Changes in capital stocks are recorded in physical units appropriate to the particular resource. As geological and ecological information on changes in natural capital stocks comes in physical units, such data must be co Method values each unit at its net price, namely, its real value as an input in the production process minus the average cost incurred (including a normal profit) in extracting the resource. Net changes in the value of stocks are attributed to current year additions (such as discoveries, net revisions, extensions, growth or reproduction) minus deductions (such as depletion, degradation or deforestation) plus any price changes of the resource during the year.

Under certain conditions (including perfect competition and optimizing behavior), the net price reflects the present value of the future income-generating capacity of the resource. This approach is considered more reliable than NRA methods which require estimation of total stock size: for non-renewable resources, information on stock changes due to extraction or discovery may be more accurate than information on the size and composition of total stock.

User Cost Method

In contrast, the *User Cost Method* divides the net revenues from the sale of an exhaustible resource into a capital element, or *user cost*, and a value-added element, which represents true income. The user cost represents the erosion of capital and indicates the portion of revenues which must be reinvested in other capital such that the total return, both from the new investments and from the portion of current extraction which may be reckoned as income, would produce a stream of income to compensate for the eventual decline in receipts from the asset.

Depending on the rate of depletion and on a discount rate, the revenue from the sales of an exhaustible resource is split into a capital element and an income element. Letting X represent true income from resource sales and R represent total receipts (net of extraction costs), the capitalized value of a *finite* series, R, accruing in equal amounts over a period of *n* years adds to:

$$\sum_{t=0}^{n} R^{*} = R \frac{\{1 - \frac{1}{(1+r)^{n+1}}\}}{\{1 - \frac{1}{(1+r)}\}}$$

while the *infinite* series X adds to:

$$\sum_{t=0}^{\infty} X^{*} = \frac{X}{\{1 - \frac{1}{(1+r)}\}}$$

Setting

$$\sum_{t=0}^{n} R^{*} = \sum_{t=0}^{\infty} X^{*}$$

such that the capitalized value of the two series are equal, and multiplying by the denominator in both quantities, one finds:

$$X = R \left\{1 - \frac{1}{(1+r)^{n+1}}\right\}$$

Dividing by R (total receipts):

$$X/R = \left\{1 - \frac{1}{(1+r)^{n+1}}\right\}$$

and

$$1 - X/R = \left\{\frac{1}{(1+r)^{n+1}}\right\}$$

X/R represents the portion of total receipts which may be consumed as income. The remainder, 1 - X/R, represents the capital element which must be reinvested [El Serafy 1993b; El Serafy 1989].

With respect to stocks of non-renewable resources, the magnitude of the user cost varies inversely with the reserve-to-extraction ratio. The User Cost Method is flexible in handling changing levels of extraction or alterations in reserve estimates. The rate of depletion, denoted by n indicates the reserve-to-extraction ratio (that is, the life expectancy of the reserve measured in years at the current period's extraction rate). Declining reserves cause n to shrink and the user cost to increase, while new discoveries cause n to increase and the user cost to decrease, *ceteris paribus*. The User Cost Method does not place a value upon new reserves; rather, it adjusts the reserve-to-extraction ratio to indicate the increased life expectancy of the reserve.

GDP is the sum of value added at each stage in the production process. The sale of fixed capital does not generate value added, thus the proceeds of such sales are not included in GDP. Accordingly, the user cost is excluded from GDP on the grounds that it represents the sale of capital as well. No adjustment to NDP is made. This differs from the Depreciation Method which subtracts the value of natural capital depletion from NDP.

2 Traditional Measures of Macroeconomic Performance

The System of National Accounts (SNA) provides information to identify a country's assets and liabilities at particular points in time, as well as to keep track of transactions such as purchases of goods and services, payments to wage and profit earners, import payments and export revenues for goods and services. Through its ability to measure disparate goods and services using a common metric, the SNA has become the standard framework used for measuring macroeconomic performance, analyzing trends of economic growth, and providing the economic counterpart of social welfare. At the heart of the SNA is the calculation of Gross Domestic Product (GDP), the market value of goods and services produced in a given period.

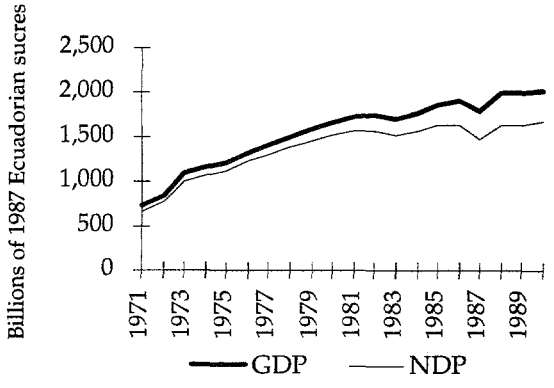
The SNA has drawbacks, however, which cast doubt on its usefulness in measuring environmentally sustainable development. While it is valuable for indicating short- to medium-term changes in economic activity, the SNA is less useful for gauging longer-term trends. Economic activities are valued at private cost rather than social cost; likewise, a zero valuation is placed upon certain essential goods and services. Furthermore, the SNA's concept of capital maintenance applies only to fixed capital while limited account is taken of the contribution of the environment to economic activity.

Increasingly, policymakers realize that economic production cannot be measured without accounting for natural capital depletion. While revenues derived from natural resource sales have the potential to finance investments in industrial capacity, infrastructure, and human capital formation, a reasonable accounting representation of the process would recognize that one form of capital has been exchanged for another. If the economic value of natural capital depletion was identified and purged from gross income measurements, a more accurate level of income would emerge which better reflects economic performance and provides an improved basis for policy prescriptions.

Economic Trends in Ecuador: 1971-1990

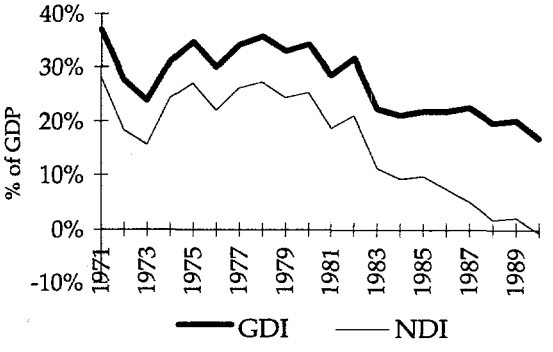
Following the discovery of vast petroleum reserves in the Oriente region in 1967 and the construction of a 500-kilometer pipeline across the Andes mountains to the Pacific Ocean, Ecuador experienced an oil boom which served as an engine for growth during the 1970s. Ecuador's economy grew at a robust rate of 8.7 percent per annum (Figure 2.1), with the petroleum and mining sector accounting for a significant portion of this growth. While the sector accounted for only 1.7 percent of GDP in 1972, petroleum and natural gas production provided 23 percent of GDP in 1974 and 20.7 percent of GDP by 1980.

Figure 2.1
National Income



Ecuador experienced rapid GDP growth in the 1970s. However, the rate of economic growth slowed significantly in the 1980s.

Figure 2.2
Domestic Investment



Net domestic investment fell significantly during the 1980s.

Economic growth slowed during the 1980s. GDP grew at an annual rate of 1.6 percent while inflation averaged 42.5 percent annually, more than twice the annual inflation rate during the 1970s. The petroleum and mining sector continued to outpace GDP but grew only 3.3 percent per annum. During the 1980s, petroleum and natural gas production peaked at 19.2 percent of GDP in 1985. In March 1987, a major earthquake severed the nation's oil pipeline, leading to a temporary suspension of oil exports and causing the sector to drop to 7.7 percent of GDP. By 1990, however, the petroleum and mining sector recovered, rising to 17.8 percent of GDP.

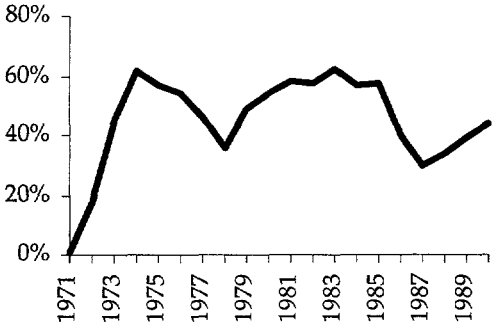
Economic stagnation in the 1980s was the result of several factors: exchange rate and monetary policies kept the national currency overvalued, while declining investment, general strikes in 1986 and 1987, natural calamities, and protectionist policies contributed to the economic slowdown. Indeed, from the time of the decline in world oil prices in 1985 until the end of the decade, Ecuador effectively ceased to grow.

Declining investment had a significant impact upon the economy. Figure 2.2 indicates a downward trend in domestic investment from 1971 to 1990. Gross domestic investment (GDI) fell from 37.1 percent of GDP in 1971 to 16.8 percent of GDP by 1990; net domestic investment (NDI) fell from 28.2 percent of GDP to -0.6 percent of GDP.

Oil exports were the leading source of foreign exchange during the 1970s and 1980s (Figure 2.3). The petroleum industry accounted for 47 percent of Ecuador's export earnings from 1971 to 1990. However, oil exports proved susceptible to stagnant production and rising domestic consumption of petroleum derivatives, contributing to a decline in oil exports after 1973.

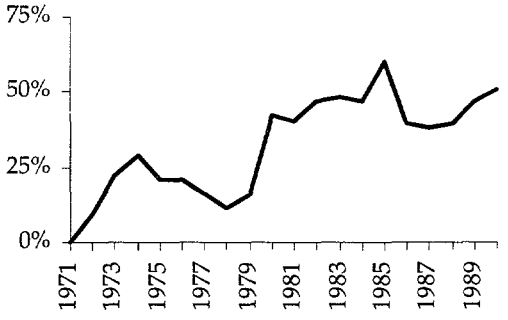
Likewise, the oil boom radically transformed public sector finances. Efforts to collect non-oil taxes diminished, public sector consumption and low-return investments increased and government subsidies, particularly implicit subsidies to consumers of petroleum derivatives, broadly expanded. Where oil revenues were insufficient to cover public spending, the Government of Ecuador borrowed from abroad or increased the money supply, giving rise to inflation. Public sector revenues and expenditures became heavily dependent on oil receipts and external borrowing. By the end of the 1970s, more than 40 percent of public sector

Figure 2.3
Petroleum derivatives as percentage of foreign trade



By 1973, crude oil exports became the nation's leading source of foreign exchange.

