Integrated Environmental-Economic Accounting of GDP

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Besides the inputs of capital and labor, the stock of the environment[1] is employed in the production of commodities.[2] The utilization of the environmental stock in production may cause depletion of natural resources and degradation of the environment. Thus, as a country develops there appears to be a trade-off between GDP growth and the quality of the environment. In this sense, GDP is a poor indicator of social welfare at the national level. Therefore, the conventional GDP is of limited usefulness in making the policies of social welfare and sustainable development.

It is thought that Integrated environmental-economic (or 'green') GDP is a more accurate measure of social welfare than is GDP itself, because it captures the disutility due to environmental damages. To quote Aaheim and Nyborg (1995), "... much of the demand for a 'green GDP' is caused by the fear that authorities will take no notice of environmental degradation as long as GDP increases, and that a common feature of the proposals of 'greening' the national product is that they are meant to provide a better informational background for evaluating and eventually changing policy." The development of green GDP accounting provides a fundamental component of policy-making for socially optimal growth and of formulating the market mechanisms for environmental management.

Adjusting GDP to account for environmental effects is difficult, though, because it requires measuring the monetary value of environmental depletion and degradation. Our study develops a method for making this adjustment, and goes on to compare green GDP across countries and over time.

1. GDP Accounts and Green GDP Accounts

When the National Accounts were systematized in the 1940s, environmental issues had a low perceived importance, and the accounting structure adopted simply ignored depletion/degradation of the environment. Since the 1970s, when the gap between economic growth and quality of life began to widen[3], the conventional System of National Accounts (SNA) has been criticized for distortions regarding the measurement of economic performance, growth and development (e.g., Hueting, 1989; Repetto, Magarth, Wells, Beer and Rossini, 1989; Congressional Budget Office, 1994; Dieren, 1995; and Milton, 1995). One of the key drawbacks of SNA is that GDP, the most widely used measure of aggregate economic activity, fails to account for the impact of economic activity on the environment. Examples of these environmental externalities include energy and land uses, water and air pollution, and deforestation. Economists have suggested that GDP accounts should be adjusted for the value of environmental damages to constitute green GDP accounts (e.g., Harrison, 1989; Hartwick, 1990; and Mäler, 1991). That is,

$$\text{green GDP} = \text{GDP} - \lambda_D \cdot D; \tag{1}$$

[1] The environment is broadly defined, including environmental and natural resources.

[2] This point comes originally from an influential paper by Weitzman (1976). He emphasizes that all sources of economic growth must be included in the notion of "capital": physical capital, human capital (labor) and natural capital (the environment).

[3] For example, while per capita income in Oman was more than 17 times higher than in neighboring Sri Lanka in 1985, life expectancy in Sri Lanka was 16 years longer than in Oman (Sen, 1991).

where D is a vector of indicators of environmental depletion or degradation and λ_D is the vector of shadow prices of such depletion or degradation. The Statistical Division of the United Nations also pursues this line of thought and outlines a System for Integrated Environmental and Economic Accounting (SEEA) (United Nations, 1993). However, the green GDP accounts depend critically upon $\lambda_D \cdot D$, the monetary valuation of the depletion/degradation of the environment. This presents a problem in that the shadow prices λ_D are not easily observable, because the markets of many environmental goods are missing or not competitive.

In its handbook the U.N. (1993) proposes three different methods for measuring shadow prices λ_D:

a. Market valuation. This approach assumes that observed market prices do not deviate significantly from the ‘true’ shadow prices λ_D, and use observed prices for adjustments in the green GDP. This compromise approach is not entirely satisfying because market prices do not necessarily reflect the environmental impacts of economic activities.

b. Contingent valuation. Willingness-to-pay (WTP) information is used to obtain shadow prices for environmental deterioration. Contingent valuation (CV) in this setting would be based on a hypothetical scenario and presents some practical difficulties in its procedure. Other major problems are that WTP is closely related to ability to pay of respondents and that the valuation is probably influenced by distorted market prices.

c. Maintenance valuation. Maintenance cost is defined as the least cost of maintaining the environmental standard unchanged, whether actually incurred or not, during the accounting period. There are similar problems of this hypothetical valuation as in the CV approach.