Figure 2.4
Percentage of public sector expenditures attributable to oil revenues



Oil revenues accounted for a growing portion of public sector expenditures.

expenditures were financed by petroleum reserves; by 1985, this figure reached 60 percent (Figure 2.4).

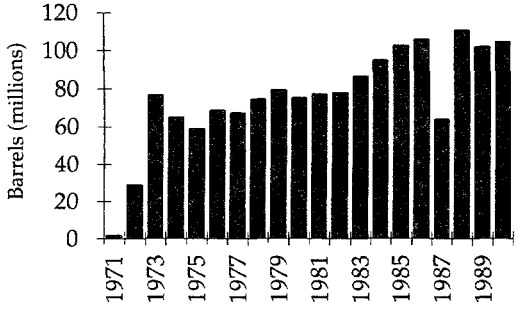
3 Natural Resource Use in Ecuador 1971 - 1990

Oil production in Ecuador dates back to the opening of off-shore production sites in 1917. Following discoveries in the nation's Amazon basin in the late 1960s, production shifted to the Oriente region, which provided over 98 percent of the nation's crude oil by 1973. On a national basis, oil production rose steadily over the two decades (Figure 3.1). In 1987, production fell due to a major earthquake, but rebounded in the late-1980s.

After the discoveries of the late-1960s and early-1970s, oil exploration was largely neglected. As a result, petroleum reserves fell to a low of 882 million barrels at the end of 1983, reducing the reserves-to-production ratio to 10:1 (Figure 3.2). However, petroleum reserves rose 81 percent between 1983 and 1987, and by 1990 the reserves-to-production ratio was 13:1.

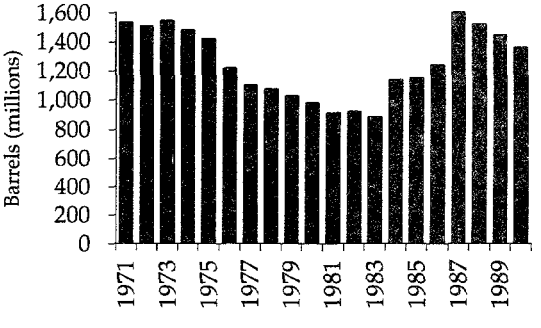
The alleged increase in proven reserves was not universally accepted. A 1991 UNDP/World Bank study noted that this increase, from 882 MMB (*million barrels*) in 1983 to 1557 MMB in 1987, had no sound technical basis [UNDP/World Bank 1991]. The study added that the probability of major discoveries in the future was low, while exploration costs were likely to increase due to deeper drilling in more distant sites within the Amazon basin.

Figure 3.1
Annual oil production



Oil production grew rapidly in the early-1970s. Following a period of steady production from 1973 to 1982, oil production rose 34% by 1990.

Figure 3.2
Proven reserves in the Oriente region



Proven reserves fell 40 percent from 1973 to 1983.

In calculating the economic value of natural capital depletion, physical accounts are based upon data supplied by the National Directorate of Hydrocarbons and verified with data from the Organization of Petroleum Exporting Countries (OPEC). Calculation of economic rent is based upon production cost data from Ecuador's state-run oil company, PETROECUADOR.

Economic rent is the international resource commodity price minus all marginal factor costs incurred in extraction and transport, including a normal return to capital and excluding taxes, duties, and royalties [Repetto *et al.* 1989]. Extraction costs in Ecuador's Oriente region are considered to be lower than the international average; while reserves of light grade oil (23° to 32° API) are at depths of 2,800 to 3,000 meters, many of these reserves have an initial pressure over 4,000 psi, keeping pumping costs low. Reserves of light grade oil were heavily exploited throughout the 1970s and 1980s; as a result, reserves which remain have an API gravity between 10.0° and 22.3°, with higher levels of contaminants (such as sulfur, nitrogen and metals) and higher viscosity. Thus, continued oil production will require enhanced oil recovery techniques to more fully exploit reserves. Furthermore, the high viscosity of heavy crudes precludes direct transportation through the national oil pipeline. In short, production and transport costs in the future are expected to remain significantly higher than during the 1970s and 1980s, reducing net rents in the petroleum sector.

Table 3.1

Annual Oil Production & Proven Reserves

Year	Annual Production *('000s of barrels)*	Proven Reserves *('000s of barrels)*	Discoveries & Revisions *('000s of barrels)*	Change in Reserves *('000s of barrels)*	Percent Change in Reserves	Reserves-to-Production Ratio
1971	1,350	1,527,434	0	1,350	..	1,131.4
1972	28,579	1,500,000	1,145	-27,434	-1.80	52.5
1973	76,221	1,538,579	114,800	38,579	2.57	20.2
1974	64,616	1,474,901	938	-63,678	-4.14	22.8
1975	58,753	1,417,000	852	-57,901	-3.93	24.1
1976	68,362	1,214,500	0	-202,500	-14.29	17.8
1977	67,002	1,098,994	0	-115,506	-9.51	16.4
1978	74,221	1,072,602	47,829	-26,392	-2.40	14.5
1979	78,799	1,023,100	29,297	-49,502	-4.62	13.0
1980	74,771	973,863	25,534	-49,237	-4.81	13.0
1981	76,804	904,078	7,018	-69,786	-7.17	11.8
1982	77,686	914,030	87,638	9,952	1.10	11.8
1983	86,345	881,744	54,059	-32,286	-3.53	10.2
1984	94,929	1,137,121	350,305	255,376	28.96	12.0
1985	102,422	1,148,002	113,303	10,881	0.96	11.2
1986	105,585	1,235,108	192,691	87,106	7.59	11.7
1987	63,785	1,594,314	422,991	359,206	29.08	25.0
1988	110,535	1,514,903	31,124	-79,411	-4.98	13.7
1989	101,796	1,441,605	28,498	-73,298	-4.84	14.2
1990	104,444	1,355,248	18,087	-86,357	-5.99	13.0

Source: PETROECUADOR 1992 and Direccion Nacional de Hidrocarburos

Note: Reliable data on reserves in the Costa region were unavailable. However, oil production in the Costa region was less than 2 percent of national oil production from 1973 to 1977, and less than 1 percent from 1978 to 1990 In 1992, Costa region reserves were estimated at 1.3 percent. of national reserves.

Depreciation Method

Data needed to construct physical accounts are provided in Table 3.1. Creation of monetary accounts requires that annual production and downward revisions of reserves be multiplied by the economic rent to calculate the value of natural capital *depreciation*; new discoveries and upward revisions are multiplied by economic rent to calculate natural capital *appreciation*.

Economic rent is calculated as a portion of PETROECUADOR's *production costs*. Production costs equal *operational costs* plus amortization of *preproduction* and *production investments* plus interest payments. Operational costs are further subdivided into *direct costs*, *indirect costs*, and *operational expenditures*. Direct costs entail on-site expenditures related to petroleum extraction. Indirect costs include off-site costs related to petroleum extraction, off-site maintenance, and return to capital. Operational expenditures are not directly related to petroleum extraction.

Preproduction investments include exploration drilling, oilfield development, penetration roads, and oil lines from well site to the central station. *Production* investments include pumps, water treatment pits, and environmental protection. With respect to the two types of investments, Ecuadorian law states that *preproduction* investments may be amortized over a period of five years while *production* investments may be amortized over a period of ten years. In this manner, the Government of Ecuador sets the production cost of crude oil. Finally, interest payments are made on funds which are borrowed from domestic and foreign sources. Approximately one-half of investment funds come from abroad.

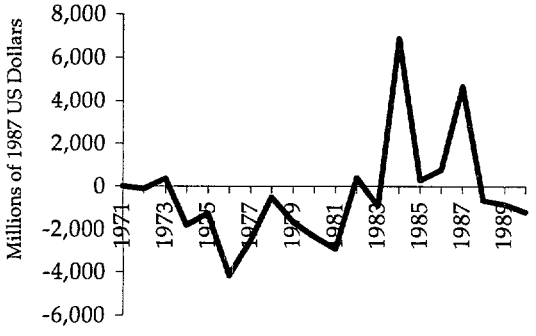
Calculations of economic rent are based upon operational cost data provided by PETROECUADOR (Appendix 3.2). These data, which relate to direct costs, indirect costs, and operational expenditures as specified by PETROECUADOR, cover 83 percent of national production from 1980 to 1991. No operational cost data were available for production during the 1970s; however, production cost data on a per barrel basis *were* available from 1972 to 1990. Thus, it is assumed that the ratio of operational costs to production costs in the 1980s is the same in the 1970s. Furthermore, in focusing upon the marginal cost of petroleum extraction, operational costs are weighted with regard to their relevance to this process. It is assumed that 100 percent of direct costs and 50 percent of indirect costs are related to petroleum extraction. Operational expenditures are not considered to be related to the marginal cost of extraction.

Weighting producer costs with regard to actual production, one finds that 50 percent of operational costs are direct costs, 38 percent are indirect costs, and 12 percent are operational expenditures. Thus, a total of 69 percent of operational costs are assumed to be directly related to petroleum extraction.[1] Economic rent is calculated by subtracting marginal extraction costs and transport costs from the F.O.B. price of crude oil on an annual basis.

Table 3.2 indicates the value of natural capital depreciation and appreciation in the petroleum sector. Natural capital *depreciation* occurred in thirteen of twenty years, when oil production was greater than new discoveries. While the decrease in petroleum reserves was nearly three times larger in 1976 than in 1981, the economic rent earned per barrel in 1981 was twice that of 1976 due to surging world oil prices. In six of twenty years, natural capital *appreciation* occurred when new discoveries outweighed oil production in the physical accounts. Although the increase in petroleum reserves was 40 percent larger in 1987 than 1984, the economic rent earned per barrel of new discoveries fell 50 percent over the same period due to a collapse in oil prices. The sum of natural capital

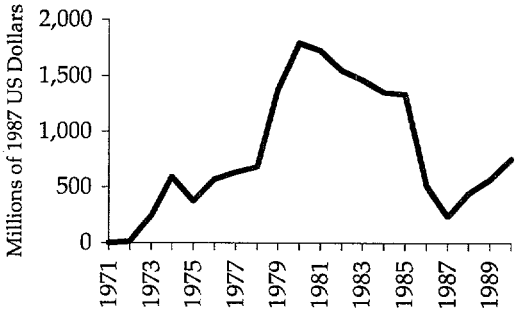
[1] [1.0 x 0.5 percent for direct costs + 0.5 x 0.38 percent for indirect costs = 69 percent of operational costs.]

Figure 3.3
Natural capital depreciation/appreciation



Ecuador experienced natural capital depreciation in the 1970s. Increases in petroleum reserves accounted for natural capital appreciation from 1984 to 1987.

Figure 3.4
User costs



User costs rose sharply in the late-1970s and remained high until new discoveries and falling world oil prices caused them to decline in the mid-1980s.

depreciation equals $7.8 billion (in 1987 dollars).

User Cost Method

Using the data provided in Tables 3.1 and 3.2 as well as a 5 percent discount rate, the user cost associated with oil production is calculated in Table 3.3. The user cost rose steadily during the 1970s as the reserves-to-production ratio declined (Figure 3.4). Between 1975 and 1980, user costs increased 273 percent due to rising world oil prices and declining reserves. Reserves continued to decline until 1984, but falling world oil prices served to reduce user costs. New discoveries, combined with low oil prices, left user costs in the late 1980s significantly lower than in the early 1980s. By 1990, the user costs was 41 percent of its value in 1980. The sum user costs from 1972 to 1990 equals $16.2 billion (in 1987 dollars), more than twice the value of natural capital depletion measured using the Depreciation Method.

Table 3.2

Natural Capital Depreciation / Appreciation

Year	F.O.B. per Barrel *(current US dollars)*	Extraction & Transport Costs per Barrel *(current US dollars)*	Net Rent per Barrel *(current US dollars)*	Net Rent per Barrel *(1987 US dollars)*	Natural Capital Depreciation / Appreciation *(1987 US dollars)*
1971	2.50	0.62	1.88	5.08	N/A
1972	2.50	0.62	1.88	4.85	-$133,052,292
1973	4.20	0.52	3.68	8.94	$344,722,520
1974	13.70	0.65	13.05	29.06	-$1,850,726,008
1975	11.50	0.70	10.80	21.97	-$1,271,877,004
1976	11.50	0.70	10.80	20.67	-$4,185,813,031
1977	13.00	0.75	12.25	21.93	-$2,532,606,166
1978	12.50	0.79	11.71	19.43	-$512,850,750
1979	23.50	0.86	22.64	34.53	-$1,709,322,457
1980	35.26	1.08	34.18	47.68	-$2,347,548,290
1981	34.48	1.35	33.13	42.00	-$2,931,203,209
1982	32.84	1.71	31.13	37.16	$369,850,147
1983	28.08	2.50	25.58	29.35	-$947,612,981
1984	27.46	2.97	24.49	26.90	$6,869,629,895
1985	25.90	3.57	22.33	23.67	$257,596,143
1986	12.70	3.94	8.76	9.05	$787,936,766
1987	16.35	3.29	13.06	13.06	$4,692,693,524
1988	12.50	3.92	8.58	8.26	-$656,041,789
1989	16.22	3.58	12.64	11.65	-$853,901,991
1990	20.32	4.23	16.09	14.21	-$1,227,158,686

Sources: PETROECUADOR Annual Reports, Direccion Nacional de Hidrocarburos, Table 3.1, and Appendix 3.2

Table 3.3

User Costs

Year	Annual Production *('000s of barrels)*	Proven Reserves *('000s of barrels)*	Reserves-to-Production Ratio	User Cost as % of Revenues	Net Rent per Barrel *(1987 U.S. dollars)*	User Cost per Barrel *(1987 US dollars)*	Total User Cost *(1987 US dollars)*
1971	1,350	1,527,434	1,131	0.0	5.08	0.00	0
1972	28,579	1,500,000	52	7.4	4.85	0.36	10,196,276
1973	76,221	1,538,579	20	35.6	8.94	3.18	242,257,800
1974	64,616	1,474,901	23	31.3	29.06	9.09	587,276,821
1975	58,753	1,417,000	24	29.4	21.97	6.45	378,928,224
1976	68,362	1,214,500	18	40.0	20.67	8.27	565,636,142
1977	67,002	1,098,994	16	42.8	21.93	9.38	628,501,182
1978	74,221	1,072,602	14	47.1	19.43	9.14	678,649,437
1979	78,799	1,023,100	13	50.5	34.53	17.45	1,375,352,935
1980	74,771	973,863	13	50.4	47.68	24.05	1,798,409,307
1981	76,804	904,078	12	53.6	42.00	22.53	1,730,019,573
1982	77,686	914,030	12	53.6	37.16	19.93	1,548,626,413
1983	86,345	881,744	10	57.9	29.35	16.98	1,466,507,072
1984	94,929	1,137,121	12	53.1	26.90	14.28	1,355,635,822
1985	102,422	1,148,002	11	55.1	23.67	13.05	1,336,473,038
1986	105,585	1,235,108	12	53.8	9.05	4.87	514,032,583
1987	63,785	1,594,314	25	28.1	13.06	3.68	234,411,617
1988	110,535	1,514,903	14	48.8	8.26	4.03	445,615,083
1989	101,796	1,441,605	14	47.7	11.65	5.56	565,956,951
1990	104,444	1,355,248	13	50.6	14.21	7.19	750,492,582

Sources: Tables 3.1 and 3.2; Appendix 3.2

4 Incorporating Natural Capital Depletion into the System of National Accounts

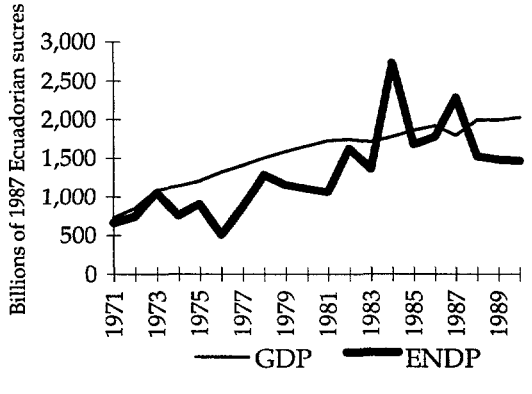
The preceding sections provided the theoretical foundations for natural resource accounting, examined Ecuador's macroeconomic performance from 1971 to 1990, and calculated the economic value of natural capital depletion in the petroleum sector. This section integrates the value of natural capital depletion into the macroeconomic accounts and offers indicators of sustainable development.

System of National Accounts

The Depreciation Method indicates that Ecuador experienced slower growth in environmentally adjusted Net Domestic Product (ENDP) from 1971 to 1990 than conventionally measured GDP. ENDP grew at an annual rate of 5.2 percent during the 1970s and 3.4 percent during the 1980s (Figure 4.1). During the 1970s, ENDP was less than GDP due to significant natural capital depletion. However, ENDP was greater than GDP in the 1980s due to sizable discoveries of oil in the Oriente. Over the twenty-year period, ENDP grew at an annual rate of 4.1 percent, lower than the GDP growth rate of 5.3 percent.

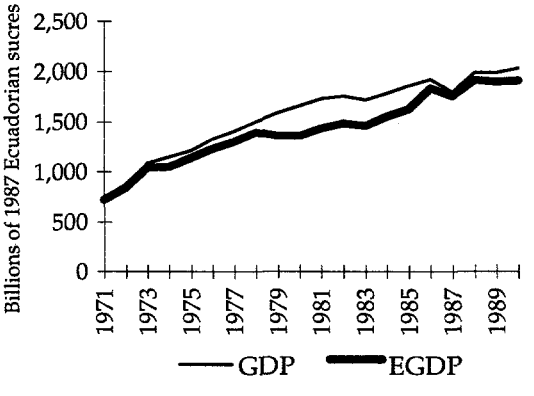
Natural capital depreciation in the form of depleted petroleum reserves from 1971 to

Figure 4.1
National Income - Depreciation Method



Natural capital depreciation occurred between 1973 and 1983. New discoveries led to natural capital appreciation in the mid-1980s.

Figure 4.2
National Income - User Cost Method



User costs caused EGDP to fall significantly below GDP from 1979 to 1986.

1990 equaled 4.3 percent of GDP or 35 percent of the value of fixed capital depreciation. Natural capital *appreciation* occurred in six of twenty years, leading to the anomalous situation whereby ENDP exceeds GDP in 1984 and 1987.

The erratic nature of ENDP presented in Figure 4.1 limits the ability to conduct long-range planning. For instance, in 1984 conventional GDP grew 4.1 percent; adjusting for oil discoveries, ENDP rose 102 percent. In 1985, GDP increased 4.2 percent, nearly identical with the previous year; however, ENDP plummeted 39 percent, due to the fact that oil discoveries (and their proxy in the national accounts, natural capital appreciation) were much smaller than the previous year.

The User Cost Method offers significantly different results. While User Cost as a percentage of GDP was only 0.2 percent of GDP in 1972, this indicator grew to 18 percent of GDP by the end of the decade (Figure 4.2). User costs as a percentage of GDP remained above 10 percent until 1986.

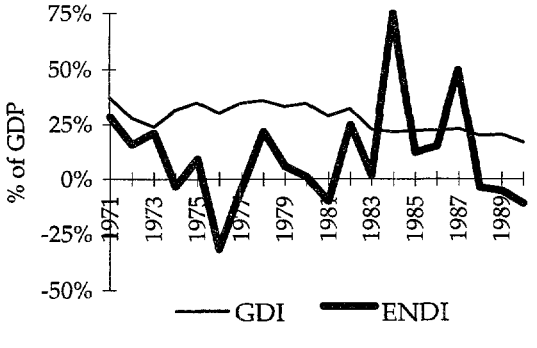
Why does the User Cost Method indicate a value for natural capital depletion twice that found using the Depreciation Method? Because oil discoveries merely lower the capital element of total revenues; natural capital *appreciation* does not occur. When petroleum reserves increased 81 percent between 1983 and 1987, the Depreciation Method indicated natural capital appreciation whereas User Cost as a percentage of GDP simply fell from 15 percent of GDP to 2 percent of GDP.

Providing for Domestic Investment

Gross domestic investment fell from 37.1 percent of GDP in 1971 to 16.8 percent of GDP in 1990, while net domestic investment fell from 28.2 percent of GDP to -0.6 percent of GDP. Incorporating natural capital depletion into domestic investment, thereby deriving environmentally adjusted Net Domestic Investment (ENDI), demonstrates a more startling statistic: ENDI fell from 28 percent of GDP to -11 percent of GDP using the Depreciation Method and -7 percent of GDP using the User Cost Method (Figures 4.3 & 4.4). Indeed, Ecuador experienced *negative* net investment in at least six of twenty years.