2. The Methodology

Much of the current debate in the literature is on the question of the suitability of green GDP as an indicator of social welfare or as an indicator of sustainability.[4] Probably influenced by the earlier Hicksian concept of income (Hicks, 1947)[5], some economists argue that green GDP is an indicator of sustainability, since it is a number representing the amount of welfare which can be enjoyed over a period of time and leave the economy with the capacity to enjoy that same amount of welfare for the next period of time. Thus sustainability is defined as constant instantaneous welfare over time, which might not be something the economy is aiming at. The economy’s objective might be maximizing the total discounted utility flow over time. Weitzman (1976) defines welfare as the present value of future consumption and demonstrates that green GDP can be interpreted as a measure of welfare if the economy is on the optimal growth path.

There is an extensive theoretical literature aimed at modeling the relationship between economic growth and environmental quality.[6] A number of studies focus on the optimal growth path on which a country maximizes its discounted social welfare over time subject to the accumulation of stocks of capital, human capital and natural capital (the

[4] See, e.g., Aaheim and Nyborg (1995), Asheim (1994), Brekke (1994), Hartwick (1990, 1994), Lintott (1996), Mäler (1991), Pemberton and Ulph (1997), Solow (1986), and Vellinga and Withagen (1996).

[5] Hicks defines that an individual’s income is “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 in the beginning”.

[6] Early contributions to this literature include articles by Forster (1972, 1973), Gruver (1976), Keeler, Spence and Zeckhauser (1971), Smith (1977), and Stephens (1976). Recent contributions include the work of Beltratti (1996), Bovenberg and Smulders (1995, 1996), Elbasha and Roe (1996), Hofkes (1996), Michel and Rotillon (1995), Mohtadi (1996), Qi and Coggins (1999), Selden and Song (1995), Smulders and Gradus (1996), Stokey (1998), Tahvonen and Kuuluvainen (1993), and Withagen (1995).

environmental stock). Social welfare includes utility from commodity goods and disutility from environmental damages. On the optimal growth path, the country achieves optimal trade-off between current welfare and the stocks of all capital left to next period. The stocks are not necessary to keep an unchanged level in the Hicksian sense. Green GDP is viewed in our study as an indicator of social welfare.

In our study, the depletion/degradation D are treated as inputs rather than as undesirable outputs (see Qi, Coggins and Xu, 2000, for details). Suppose that all countries in the world use capital K and labor L, as well as environmental input D, to produce a single output y that is GDP. Country k ($k = 1, \cdots, K$) uses inputs $x^{k,t} = \left(K^{k,t}, L^{k,t}, D^{k,t}\right)$ to produce GDP $y^{k,t}$ in period t. The cross-country (world) technology set in period t is

$$S^t = \left\{ (x, y) : y \le \sum_{k=1}^{K} z^{k,t} y^{k,t}, \ \sum_{k=1}^{K} z^{k,t} x^{k,t} \le x, \ z^{k,t} \ge 0 \right\}; \tag{2}$$

where $z^{k,t}$ is the intensity variable indicating at what intensity technology k may be employed in production. This activity-analysis model is originated by von Neumann.[7] It satisfies constant returns to scale and free disposability of inputs and outputs (Färe, Grosskopf and Roos, 1998).