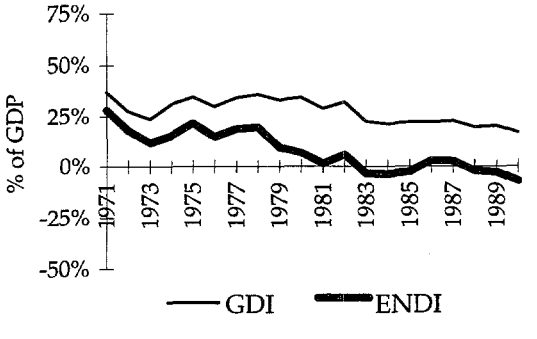
Integral to the issue of domestic investment is the formation of human capital. Economists believe that investing in people—alleviating poverty,

Figure 4.3
Domestic Investment - Depreciation Method



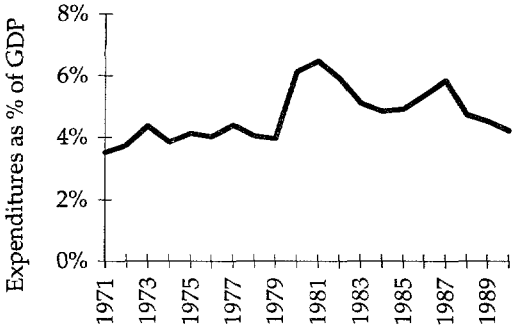
The Depreciation Method indicates that ENDI was negative in seven of twenty years.

Figure 4.4
Domestic Investment - User Cost Method



The User Cost Method highlights the particularly low level of ENDI during the 1980s.

Figure 4.5
Human capital expenditures



Human capital expenditures rose from 3.5 percent of GDP in 1971 to 6.5 percent in 1981. However, human capital expenditures declined during the 1980s, falling to 4.2 percent of GDP in 1990.

addressing population growth, and developing human resources—is essential for long-term economic prosperity. If Ecuador's natural capital was replaced with human capital, negative rates of domestic investment in the 1980s would be less worrisome. However, human capital expenditures fell throughout the 1980s (in real terms). Furthermore, the human capital development effort (that is, expenditures on education, health, and community development as a percentage of total public sector expenditures) was lower in 1990 than at any point since 1972 (Figure 4.5).

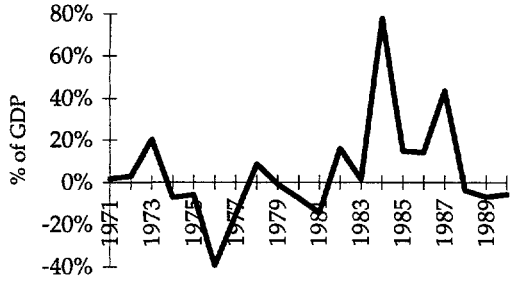
Saving for the Future

Net savings measures highlight the rate of change of wealth, thereby providing an important indicator of the effect of economic policy on long-run development prospects. If the savings rate is positive after adjusting for natural capital depletion, then economic development is considered to be sustainable. However, if gross domestic investment is less than the combined value of fixed capital depreciation and natural capital depletion, then the country is drawing down its capital base to finance current consumption. Countries must devote a portion of current income to capital maintenance in order to *sustain* existing national income levels; countries must expand the capital stock through domestic savings or foreign borrowing to *increase* national income. The net addition to capital is their main source for generating a higher level of future income. However, if revenues from natural resource sales are consumed and if capital formation falls short of the combined value of fixed capital depreciation and natural capital depletion, the integrated accounts will indicate the level of disinvestment which has occurred.

Calculating genuine savings as GDP minus the sum of public and private consumption, fixed asset depreciation, and natural capital depletion, economists are able to estimate a nation's efforts to create new wealth. In the case of Ecuador, only one-half of the surveyed years indicate positive genuine savings. Figure 4.6—derived using the Depreciation Method—indicates that ten of twenty years suffered negative genuine savings. Three of the ten years in which there were positive genuine savings occurred in the early-1970s, prior to the onset of large-scale oil production; five of the remaining years correspond with periods in which petroleum reserves increased in size.

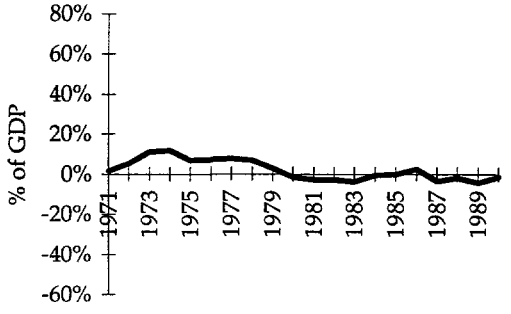
The User Cost Method highlights the fact that genuine savings during the 1980s were significantly lower than during the 1970s (Figure 4.7). Indeed, genuine savings fell sharply after 1978, rising above zero only in 1986 following a rash of new discoveries. However, the 1987 earthquake helped to hold genuine savings below zero for the remainder of the decade.

Figure 4.6
Genuine Savings - Depreciation Method



Genuine savings fell below zero in ten of twenty years.

Figure 4.7
Genuine Savings - User Cost Method



The User Cost Method highlights the fact that genuine savings declined considerably after 1978.

5 Policy Implications

Ecuador's petroleum sector faces a difficult road ahead. The API gravity of crude oil in the Oriente has fallen from 28° to between 23° and 24° with increased levels of contaminants. Higher viscosity has led to increased transport costs through the nation's aging pipeline. Likewise, discovery costs are rising.

Despite such obstacles, Ecuadorian policymakers are debating an increase in the level of oil production. Central to this debate is an expansion of the nation's oil pipeline to permit transport of heavier crude oil from the Amazon lowlands. Construction plans have been drawn up, with initial investment costs for four alternatives ranging from $570 million to $770 million.

Should Ecuador invest significant financial resources to expand oil production? Examining environmentally adjusted net domestic investment from 1971 to 1990, one sees that the nation ran down its capital base while making little effort—particularly in the 1980s—to substitute fixed capital for depleted natural capital.

The failure to reinvest oil revenues in other capital assets is largely the result of policy failures which accompanied Ecuador's oil boom. As noted in Chapter 2, while increased oil revenues accruing to the Government of Ecuador transformed public sector finances, efforts to collect non-oil taxes diminished, public sector consumption and low-return investments increased, and government subsidies expanded. In real terms, non-financial public sector expenditures rose from 23% of GDP in 1973 to 33% of GDP in 1982. However, non-oil public sector revenues fell from 24% of GDP in 1973 to 17% in 1982. According to sources in the Central Bank of Ecuador, less than one-half of businesses and individuals actually pay their entire tax liability. As a result, the public sector deficit, largely financed by foreign borrowing, grew to 7.5% of GDP in 1990 compared to a surplus of 3.1% in 1973. To a considerable extent, the Government of Ecuador substituted borrowing for declining non-oil taxation.

Heavy dependence upon oil receipts continued throughout the two decades. Whereas in 1973 oil revenues accounted for 22% of public sector expenditures, by 1990, 50% of public sector expenditure were financed by oil revenues.

Where were the oil revenues directed? One study indicates that Ecuador used a majority of oil revenues to sustain an increase in public consumption equal to 6% of GDP and a reduction of taxes equal to 2% of GDP [World Bank 1991]. More than 50% of public oil revenues were redistributed in the form of subsidies; of these, none were as large as the implicit subsidies to consumers of petroleum derivatives. From 1970 to 1981, domestic oil prices were held constant in current terms, dropping in real terms to 32% of their 1970

value by 1981. Oil prices remained low throughout the 1980s; in 1988, domestic prices for petroleum derivatives were barely one-third of world prices, and in real terms, were lower than in 1980 [UNDP/World Bank 1991].

In light of the fact that oil revenues continue to be targeted towards current public sector expenditures rather towards domestic investment, and non-oil tax revenues lag far behind public sector expenditures, it is unlikely that an increase in the rate of natural capital depletion will spur additional investment outside the petroleum sector. In short, until such policy failures are addressed, speeding natural capital depletion is an unwise decision.

Conclusion

Natural resource accounting (NRA) allows for the calculation of environmentally adjusted national income, an approximation of Hicksian income. In this case study of natural capital depletion in Ecuador over two decades, NRA highlights the serious decline in domestic investment and genuine savings. However, while the two NRA methods point out problems facing resource-dependent nations, they do so in strikingly different manners.

Examining natural capital depletion in Ecuador during the 1970s and 1980s, the Depreciation Method indicates that natural capital depreciation peaked at 53.8 percent of GDP in 1976; in contrast, the User Cost Method highlights *ten years* in which the User Cost as a percentage of GDP was higher than in 1976. Five years between 1971 and 1980 indicate *negative* Genuine Savings according to the Depreciation Method but *positive* Genuine Savings using the User Cost Method; similarly, four years between 1981 and 1990 indicate *positive* Genuine Savings using the Depreciation Method but *negative* Genuine Savings using the User Cost Method.

Why does this occur? Many economists claim that the Depreciation Method places too high a value on resource discoveries, allowing the anomalous situation whereby net output exceeds gross output. Several suggestions have been made to rectify this problem. The first alternative is to value discoveries at their marginal cost of discovery; a second alternative is to place a zero value upon discoveries. The first option may be unworkable from an empirical perspective: oil companies are often unwilling to disclose specific information regarding exploration costs. The second option may serve as an upper limit to the value of natural capital depletion. In Ecuador's case, placing a zero value upon resource discoveries increases the value of natural capital depreciation over the two decades from $7.8 billion (1987 US dollars) to $37.5 billion (1987 US dollars)! Using this approach, Ecuador experienced negative genuine savings from 1974 to 1990.

Is the User Cost Method superior to the Depreciation Method? Not necessarily. The User Cost Method relies heavily upon reserve estimates, which, according to a 1991 UNDP/World Bank study, were of dubious quality. In addition, user costs fluctuate dramatically with the choice of discount rate. While user costs from 1971 to 1990 are calculated at $16.2 billion (1987 US dollars) using a 5 percent discount rate, a 10 percent discount rate would lower user costs to $8.3 billion (1987 US dollars). Finally, the User Cost method is discounted by its critics as inconsistent with the concepts embodied in the SNA. In the SNA, the value of an asset is determined by its market price, or proxy thereof. In contrast, the User Cost does not value exhaustible resources according to market mechanisms.

Which natural resource accounting method was preferred by policymakers? Discussions with individuals in the Central Bank in Ecuador, the Ministry of Finance as well as other government ministries indicated that the majority preferred the User Cost Method, particularly for its handling of resource

discoveries. The erratic nature of indicators derived using the Depreciation Method was considered as a significant deterrent to universal acceptance. More specifically, Ecuadorians did not consider as useful the Depreciation Method estimates for 1987 which showed ENDP rising 28.1 percent in the very year a massive earthquake rocked the nation. In contrast, the User Cost Method's EGDP declined 4.4 percent, albeit less than traditionally measured GDP which plummeted 6.5 percent. While post-1972 user costs ranged from $265 million to $1.9 billion, their relative predictability was seen to allow for better long-term planning.

In closing, natural resource accounting (NRA) provides a more realistic measure of the capacity of an economy to produce than the traditional System of National Accounts. NRA does not give an indication as to whether a nation's use of natural capital has been in the country's best interest; however, indicators derived through NRA may be extremely useful in reminding policymakers of the potential tradeoffs which have been made. In this case study, they indicate that Ecuador faces a long, difficult road ahead in the transition towards environmentally sustainable development.

References

Ahmad, Yusuf; El Serafy, Salah; and Lutz, Ernst, eds. *Environmental Accounting for Sustainable Development.* Washington, DC: World Bank, 1989.

Banco Central del Ecuador. *Cuentas Nacionales del Ecuador 1970-1993. No. 17 - 1994.* Quito: Banco Central del Ecuador, 1994.

Bartelmus, Peter; Lutz, Ernst; and Schweinfest, Stefan. "Integrated Environmental and Economic Accounting: A Case Study for Papua New Guinea." In *Toward Improved Accounting for the Environment*, pp. 108-143. Edited by Ernst Lutz. Washington, DC: World Bank, 1993.

Daly, Herman. "From Empty-world Economics to Full-world Economics: Recognizing an Historical Turning Point in Economic Development." In *Population, Technology, and Lifestyle: The Transition to Sustainability*, pp. 23-37. Edited by Robert Goodland; Herman Daly; and Salah El Serafy. Washington, DC: Island Press, 1992.

El Serafy, Salah. "The Environment as Capital." In *Toward Improved Accounting for the Environment*, pp. 17-21. Edited by Ernst Lutz. Washington, DC: World Bank, 1993.

El Serafy, Salah. *Country Macroeconomic Work and Natural Resources.* Environment Department Working Paper No. 58. Environment Department. Washington, DC: World Bank, 1993b.

El Serafy, Salah. "Depletable Resources: Fixed Capital or Inventories?" International Association of Research in Income and Wealth on Environmental Accounting. Baden, Austria. May 27-31, 1991. Mimeograph.

El Serafy, Salah, and Lutz, Ernst. "Environmental and Resource Accounting: An Overview." In *Environmental Accounting for Sustainable Development*, pp. 1-7. Edited by Yusuf Ahmad; Salah El Serafy; and Ernst Lutz. Washington, DC: World Bank, 1989.

El Serafy, Salah. "The Proper Calculation of Income from Depletable Natural Resources." In *Environmental Accounting for Sustainable Development*, pp. 10-18. Edited by Yusuf Ahmad; Salah El Serafy; and Ernst Lutz. Washington, DC: World Bank, 1989.

Energy Economics Research Limited. *Oil & Energy Trends: Annual Statistical Review.* Reading, United Kingdom: Energy Economics Research Limited, 1991.

Hartwick, John, and Hageman, Ange. *Economic Depreciation of Mineral Stocks and the Contribution of El Serafy.* Environment Department Divisional Working Paper No. 1991-27. Environment Department. Washington, DC: World Bank, 1991a.

Hicks, John. *Value and Capital.* 2nd ed. Oxford: Clarendon Press, 1946.

Landefeld, Stephen and Carson, Carol. "Integrated Economic and Environmental Satellite Accounts." *Survey of Current Business*. April 1994.

Ministerio de Finanzas. *Estadisticas Fiscales. No. 2, 3, & 4.* Quito: Ministerio de Finanzas, 1994.

Organization of Petroleum Exporting Countries. *OPEC Annual Statistical Bulletin 1990.* Vienna: Organization of Petroleum Exporting Countries, 1991.

Organization of Petroleum Exporting Countries. *OPEC Annual Statistical Bulletin.* Annual Publication. Vienna: Organization of Petroleum Exporting Countries, 1990.

PETROECUADOR. "Alternativas de Transporte de la Nueva Produccion de Petroleo proveniente del Oriente Ecuatoriano." Document prepared for Vicepresidente de la Republica Econ. Alberto Dahik Garzozi. January 1993. (Mimeographed.)

PETROECUADOR. *Informe Estadistico de la Actividad Hidrocarburifera del Pais: 1972 - 1991.* Quito: PETROECUADOR, 1992.

Robert Repetto et al. *Wasting Assets: Natural Assets in the National Income Accounts.* Washington, DC: World Resources Institute, 1989.

Solorzano, Raul et al. *Accounts Overdue: Natural Resource Depreciation in Costa Rica.* Washington, DC: World Resources Institute, 1991.

Solow, Robert. "An almost practical step toward sustainability." *Resources Policy* (September 1993): 162-172.

Southgate, Douglas, and Whitaker, Morris. *Economic Progress and the Environment: One Developing Country's Policy Crisis.* New York: Oxford University Press, 1994.

United Nations Development Programme/World Bank. *Ecuador's Energy Situation: Analysis of Current Problems, Short-term and Medium-term Policy Guidelines and Repercussions on the Economy.* April 1991.

World Bank. *Ecuador: Public Sector Reforms for Growth in an Era of Declining Oil Output.* Washington, DC: World Bank, 1991.

Appendices

Appendix 2.1.a

Sectoral Origins of GDP

Billions of 1987 Ecuadorian sucres

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Agri., Livestock & Fisheries	165.9	189.9	213.4	215.2	217.0	225.6	234.5	224.7	215.2	201.7
Bananas, Coffee & Cocoa	45.2	51.7	52.8	56.5	42.3	54.0	70.7	61.2	55.7	39.0
Other Agricultural Products	57.8	64.5	79.5	78.8	87.9	83.7	72.3	65.8	63.0	63.9
Livestock	50.3	57.8	62.3	61.7	66.0	65.2	67.1	72.5	70.7	68.5
Forestry	6.3	7.7	9.3	9.9	11.4	12.6	14.3	15.1	15.2	15.0
Fisheries	6.3	8.3	9.5	8.2	9.4	10.1	10.0	10.1	10.6	15.4
Petroleum & Mining	11.2	27.8	107.6	202.1	140.1	141.9	132.9	107.7	187.1	202.3
Petroleum & Natural Gas	(0.8)	14.9	102.5	264.6	173.0	173.9	179.2	131.6	274.0	343.8
Refined Petroleum	10.1	10.9	1.8	(65.7)	(36.6)	(35.8)	(50.6)	(28.7)	(91.8)	(146.5)
Other Mining	2.0	2.0	3.3	3.2	3.7	3.8	4.3	4.7	4.9	5.1
Manufacturing	136.3	158.0	188.8	177.0	193.1	228.7	253.7	286.4	305.3	293.7
Food, Beverages, & Tobacco	67.5	75.8	87.0	81.1	86.2	107.1	122.0	140.8	149.3	135.8
Processed Meat & Fish	10.3	11.9	14.3	14.5	17.5	20.3	21.8	23.7	25.2	29.4
Cereals	10.1	11.7	10.8	9.0	11.7	12.2	12.7	13.6	12.7	12.8
Sugar	11.9	11.1	12.1	16.3	11.4	11.2	9.3	10.8	10.8	14.8
Other Food Products	17.5	20.4	27.4	22.9	22.9	38.5	53.8	60.5	62.2	43.6
Beverages	15.6	18.8	20.4	16.3	19.7	20.3	20.4	25.3	27.7	26.3
Processed Tobacco	2.0	1.9	2.1	2.1	3.0	4.5	4.0	6.8	10.7	9.0
Textiles, Cloth, & Leather	25.7	32.7	38.6	35.1	42.1	46.4	52.7	54.4	55.7	55.4
Lumber & Wood Products	6.4	8.6	10.7	11.8	11.6	13.0	13.8	14.3	14.8	14.7
Paper, Print., & Publish.	8.1	9.1	10.3	9.5	11.8	14.0	13.7	14.8	16.3	18.7
Chemicals & Rubber	12.7	11.6	15.1	12.1	12.5	14.4	15.3	18.3	19.6	20.4
Nonmetallic Mineral Prod.	12.0	15.1	17.9	18.4	19.9	21.9	25.4	31.4	36.1	33.3
Metallic Prod. & Mach.	4.0	5.0	9.1	9.0	9.1	11.9	10.8	12.5	6.4	7.8
Other Goods	-	-	-	-	-	-	-	-	7.0	7.6
Public Utilities	7.3	9.9	10.6	8.0	9.1	10.1	10.8	11.8	12.1	13.8
Construction	39.0	40.0	43.9	51.3	67.2	88.0	88.2	115.0	109.5	123.3
Wholesale & Retail Trade	107.9	129.4	167.4	165.9	190.2	203.6	221.3	231.9	234.6	242.4
Transport & Comm.	48.6	57.9	64.8	58.0	69.2	82.4	89.9	122.7	121.7	131.2
Services	171.8	189.1	227.0	224.4	268.0	294.5	308.8	336.7	339.2	386.6
Financial Services	15.3	18.5	24.6	29.1	30.2	34.3	38.8	47.8	50.1	62.5
Public Administration	57.3	64.6	83.5	90.0	108.2	117.7	115.5	121.0	118.2	150.8
Others	99.2	106.0	118.9	105.3	129.7	142.5	154.4	167.9	170.8	173.3
Indirect Taxes	35.6	42.7	61.4	46.7	55.2	51.3	70.2	71.6	65.8	68.2
GDP at Market Prices	723.6	844.7	1,085.1	1,148.6	1,209.1	1,326.2	1,410.2	1,508.5	1,590.5	1,663.2