If the technology is efficient, the shadow prices are the equilibrium prices that will ensure that decentralized, general equilibrium outcomes are socially optimal. Thus, these 'efficient' shadow prices are the maximal values of marginal products where the technology is on the production frontier. For the technology set S^t (equation 2), the maximal potential GDP for given inputs $x = (K, L, D)$ is

$$F^t(x) = \max_{z^{k,t} \ge 0} \left\{ \sum_{k=1}^{K} z^{k,t} y^{k,t} : \sum_{k=1}^{K} z^{k,t} x^{k,t} \le x \right\}: \tag{3}$$

The Lagrangian for this problem $L = \sum_{k=1}^{K} z^{k,t} y^{k,t} + \lambda \cdot \left(x - \sum_{k=1}^{K} z^{k,t} x^{k,t} \right)$. By the Envelope theorem, $\nabla_D F^t(x) = \lambda_D$. The dual values for the environmental constraints in this maximum problem are the efficient shadow prices of environmental externalities D in period t.

There are two practical problems on the above derivation of shadow prices. The duality theory tells us that

$$F^t(x) = \lambda \cdot x = \lambda_K K + \lambda_L L + \lambda_D \cdot D: \tag{4}$$

The efficient shadow prices, λ, ensure the maximum of output. That is, the values of λ is the shadow prices of the technology $(x, F(x))$ rather than those of the actual technology (x, y). It brings the first problem: what are the actual values of shadow prices because technologies in the real world may be not on the production frontier. The second problem is related to the selection of environmental externalities D. We note from the maximization problem (3) that the maximum value of $F^t(x)$ decreases with the increase on the number of constraints. The monetary valuation of the environment damages, $\lambda_D \cdot D$, may change significantly according to equation (4). So that another problem can arise in practice: how many indicators are included in the vector D and what are these indicators.

To estimate the actual shadow prices for technology (x, y), the concept of distance function is introduced. Let $x \in R^N_+$ denote a vector of inputs and $y \in R^M_+$ denote an

[7] See Karlin (1959).

output vector. The technology set S^t is defined by the production possibility set

$$S^t = \{(x; y) : x \text{ can produce } y \text{ at period } t\}: \quad (5)$$

The output distance function, due to Shephard (1970), is defined by

$$D^t(x; y) = \inf \left\{ \theta : (x; \frac{y}{\theta}) \in S^t \right\}: \quad (6)$$

The function $D^t(x; y)$ is the reciprocal of the maximal radial expansion of the output vector y in period t consistent with technological feasibility for given the inputs x, or alternatively, $\left(x; \frac{y}{D^t(x; y)} \right)$ is on the production frontier. By the definition, $D^t(x; y) \leq 1$ if the technology $(x; y) \in S$ and $D^t(x; y) = 1$ if $(x; y)$ is on the production frontier. So that $D^t(x; y)$ is a measurement of efficiency of the technology $(x; y)$.

For a single output (GDP) y and multiple inputs $x = (K; L; D)$, the output distance function can be easily derived as

$$D^t(x; y) = \frac{y}{F^t(x)}; \quad (7)$$

where $F^t(x)$ is defined by equation (3). Therefore, we get

$$y = D^t(x; y) \lambda \cdot x = D^t(x; y) (\lambda_K K + \lambda_L L + \lambda_D \cdot D): \quad (8)$$

This implies that at the price levels of $D^t(x; y) \lambda$, the inputs $x = (K; L; D)$ make their contributions to the production of actual output y. Hence, the actual shadow prices for technology $(x; y)$ are $D^t(x; y) \lambda$. The estimates of the actual shadow prices can be thought of as the Pigouvian tax rates or as the prices at which pollution permits would trade in the economy which aggregate technology is $(x; y)$. They also represent as the unit costs of abatement in this competitive economy.

In fact, all environmental indicators have obvious or potential effects on a country's production processes. In this sence, the number of indicators which are included in the environmental vector D cannot be decided. If Q is an index of environmental quality used in production and λ is the corresponding shadow prices of this index, the green GDP accounts can be rewritten as

$$\text{green GDP} = \text{GDP} - \lambda Q: \quad (9)$$

In our study, energy use, land use, water pollution, and CO_2 emissions act as the indexes of environmental quality. Energy use has important effects on all types of economies. Land use plays an important role on the progress of economic development from agricultural economy to industrialized countries. The total CO_2 emissions are selected as a representative of air pollutants because not only CO_2 is a major green-house air but also other air pollutants, like SO_2, NO_x, CO, VOC (volitile organic compound), PM (particulate matter), NH_3, and CH_4, are heavily dependent on the structure of economy. Organic water pollutant (BOD) emissions is also chosen as one index of environmental quatity. These four indicators appear to be good representives of environmental quality amonst countries.