Appendix 2.1.b

Sectoral Origins of GDP

Billions of 1987 Ecuadorian sucres

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Agri., Livestock & Fisheries	206.7	212.0	223.3	241.5	247.9	289.6	274.6	285.3	277.7	272.6
Bananas, Coffee & Cocoa	27.6	27.0	21.6	31.4	33.4	37.8	31.2	29.9	27.6	37.4
Other Agricultural Produ	74.0	67.6	75.5	79.9	79.9	96.2	87.3	105.6	97.0	89.4
Livestock	74.7	83.5	89.0	91.5	96.4	103.5	86.8	83.1	90.0	79.8
Forestry	14.5	16.4	15.2	14.6	13.9	16.6	21.7	21.6	18.8	19.1
Fisheries	15.9	17.6	22.1	24.0	24.3	35.5	47.6	45.1	44.2	46.8
Petroleum & Mining	218.6	220.7	263.4	278.4	317.5	191.4	122.6	195.8	232.7	301.9
Petroleum & Natural Gas	299.9	304.6	315.2	331.0	357.0	189.2	137.8	189.9	251.3	361.8
Refined Petroleum	(86.7)	(89.1)	(60.6)	(61.6)	(48.8)	(11.9)	(29.9)	(18.0)	(35.2)	(76.1)
Other Mining	5.4	5.2	8.8	9.1	9.4	14.1	14.7	23.9	16.5	16.2
Manufacturing	297.7	311.1	317.0	368.9	352.3	380.4	350.3	425.1	419.3	393.6
Food, Beverages, & Tobac	131.5	137.9	156.2	193.3	186.7	198.9	188.3	232.2	249.8	251.0
Processed Meat & Fi	30.9	26.7	27.1	27.1	28.5	32.8	41.5	52.8	44.9	58.8
Cereals	15.1	17.4	25.6	32.8	33.5	32.4	28.3	33.2	64.3	60.1
Sugar	13.0	10.7	18.3	22.1	17.5	12.4	15.3	18.4	19.2	18.3
Other Food Products	37.1	44.9	46.1	69.7	68.5	75.0	58.3	85.8	76.1	73.5
Beverages	26.4	27.3	26.5	28.2	27.3	32.3	31.0	26.7	27.0	24.4
Processed Tobacco	9.1	10.9	12.5	13.4	11.4	14.1	14.0	15.4	18.3	15.9
Textiles, Cloth, & Leather	60.0	64.3	59.6	67.3	64.3	64.8	59.7	67.6	61.4	47.9
Lumber & Wood Product	14.3	15.7	14.0	15.1	12.6	15.8	14.5	13.7	11.8	7.5
Paper, Print., & Publish.	19.7	19.1	20.4	18.7	18.0	23.0	26.0	31.6	31.0	33.9
Chemicals & Rubber	20.1	20.2	19.1	14.6	12.9	15.2	11.2	13.9	14.8	6.9
Nonmetallic Mineral Proc	34.5	36.0	32.8	41.5	39.0	42.3	31.3	39.5	27.1	28.8
Metallic Prod. & Mach.	8.4	8.0	8.7	10.6	11.4	11.4	9.0	11.2	9.7	4.2
Other Goods	9.1	9.9	6.3	7.7	7.5	9.1	10.2	15.4	13.9	13.4
Public Utilities	12.6	15.5	10.0	8.8	5.7	9.0	7.4	1.4	1.5	(3.6)
Construction	151.6	158.2	105.3	80.7	81.4	93.3	99.0	92.1	90.7	81.6
Wholesale & Retail Trade	230.1	242.3	233.5	285.8	290.4	342.5	363.1	402.7	430.7	430.5
Transport & Comm.	148.3	151.7	166.1	127.2	159.1	174.2	169.7	195.3	177.4	175.5
Services	404.3	387.8	347.0	334.0	334.9	349.4	330.4	313.2	284.0	270.0
Financial Services	60.3	60.5	54.3	35.4	33.3	35.9	52.4	63.9	32.2	30.7
Public Administration	153.9	146.8	128.1	138.7	144.9	156.7	147.9	135.0	104.7	95.8
Others	190.2	180.5	164.6	160.0	156.8	156.8	130.1	114.3	147.0	143.6
Indirect Taxes	61.5	51.1	48.1	58.8	70.4	89.3	77.4	79.7	75.5	111.4
GDP at Market Prices	1,731.3	1,750.4	1,713.9	1,784.0	1,859.7	1,919.3	1,794.5	1,990.6	1,989.4	2,033.5

Source: Central Bank of Ecuador, *Cuentas Nacionales del Ecuador 1970-1993, No. 17 - 1994*

Appendix 2.2

National Income

(billions of 1987 Ecuadorian sucres)

Year	Gross Domestic Product	Net Domestic Product	GDP Growth Rate	Year	Gross Domestic Product	Net Domestic Product	GDP Growth Rate
1971	723.6	659.7		1981	1731.3	1560.9	4.1%
1972	844.7	765.1	16.7%	1982	1750.4	1563.0	1.1%
1973	1085.1	996.3	28.5%	1983	1713.9	1522.4	-2.1%
1974	1148.6	1069.2	5.8%	1984	1784.0	1572.7	4.1%
1975	1209.1	1116.3	5.3%	1985	1859.7	1633.6	4.2%
1976	1326.2	1221.1	9.7%	1986	1919.3	1644.0	3.2%
1977	1410.2	1297.2	6.3%	1987	1794.5	1479.2	-6.5%
1978	1508.5	1378.9	7.0%	1988	1990.6	1634.7	10.9%
1979	1590.5	1452.7	5.4%	1989	1989.5	1628.7	-0.1%
1980	1663.2	1513.5	4.6%	1990	2033.5	1679.0	2.2%
1971-1980							8.7%
1981-1990							1.6%
1971-1990							5.3%

Source: Central Bank of Ecuador, *Cuentas Nacionales del Ecuador 1970-1993, No. 17 - 1994*

Appendix 2.3

Oil in the Economy

(billions of 1987 Ecuadorian sucres)

Year	Gross Domestic Product	GDP from Petroleum Sector	Oil as % of Total	Year	Gross Domestic Product	GDP from Petroleum Sector	Oil as % of Total
1971	723.6	..	0.0%	1981	1731.3	299.9	17.3%
1972	844.7	14.9	1.8%	1982	1790.4	304.6	17.0%
1973	1085.1	102.5	9.4%	1983	1713.9	315.2	18.4%
1974	1148.6	264.5	23.0%	1984	1784.0	331.0	18.6%
1975	1209.1	173.0	14.3%	1985	1859.7	357.0	19.2%
1976	1326.2	173.9	13.1%	1986	1919.3	189.2	9.9%
1977	1410.2	179.2	12.7%	1987	1794.5	137.8	7.7%
1978	1508.5	131.6	8.7%	1988	1990.6	189.9	9.5%
1979	1590.5	274.0	17.2%	1989	1989.5	251.3	12.6%
1980	1663.2	343.8	20.7%	1990	2033.5	361.8	17.8%

Source: Central Bank of Ecuador, *Cuentas Nacionales del Ecuador 1970-1993, No. 17 - 1994*

Appendix 2.4

Domestic Investment

(billions of 1987 Ecuadorian sucres)

Year	Gross Domestic Investment	Net Domestic Investment	GDI as % of GDP	Year	Gross Domestic Investment	Net Domestic Investment	GDI as % of GDP
1971	268.1	204.2	37.1%	1981	494.8	324.3	28.6%
1972	233.7	154.1	27.7%	1982	557.3	369.9	31.8%
1973	258.7	169.9	23.8%	1983	383.2	191.7	22.4%
1974	358.1	278.7	31.2%	1984	377.7	166.4	21.2%
1975	419.7	327.0	34.7%	1985	407.7	181.6	21.9%
1976	397.8	292.7	30.0%	1986	420.0	144.7	21.9%
1977	483.2	370.2	34.3%	1987	406.8	91.5	22.7%
1978	540.7	411.1	35.8%	1988	391.7	35.8	19.7%
1979	525.4	387.5	33.0%	1989	403.1	42.3	20.3%
1980	571.5	421.7	34.4%	1990	341.7	-12.7	16.8%

Source: Central Bank of Ecuador, *Cuentas Nacionales del Ecuador 1970-1993, No. 17 - 1994*

Appendix 2.5

Foreign Trade
Value of Exports

(billions of 1987 Ecuadorian sucres)

Year	Value of Exports	Fuels	Non-Fuels	Fuels as % of Total	Year	Value of Exports	Fuels	Non-Fuels	Fuels as % of Total
1971	108.2	0.7	107.5	0.6%	1981	376.9	219.5	157.4	58.2%
1972	158.8	28.3	130.5	17.8%	1982	368.7	211.3	157.4	57.3%
1973	270.4	120.4	150.0	44.5%	1983	407.0	254.1	152.9	62.4%
1974	415.9	257.2	158.7	61.8%	1984	460.7	262.0	198.8	56.9%
1975	316.9	180.8	136.1	57.1%	1985	497.5	286.7	210.8	57.6%
1976	340.9	185.1	155.8	54.3%	1986	436.7	173.9	262.8	39.8%
1977	350.2	161.4	188.8	46.1%	1987	431.5	127.3	304.2	29.5%
1978	321.9	116.7	205.2	36.2%	1988	566.3	191.2	375.1	33.8%
1979	412.1	201.2	210.9	48.8%	1989	584.9	231.0	353.9	39.5%
1980	418.4	228.2	190.2	54.5%	1990	665.8	292.2	373.6	43.9%

Source: Central Bank of Ecuador, *Cuentas Nacionales del Ecuador 1970-1993, No. 17 - 1994*

Appendix 2.6

Distribution of Crude Oil Production

(thousands of barrels)

Year	Total Production	Exports	Domestic Market	Year	Total Production	Exports	Domestic Market
				1981	76,804	38,545	39,001
1972	28,579	24,962	1,739	1982	77,686	32,415	43,009
1973	76,221	71,126	16,883	1983	86,345	50,888	35,255
1974	64,616	43,843	18,823	1984	94,929	53,791	39,652
1975	58,753	42,800	15,603	1985	102,422	59,591	39,516
1976	68,362	46,660	21,449	1986	105,585	63,326	42,340
1977	67,002	37,393	27,692	1987	63,785	35,523	37,359
1978	74,221	42,305	32,236	1988	110,535	45,708	65,327
1979	78,779	39,932	36,651	1989	101,796	52,266	49,674
1980	74,771	33,769	39,509	1990	104,444	55,363	50,455

Source: PETROECUADOR, *Informe Estadistico de la Actividad Hidrocarburifera del Pais 1972-1991*

Total Production: Includes production of CEPE-PETROECUADOR, Anglo, Aguarico-Pastaza, Gulf, Texaco and City.

Exports: Includes exports of CEPE-PETROECUADOR, Texaco, Gulf and City.

Domestic Market: Corresponds to the volume of crude oil delivered to refineries, and to the compensation account which finances the importation of oil derivatives for domestic consumption.

Appendix 2.7

Oil Revenues and Public Sector Expenditures

(millions of current Ecuadorian sucres)

Year	Oil Revenues accruing to Government	Public Sector Expend.	Oil as % of Public Sector Expend.	Year	Oil Revenues accruing to Government	Public Sector Expend.	Oil as % of Public Sector Expend.
1971	0	4,055	0.0%	1981	15,718	39,297	40.0%
1972	506	5,418	9.3%	1982	21,628	45,996	47.0%
1973	1,787	7,973	22.4%	1983	28,950	60,187	48.1%
1974	3,312	11,389	29.1%	1984	46,804	99,873	46.9%
1975	2,579	12,364	20.9%	1985	113,975	189,472	60.2%
1976	3,033	14,653	20.7%	1986	73,612	186,803	39.4%
1977	2,654	16,453	16.1%	1987	89,633	236,762	37.9%
1978	2,159	19,057	11.3%	1988	164,798	415,456	39.7%
1979	3,675	23,085	15.9%	1989	391,843	835,394	46.9%
1980	15,946	37,549	42.5%	1990	690,352	1,363,149	50.6%

Source: Central Bank of Ecuador, *Cuentas Nacionales del Ecuador 1970-1993, No. 17 - 1994*

Appendix 3.1

Annual Oil Production by Region

(thousands of barrels)

Year	Oriente Region	Costa Region	Oriente as % of Total	Year	Oriente Region	Costa Region	Oriente as % of Total
1971	0	1,350	0.00%	1981	76,293	512	99.33%
1972	27,434	1,144	96.00%	1982	77,167	519	99.33%
1973	75,199	1,022	98.66%	1983	86,068	277	99.68%
1974	63,678	937	98.55%	1984	94,512	417	99.56%
1975	57,921	831	98.59%	1985	101,984	438	99.57%
1976	67,594	768	98.88%	1986	105,173	412	99.61%
1977	66,313	689	98.97%	1987	63,416	369	99.42%
1978	73,589	632	99.15%	1988	110,173	362	99.67%
1979	78,253	546	99.31%	1989	101,470	326	99.68%
1980	74,221	550	99.26%	1990	104,100	344	99.67%

Source: PETROECUADOR 1992

Appendix 3.2

Operational Costs by Producer

Producer	1991 PETRO Oriente	1991 PETRO City	1991 PETRO Penin	1991 PETRO Oryx	1989 CEPE Texaco	1989 CEPE Oriente
Direct Costs	34.0%	60.8%	44.0%	8.2%	65.1%	34.2%
Indirect Costs	43.9%	28.2%	22.6%	90.3%	23.1%	44.6%
Operational Expend.	22.1%	11.0%	33.5%	1.4%	11.8%	21.1%
Other	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Weighted D.C.	7.8%	1.0%	0.1%	0.1%	51.0%	6.6%
Weighted I.C.	10.1%	0.5%	0.1%	0.8%	18.1%	8.6%
Weighted O.E.	5.1%	0.2%	0.1%	0.0%	9.2%	4.1%
Weighted Other	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Weights equal percentage of total production in representative year by individual producer	23.0%	1.6%	0.3%	0.9%	78.3%	19.2%

Producer	1989 CEPE City	1989 CEPE Penin	1988 CEPE Texaco	1988 CEPE Oriente	1988 CEPE City	1988 CEPE Penin
Direct Costs	56.6%	16.6%	53.4%	24.9%	54.5%	27.4%
Indirect Costs	15.2%	23.1%	38.8%	58.2%	17.5%	34.0%
Operational Expend.	28.2%	60.3%	7.8%	16.9%	28.0%	38.7%
Other	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Weighted D.C.	1.2%	0.0%	41.8%	4.8%	1.2%	0.1%
Weighted I.C.	0.3%	0.1%	30.4%	11.2%	0.4%	0.1%
Weighted O.E.	0.6%	0.2%	6.1%	3.2%	0.6%	0.1%
Weighted Other	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Weights equal percentage of total production in representative year by individual producer	2.2%	0.3%	78.3%	19.2%	2.2%	0.3%

Producer	1987 CEPE Texaco	1987 CEPE Oriente	1987 CEPE City	1987 CEPE Penin	1986 CEPE Texaco	1986 CEPE Oriente
Direct Costs	46.5%	20.8%	41.2%	30.6%	56.9%	27.9%
Indirect Costs	39.7%	56.1%	18.0%	28.6%	28.9%	57.1%
Operational Expend.	13.9%	23.1%	40.8%	40.8%	14.2%	15.0%
Other	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Weighted D.C.	36.2%	4.0%	0.8%	0.2%	45.6%	5.0%
Weighted I.C.	30.9%	10.9%	0.4%	0.2%	23.1%	10.3%
Weighted O.E.	10.8%	4.5%	0.8%	0.2%	11.3%	2.7%
Weighted Other	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Weights equal percentage of total production in representative year by individual producer	78.0%	19.4%	2.0%	0.6%	80.0%	18.0%

Producer	1986 CEPE City	1986 CEPE Penin	1985 CEPE Texaco	1985 CEPE Oriente	1985 CEPE City	1984 CEPE Texaco
Direct Costs	52.1%	35.8%	62.1%	15.1%	32.9%	53.9%
Indirect Costs	18.0%	15.9%	30.0%	71.0%	16.5%	34.8%
Operational Expend.	29.9%	48.4%	7.9%	14.0%	50.6%	11.3%
Other	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Weighted D.C.	0.9%	0.1%	52.1%	2.1%	0.5%	46.2%
Weighted I.C.	0.3%	0.1%	25.2%	9.9%	0.3%	29.8%
Weighted O.E.	0.5%	0.2%	6.6%	2.0%	0.8%	9.7%
Weighted Other	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Weights equal percentage of total production in representative year by individual producer	1.7%	0.4%	83.9%	14.0%	1.6%	85.8%

Producer	1984 CEPE Oriente	1984 CEPE City	1984 CEPE Penin	1983 CEPE Texaco	1983 CEPE Penin	1982 CEPE Texaco
Direct Costs	18.2%	17.8%	29.3%	56.7%	29.3%	56.4%
Indirect Costs	66.2%	60.5%	14.6%	32.3%	20.1%	32.5%
Operational Expend.	15.6%	21.7%	56.1%	11.0%	50.6%	11.2%
Other	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Weighted D.C.	2.2%	0.3%	0.1%	50.4%	0.1%	54.0%
Weighted I.C.	8.1%	1.0%	0.1%	28.7%	0.1%	31.1%
Weighted O.E.	1.9%	0.3%	0.2%	9.7%	0.2%	10.7%
Weighted Other	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Weights equal percentage of total production in representative year by individual producer	12.2%	1.6%	0.4%	88.8%	0.3%	95.8%

Producer	1982 CEPE City	1982 CEPE Penin	1981 CEPE Penin	1980 CEPE Texaco	1980 CEPE Penin
Direct Costs	49.1%	21.7%	73.4%	41.0%	96.5%
Indirect Costs	15.4%	16.8%	7.0%	52.6%	0.9%
Operational Expend.	22.0%	61.5%	19.6%	6.3%	2.6%
Other	13.5%	0.0%	0.0%	0.0%	0.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%
Weighted D.C.	0.8%	0.2%	0.5%	39.9%	0.7%
Weighted I.C.	0.2%	0.1%	0.0%	51.2%	0.0%
Weighted O.E.	0.4%	0.4%	0.1%	6.2%	0.0%
Weighted Other	0.2%	0.0%	0.0%	0.0%	0.0%
Weights equal percentage of total production in representative year by individual producer	1.6%	0.7%	0.7%	97.3%	0.7%

Appendix 4.1

National Income
Depreciation Method
(billions of 1987 Ecuadorian sucres)

Year	Gross Domestic Product	Fixed Capital Depreciation	Natural Capital Depreciation	Natural Capital Depreciation as % of GDP	------- Growth Rate ------ GDP	ENDP
1971	723.6	63.9	0.0	0.0%		
1972	844.7	79.6	22.7	2.7%	16.7%	12.5%
1973	1085.1	88.8	-58.8	-5.4%	28.5%	42.1%
1974	1148.6	79.4	315.5	27.5%	5.8%	-28.6%
1975	1209.1	92.7	216.8	17.9%	5.3%	19.4%
1976	1326.2	105.1	713.5	53.8%	9.7%	-43.6%
1977	1410.2	113.0	431.7	30.6%	6.3%	70.5%
1978	1508.5	129.6	87.4	5.8%	7.0%	49.2%
1979	1590.5	137.9	291.4	18.3%	5.4%	-10.1%
1980	1663.2	149.8	400.2	24.1%	4.6%	-4.1%
1981	1731.3	170.5	499.7	28.9%	4.1%	-4.7%
1982	1750.4	187.4	-63.0	-3.6%	1.1%	53.2%
1983	1713.9	191.5	161.5	9.4%	-2.1%	-16.3%
1984	1784.0	211.3	-1171.0	-65.6%	4.1%	101.6%
1985	1859.7	226.1	-43.9	-2.4%	4.2%	-38.9%
1986	1919.3	275.3	-134.3	-7.0%	3.2%	6.0%
1987	1794.5	315.3	-799.9	-44.6%	-6.5%	28.2%
1988	1990.6	355.9	111.8	5.6%	10.9%	-33.2%
1989	1989.5	360.8	145.6	7.3%	-0.1%	-2.6%
1990	2033.5	354.4	209.2	10.3%	2.2%	-0.9%
1971-1980					8.7%	5.4%
1981-1990					1.6%	3.3%
1971-1990					5.3%	4.1%

Sources: Table 3.2 and Appendix 2.2

ENDP: Environmentally adjusted Net Domestic Product
ENDP = NDP - Natural Capital Depreciation

Appendix 4.2

National Income
User Cost Method
(billions of 1987 Ecuadorian sucres)