One of the indexes as an input each time, besides capital and labor, enters the GDP production. When using an index, we can compute a value of green GDP each time by equation (9). The mean of the green GDP values is finally the measure of green GDP for a country in a year. The green GDP accounts are, hence, as

$$\text{green GDP} = \text{GDP} - \frac{1}{I}\sum_{i=1}^{I} \lambda_i Q_i; \qquad (10)$$

where λ_i is the actual shadow price of the index Q_i and $\frac{1}{I}\sum_{i=1}^{I} \lambda_i Q_i$ is the monetary valuation of environmental externalities.

3. Data and Results

All the data used in our study are annual data on country level. A sample of 103 countries is collected, including developed countries and developing countries. The sample covers all major countries in the world. The period of data is from 1980 to 1997. The economic variables in the dataset include GDP, capital stock and labor. Capital stock is the total capital stock which includes residential and non-residential capital stocks. Labor is the total labor force defined by the International Labour Organization. GDP is based on purchasing power parity (PPP), and the values of capital stock are also converted in terms of PPP. So that discounting of GDP and capital stock is not needed because their values are in real terms. Energy use, land use, water pollution, and CO_2 emissions are applied as the indexes of environmental quality in our study. Energy use is referred as the total commercial consumption from all kinds of energy in term of oil equivalent, and water pollution is referred as organic water pollutant (BOD) emissions.

The data are from various sources. Most of them are from the World Bank Development Indicators, the World Resources Database by World Resources Institute, the Penn World Tables, and OECD statistical publications. All data are through checking their integrity and testing for the compatibility across countries and amongst the sources.

Taking one of the environmental indicators, Q_i, which is energy use, land use, water pollutants, or CO_2 emissions, as an index of environmental quality, we derive the actual shadow price λ_i for Q_i by using linear programming technique. The derivation is under a data-envelopment-analysis (DEA) framework in which a dynamic cross-country technology is constituted by the data of 103 countries for each year in 1980 - 97. The shadow price is in terms of the world aggregate technology $(x; y)$ where inputs $x = (K; L; Q_i)$.

After examination on the shadow prices we obtain, we find that the time series of shadow prices $\{\lambda_i\}$ fluctuate highly. This situation is caused by random shocks. Also, from the maximization problem (equation 3), we see that λ_i is determined by the constraint Q_i and the technology set S^t. The shadow price λ_i declines as the index of environmental externalities, Q_i, becomes larger. This means that the environmental damages $\lambda_i Q_i$ may be valued at a small level when there are large amounts of environmental externalities. It conflicts with common consideration on social welfare. So that the mean of the shadow prices $\{\lambda_i\}$ is taken as the shadow value when doing the monetary valuation of environmental damages. Here the time factor is ignored because all the monetary terms are in real goods. Our approach on shadow prices λ_i implies that people are consistently rational. In this way, all the countries in all years have a consistent standard on valuing green GDP.

The monetary valuation of environmental damages, $\frac{1}{I}\sum_{i=1}^{I} \lambda_i Q_i$, as percentage of GDP, is complied on Table 1 and Table 2. Table 1 is for the whole world in period of 1980 - 1997 and Table 2 is by country in selected years. The values of environmental externalities per unit of GDP on the world increase in 1980 - 83. It implies that the environmental quality is sacri…ced on some scales to GDP growth in this period. The world's environmental externalities for producing one unit of GDP decline steadily since 1992. Note that since 1992, the world's economy experiences a prosperous period. So that it suggests that the environment can be improved when economies grow rapidly. This point can be con…rmed further by later observation on the growth of GDP and green GDP by country. In the middle of the period, There are ‡uctuations on the values of environmental externalities per unit of GDP.

We calculate green GDP by country in the selected years, 1980, 1992, and 1997, in Table 3. For comparison, Table 4 is attached for GDP values. Both GDP and green GDP are measured on PPP. We can combine Table 3, Table 4, and Table 2 to see individual country's information. Countries can be divided into three groups, developed countries, east European and former U.S.S.R countries, and other countries.

Developed countries include Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany (91-), Greece, Italy, Japan, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, and United States.

In 1997, the values of environmental damages as % of GDP for these countries are in the range between 9.2% and 18.3%. All values are below the world average (18.3%). This implies that the environment in the developed countries, relative to the world, is satisfactory in their progresses of economic development. The most satisfactory countries in this category are Italy (9.2%), Austria (10.6%), France (12.0%), and Japan (12.0%). The least satisfactory countries in this category are Finland (18.3%), Canada (17.5%), and Australia (16.3%). U.S.A. is the …fth least satisfactory country out of these 19 countries.

The growth of green GDP in 1992 - 97 is in the range between 0.4% and 4.2% of annual rates for these countries. The highest are Australia (4.2%), Norway (4.2%), and U.S.A. (3.7%). The lowest are Switzerland (0.4%), Italy (1.0%), Germany (1.3%), and Greece (1.3%). The annual growth rates of GDP for these countries are from 0.2% to 3.7%. The highest is Norway (3.9%), Australia (3.7%), and U.S.A. (3.4%). The lowest is Switzerland (0.2%), Italy (0.9%), and Germany (0.9%). We …nd a result that green GDP grows faster than GDP in all these developed countries. This is consistent with the previous …nding that the values of environmental damages per unit of GDP for these countries are below the world average. This result may show that the environmental quality tends to be improved as economies grows in high-income countries. So that it demonstrates, to some extent, the existence of the environmental Kuznet curve (or called inverted-U curve) on the high-income stage.

East European and former U.S.S.R countries include Armenia, Azerbaijan, Bulgaria, Croatia, Czech Republic, Hungary, Kyrgyz Republic, Latvia, Lithuania, Macedonia FYR, Moldova, Poland, Romania, Russian Federation, Slovak Republic, Slovenia, and Ukraine.

The values of environmental damages as % of GDP for these countries in transition are between 21.4% and 72.7% in 1997. All values are above the world average. This implies that the environmental quality in these countries is worsen, compared with the whole world. The best in this category is Kyrgyz Republic (21.4%), Slovenia (24.0%), and Armenia (24.6%). The worst countries are Ukraine (72.7%), Azerbaijan (60.1%), and Moldova (56.6%).

In these east European and former U.S.S.R countries, the annual growth rates of green GDP in 1992 - 97 is in the range between -22.3% and 10.8%. The best performances belong to Armenia (10.8%), Slovak Republic (6.6%), and Poland (5.8%). The worst is in Ukraine (-22.3%), Azerbaijan (-12.7%), and Moldova (-7.7%). The annual growth rates of GDP for these countries are from -13.0% to 4.1%. The highest is in Poland (4.1%), Slovak Republic (3.9%), and Slovenia (3.7%). The lowest is in Ukraine (-13.0%), Azerbaijan (-9.1%), and Moldova (-9.1%). In these countries in transition, the east European countries except Bulgaria, have positive growth on both GDP and green GDP, while former U.S.S.R countries except Armenia and Latvia have negative growth on both GDP and green GDP.

In other countries, the lowest values of environmental damages as % of GDP in 1997 belong to Hong Kong (6.4%), Malta (9.1%), and Colombia (9.7%), and the highest is in Tanzania (54.9%), Trinidad and Tobago (52.1%), and Jamaica (40.3%).