Year	GDP	User Cost	User Cost as % of GDP	------- Growth Rate ------ GDP	EGDP
1971	723.6	0.0	0.0%		
1972	844.7	1.7	0.2%	16.7%	16.5%
1973	1085.1	41.3	3.8%	28.5%	23.8%
1974	1148.6	100.1	8.7%	5.8%	0.4%
1975	1209.1	64.6	5.3%	5.3%	9.2%
1976	1326.2	96.4	7.3%	9.7%	7.4%
1977	1410.2	107.1	7.6%	6.3%	6.0%
1978	1508.5	115.7	7.7%	7.0%	6.9%
1979	1590.5	234.4	14.7%	5.4%	-2.6%
1980	1663.2	306.6	18.4%	4.6%	0.0%
1981	1731.3	294.9	17.0%	4.1%	5.9%
1982	1750.4	264.0	15.1%	1.1%	3.5%
1983	1713.9	250.0	14.6%	-2.1%	-1.5%
1984	1784.0	231.1	13.0%	4.1%	6.1%
1985	1859.7	227.8	12.3%	4.2%	5.1%
1986	1919.3	87.6	4.6%	3.2%	12.2%
1987	1794.5	40.0	2.2%	-6.5%	-4.2%
1988	1990.6	76.0	3.8%	10.9%	9.1%
1989	1989.5	96.5	4.8%	-0.1%	-1.1%
1990	2033.5	127.9	6.3%	2.2%	0.7%

Sources: Table 3.3 and Appendix 2.2

EGDP: Environmentally adjusted Gross Domestic Product
EGDP = GDP - User Cost

Appendix 4.3

Domestic Investment
Depreciation Method

(billions of 1987 Ecuadorian sucres)

Year	Gross Domestic Investment	Fixed Capital Depreciation	Natural Capital Depreciation	Environmentally-adjusted Net Domestic Investment	ENDI as % of GDP
1971	268.1	63.9	0.0	204.2	28.2%
1972	233.7	79.6	22.7	131.4	15.6%
1973	258.7	88.8	-58.8	228.6	21.1%
1974	358.1	79.4	315.5	-36.8	-3.2%
1975	419.7	92.7	216.8	110.2	9.1%
1976	397.8	105.1	713.5	-420.8	-31.7%
1977	483.2	113.0	431.7	-61.5	-4.4%
1978	540.7	129.6	87.4	323.7	21.5%
1979	525.4	137.9	291.4	96.2	6.0%
1980	571.5	149.8	400.2	21.6	1.3%
1981	494.8	170.5	499.7	-175.3	-10.1%
1982	557.3	187.4	-63.0	432.9	24.7%
1983	383.2	191.5	161.5	30.1	1.8%
1984	377.7	211.3	-1171.0	1337.4	75.0%
1985	407.7	226.1	-43.9	225.5	12.1%
1986	420.0	275.3	-134.3	279.0	14.5%
1987	406.8	315.3	-799.9	891.4	49.7%
1988	391.7	355.9	111.8	-76.0	-3.8%
1989	403.1	360.8	145.6	-103.2	-5.2%
1990	341.7	354.4	209.2	-221.9	-10.9%

Sources: Table 3.2 and Appendix 2.4

GDI: Gross Domestic Investment

ENDI: Environmentally adjusted Net Domestic Investment

ENDI = GDI - Fixed Asset Depreciation - Natural Capital Depreciation

Appendix 4.4

Domestic Investment
User Cost Method
(billions of 1987 Ecuadorian sucres)

Year	Gross Domestic Investment	Fixed Capital Depreciation	User Cost	Environmentally-adjusted Net Domestic Investment	ENDI as % of GDP
1971	268.1	63.9	0.0	204.2	28.2%
1972	233.7	79.6	1.7	152.4	18.0%
1973	258.7	88.8	41.3	128.6	11.8%
1974	358.1	79.4	100.1	178.6	15.5%
1975	419.7	92.7	64.6	262.4	21.7%
1976	397.8	105.1	96.4	196.3	14.8%
1977	483.2	113.0	107.1	263.0	18.7%
1978	540.7	129.6	115.7	295.4	19.6%
1979	525.4	137.9	234.4	153.1	9.6%
1980	571.5	149.8	306.6	115.2	6.9%
1981	494.8	170.5	294.9	29.4	1.7%
1982	557.3	187.4	264.0	105.9	6.1%
1983	383.2	191.5	250.0	-58.3	-3.4%
1984	377.7	211.3	231.1	-64.7	-3.6%
1985	407.7	226.1	227.8	-46.3	-2.5%
1986	420.0	275.3	87.6	57.1	3.0%
1987	406.8	315.3	40.0	51.5	2.9%
1988	391.7	355.9	76.0	-40.2	-2.0%
1989	403.1	360.8	96.5	-54.1	-2.7%
1990	341.7	354.4	127.9	-140.7	-6.9%

Sources: Table 3.3 and Appendix 2.4

GDI: Gross Domestic Investment
ENDI: Environmentally adjusted Net Domestic Investment
ENDI = GDI - Fixed Asset Depreciation - User Cost

Appendix 4.5

Human Capital Development

(billions of 1987 Ecuadorian sucres)

Year	GDP	Public Sector Expenditures (a)	Human Capital Expenditures (b)	Development Effort (b/a)
1971	723.6	112.7	25.4	22.5%
1972	844.7	117.4	31.6	26.9%
1973	1085.1	148.9	47.2	31.7%
1974	1148.6	156.6	44.2	28.2%
1975	1209.1	156.1	49.7	31.9%
1976	1326.2	188.3	53.3	28.3%
1977	1410.2	197.4	62.1	31.4%
1978	1508.5	187.3	60.9	32.5%
1979	1590.5	182.8	63.1	34.5%
1980	1663.2	258.3	101.9	39.5%
1981	1731.3	298.9	112.0	37.5%
1982	1750.4	301.3	103.6	34.4%
1983	1713.9	244.5	87.2	35.7%
1984	1784.0	255.4	86.3	33.8%
1985	1859.7	299.1	91.5	30.6%
1986	1919.3	327.8	102.6	31.3%
1987	1794.5	308.0	105.0	34.1%
1988	1990.6	312.3	94.2	30.1%
1989	1989.5	335.1	90.2	26.9%
1990	2033.5	353.2	86.3	24.4%

Source: Ministry of Finance *Estadisticas Fiscales #2, 3, & 4*

Human Capital Expenditures include Education, Culture, Health and Community Development

Appendix 4.6

Genuine Savings
Depreciation Method
(billions of 1987 Ecuadorian sucres)

Year	Gross Domestic Product	Public and Private Consumption	Fixed Capital Depreciation	Natural Capital Depreciation	Genuine Savings	Genuine Savings as % of GDP
1971	723.6	647.6	63.9	0.0	12.1	1.7%
1972	844.7	718.0	79.6	22.7	24.4	2.9%
1973	1085.1	835.8	88.8	-58.8	219.2	20.2%
1974	1148.6	835.9	79.4	315.5	-82.2	-7.2%
1975	1209.1	969.2	92.7	216.8	-69.6	-5.8%
1976	1326.2	1030.2	105.1	713.5	-522.7	-39.4%
1977	1410.2	1082.8	113.0	431.7	-217.3	-15.4%
1978	1508.5	1162.0	129.6	87.4	129.5	8.6%
1979	1590.5	1175.6	137.9	291.4	-14.3	-0.9%
1980	1663.2	1233.6	149.8	400.2	-120.3	-7.2%
1981	1731.3	1312.6	170.5	499.7	-251.4	-14.5%
1982	1750.4	1349.4	187.4	-63.0	276.7	15.8%
1983	1713.9	1335.0	191.5	161.5	25.9	1.5%
1984	1784.0	1354.1	211.3	-1171.0	1389.6	77.9%
1985	1859.7	1406.1	226.1	-43.9	271.4	14.6%
1986	1919.3	1507.3	275.3	-134.3	271.0	14.1%
1987	1794.5	1499.8	315.3	-799.9	779.3	43.4%
1988	1990.6	1598.3	355.9	111.8	-75.4	-3.8%
1989	1989.5	1617.2	360.8	145.6	-134.0	-6.7%
1990	2033.5	1583.9	354.4	209.2	-114.1	-5.6%

Sources: Table 3.2, Central Bank of Ecuador, *Cuentas Nacionales del Ecuador: 1970-1993, No. 17 - 1994*

Genuine Savings = GDP - Consumption (Public and Private) - Depreciation of Fixed Capital - Depreciation of Natural Capital

Appendix 4.7

Genuine Savings
User Cost Method
(billions of 1987 Ecuadorian sucres)

Year	Gross Domestic Product	Public and Private Consumption	Fixed Capital Depreciation	User Cost	Genuine Savings	Genuine Savings as % of GDP
1971	723.6	647.6	63.9	0.0	12.1	1.7%
1972	844.7	718.0	79.6	1.7	45.3	5.4%
1973	1085.1	835.8	88.8	41.3	119.1	11.0%
1974	1148.6	835.9	79.4	100.1	133.2	11.6%
1975	1209.1	969.2	92.7	64.6	82.6	6.8%
1976	1326.2	1030.2	105.1	96.4	94.4	7.1%
1977	1410.2	1082.8	113.0	107.1	107.2	7.6%
1978	1508.5	1162.0	129.6	115.7	101.2	6.7%
1979	1590.5	1175.6	137.9	234.4	42.7	2.7%
1980	1663.2	1233.6	149.8	306.6	-26.7	-1.6%
1981	1731.3	1312.6	170.5	294.9	-46.6	-2.7%
1982	1750.4	1349.4	187.4	264.0	-50.4	-2.9%
1983	1713.9	1335.0	191.5	250.0	-62.6	-3.7%
1984	1784.0	1354.1	211.3	231.1	-12.5	-0.7%
1985	1859.7	1406.1	226.1	227.8	-0.4	0.0%
1986	1919.3	1507.3	275.3	87.6	49.1	2.6%
1987	1794.5	1499.8	315.3	40.0	-60.6	-3.4%
1988	1990.6	1598.3	355.9	76.0	-39.6	-2.0%
1989	1989.5	1617.2	360.8	96.5	-84.9	-4.3%
1990	2033.5	1583.9	354.4	127.9	-32.8	-1.6%

Sources: Table 3.3, Central Bank of Ecuador, *Cuentas Nacionales del Ecuador: 1970-1993 No. 17 - 1994*

Genuine Savings = GDP - Consumption (Public and Private) - Depreciation of Fixed Capital - User Cost

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