Malta (22.4% of green GDP and 19.1% of GDP), China (19.0% of green GDP and 10.6% of GDP), and Colombia (15.3% of green GDP and 13.3% of GDP) have the top three highest growth on both of green GDP and GDP in 1992 - 97. On the other hand, Angola (-7.6% of green GDP and -6.6% of GDP), Jamaica (-1.8% of green GDP and -0.5% of GDP), and Congo Rep. (0.5% of green GDP and 0.0% of GDP) get the lowest growth on green GDP and GDP.

Overall, we see that the growth of GDP and green GDP coincides on almost all countries including developed and developing countries, though the growth rates have some di¤erences on scale. It appears that most countries do not worsen the environmental quality to get the gains of GDP, even for the countries in their early development stages.

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Table 1: Value of environmental damages as % of GDP, world level in 1980-97

Year	Value of environmental damages (% of GDP)
1980	22.0%
1981	22.2%
1982	23.1%
1983	23.3%
1984	22.8%
1985	22.1%
1986	20.5%
1987	19.3%
1988	18.6%
1989	19.1%
1990	20.1%
1991	19.9%
1992	20.8%
1993	20.4%
1994	19.9%
1995	19.3%
1996	18.8%
1997	18.3%

Table 2: Value of environmental damages as % of GDP, by country in selected years

Country	Value of environmental damages (% of GDP) 1980	1992	1997
Algeria	13.8%	17.5%	17.8%
Angola	..	9.0%	13.7%
Argentina	13.5%	11.9%	11.2%
Armenia (92-)	..	48.6%	24.6%
Australia	21.7%	17.9%	16.3%
Austria	15.5%	11.5%	10.6%
Azerbaijan (92-)	..	51.0%	60.1%
Bangladesh	14.3%	19.5%	18.2%
Belgium	19.1%	14.7%	14.1%
Benin	19.5%	..	..
Bolivia	14.2%	16.0%	17.5%
Brazil	15.1%	13.4%	12.1%
Bulgaria	64.5%	44.5%	45.6%
Cameroon	18.5%	15.8%	16.2%
Canada	23.1%	18.6%	17.5%
Chile	17.3%	16.2%	14.1%
China	80.8%	54.8%	35.1%
Colombia	10.4%	17.2%	9.7%
Congo, Rep.	..	23.3%	21.4%
Costa Rica	..	22.3%	21.4%
Cote d'Ivoire	16.6%	..	..
Croatia (92-)	..	35.3%	26.5%
Cyprus	19.2%	14.9%	13.2%
Czech Republic (92-)	..	32.5%	25.2%
Denmark	18.1%	16.4%	14.5%
Dominican Republic	33.8%	..	..
Ecuador	19.0%	19.9%	17.5%
Egypt, Arab Rep.	30.9%	23.9%	23.1%
El Salvador	9.5%	9.8%	16.7%
Ethiopia	..	25.5%	18.6%
Finland	..	19.7%	18.3%
France	17.0%	13.0%	12.0%
Gabon	18.7%	13.5%	13.2%
Germany (91-)	..	14.0%	12.2%
Ghana	14.4%	12.2%	11.8%
Greece	12.8%	13.1%	12.9%
Guatemala	12.9%	11.2%	11.7%
Haiti	8.2%	..	..
Honduras	21.5%	28.5%	38.8%
Hong Kong, China	22.3%	10.8%	6.4%
Hungary	34.1%	28.3%	25.1%
Iceland	27.6%	22.0%	21.2%
India	29.3%	21.9%	18.9%
Indonesia	20.7%	22.5%	20.4%
Iran, Islamic Rep.	13.8%	18.2%	18.6%
Ireland	25.3%	17.3%	12.8%
Israel	15.0%	14.3%	14.0%
Italy	11.7%	9.7%	9.2%
Jamaica	32.7%	36.3%	40.3%
Japan	15.9%	12.5%	12.0%
Jordan	17.0%	30.3%	24.6%
Kenya	32.4%	31.9%	32.9%
Korea, Rep.	25.9%	17.4%	16.4%
Kyrgyz Republic (92-)	..	36.7%	21.4%
Latvia (92-)	..	47.7%	34.0%

Lithuania (92-)	..	39.9%	35.2%
Macedonia, FYR (92)	..	45.5%	46.4%
Malaysia	19.7%	19.7%	20.6%
Malta	27.9%	20.6%	9.1%
Mexico	11.1%	11.8%	10.9%
Moldova (92-)	..	59.9%	56.6%
Morocco	9.7%	15.4%	15.3%
Mozambique	..	40.4%	23.1%
Nepal	23.5%	23.3%	16.7%
Netherlands	18.3%	13.8%	12.6%
New Zealand	19.8%	19.1%	16.9%
Nicaragua	18.0%	..	..
Nigeria	41.3%	40.2%	35.6%
Norway	25.3%	15.6%	14.3%
Pakistan	18.3%	15.3%	16.5%
Panama	16.8%	15.4%	18.3%
Paraguay	..	..	..
Peru	11.7%	12.1%	11.2%
Philippines	13.6%	13.1%	12.3%
Poland	56.1%	37.7%	32.5%
Portugal	16.2%	17.5%	16.0%
Romania	38.9%	44.7%	35.0%
Russian Federation (92-)	..	39.3%	42.1%
Saudi Arabia	11.5%	20.1%	..
Senegal	23.5%	17.2%	18.3%
Singapore	29.8%	23.2%	20.7%
Slovak Republic (92-)	..	35.5%	25.4%
Slovenia (92-)	..	30.4%	24.0%
South Africa	19.4%	23.1%	21.5%
Spain	16.3%	12.8%	12.8%
Sri Lanka	16.8%	17.4%	16.8%
Sweden	19.6%	15.6%	14.3%
Switzerland	..	13.0%	12.2%
Syrian Arab Republic	23.7%	23.9%	21.6%
Tanzania	55.1%	56.9%	54.9%
Thailand	21.9%	18.8%	19.9%
Trinidad and Tobago	31.4%	51.6%	52.1%
Tunisia	14.6%	..	16.2%
Turkey	16.3%	13.5%	12.7%
Ukraine (92-)	..	51.8%	72.7%
United Arab Emirates	12.0%	..	..
United Kingdom	22.4%	16.0%	13.7%
United States	20.8%	17.1%	15.7%
Uruguay	19.7%	19.1%	14.4%
Venezuela, RB	22.8%	24.4%	25.8%
Yemen, Rep. (90-)	..	28.7%	26.0%
Zambia	45.8%	46.6%	37.2%
Zimbabwe	31.3%	31.8%	23.6%
World	22.0%	20.8%	18.3%

Table 3: Green GDP, by country in selected years

Country	Green GDP (million of 1995 int'l $) 1980	1992	1997	Average annual change (%) 1980-97	1992-97
Algeria	90395	107988	112679	1.3%	0.9%
Angola	..	22685	15264	..	-7.6%
Argentina	282154	301425	372693	1.7%	4.3%
Armenia (92-)	..	3449	5768	..	10.8%
Australia	197901	275273	337420	3.2%	4.2%
Austria	113372	149794	163073	2.2%	1.7%
Azerbaijan (92-)	..	12401	6286	..	-12.7%
Bangladesh	66706	105284	132915	4.1%	4.8%
Belgium	148376	186035	199178	1.7%	1.4%
Benin	2368	..	..	..	..
Bolivia	11478	11870	14199	1.3%	3.6%
Brazil	728408	808991	966684	1.7%	3.6%
Bulgaria	15555	25234	21007	1.8%	-3.6%
Cameroon	12570	16182	16905	1.8%	0.9%
Canada	381811	505598	575985	2.4%	2.6%
Chile	43360	73018	110008	5.6%	8.5%
China	143387	982850	2341569	17.9%	19.0%
Colombia	151325	109791	223557	2.3%	15.3%
Congo, Rep.	..	2068	2115	..	0.5%
Costa Rica	..	13497	15788	..	3.2%
Cote d'Ivoire	14692	..	..	..	..
Croatia (92-)	..	16758	21919	..	5.5%
Cyprus	4532	9240	10959	5.3%	3.5%
Czech Republic (92-)	..	79675	98137	..	4.3%
Denmark	74353	90855	107266	2.2%	3.4%
Dominican Republic	13559	..	..	..	..
Ecuador	21079	26954	31568	2.4%	3.2%
Egypt, Arab Rep.	54945	113212	139616	5.6%	4.3%
El Salvador	16587	16998	19843	1.1%	3.1%
Ethiopia	..	18499	29106	..	9.5%
Finland	..	70702	84364	..	3.6%
France	771104	997454	1069720	1.9%	1.4%
Gabon	4478	5273	6301	2.0%	3.6%
Germany (91-)	..	1463103	1563274	..	1.3%
Ghana	17090	22844	27160	2.8%	3.5%
Greece	99894	116259	124114	1.3%	1.3%
Guatemala	23133	26796	32017	1.9%	3.6%
Haiti	11882	..	..	..	..
Honduras	7236	8447	8935	1.2%	1.1%
Hong Kong, China	45051	104357	137835	6.8%	5.7%
Hungary	65768	65593	74287	0.7%	2.5%
Iceland	3389	4480	5198	2.5%	3.0%
India	563086	1113067	1565007	6.2%	7.1%
Indonesia	168665	343389	485665	6.4%	7.2%
Iran, Islamic Rep.	163770	227542	256067	2.7%	2.4%
Ireland	24992	40757	63988	5.7%	9.4%
Israel	43552	68423	86428	4.1%	4.8%
Italy	817086	1016193	1068580	1.6%	1.0%
Jamaica	4872	5746	5239	0.4%	-1.8%
Japan	1600630	2477850	2679986	3.1%	1.6%
Jordan	5932	6970	11679	4.1%	10.9%
Kenya	11849	17223	19007	2.8%	2.0%
Korea, Rep.	138178	402542	559199	8.6%	6.8%
Kyrgyz Republic (92-)	..	8745	8286	..	-1.1%
Latvia (92-)	..	7590	9002	..	3.5%

Lithuania (92-)	..	14904	14789	..	-0.2%
Macedonia, FYR (92)	..	5449	4480	..	-3.8%
Malaysia	52326	104258	153190	6.5%	8.0%
Malta	1587	2752	7564	9.6%	22.4%
Mexico	459876	566161	631757	1.9%	2.2%
Moldova (92-)	..	5981	4004	..	-7.7%
Morocco	49514	66583	73412	2.3%	2.0%
Mozambique	..	4964	9165	..	13.0%
Nepal	9447	15740	21650	5.0%	6.6%
Netherlands	198423	260017	294817	2.4%	2.5%
New Zealand	39135	44924	55161	2.0%	4.2%
Nicaragua	7034	..	..	..	..
Nigeria	37297	50648	60682	2.9%	3.7%
Norway	54868	80532	98781	3.5%	4.2%
Pakistan	75075	160743	183752	5.4%	2.7%
Panama	7710	10181	11473	2.4%	2.4%
Paraguay	..	..	..	..	..
Peru	74120	69013	96261	1.5%	6.9%
Philippines	168759	192006	236583	2.0%	4.3%
Poland	98105	144456	191247	4.0%	5.8%
Portugal	79139	106968	119107	2.4%	2.2%
Romania	102967	71395	90094	-0.8%	4.8%
Russian Federation (92-)	..	856601	579915	..	-7.5%
Saudi Arabia	159182	162147	..	..	..
Senegal	5669	8119	9182	2.9%	2.5%
Singapore	15826	37609	60373	8.2%	9.9%
Slovak Republic (92-)	..	26950	37649	..	6.9%
Slovenia (92-)	..	15910	20856	..	5.6%
South Africa	236509	238751	276013	0.9%	2.9%
Spain	363365	498070	539444	2.4%	1.6%
Sri Lanka	21975	34329	44786	4.3%	5.5%
Sweden	118428	141697	153377	1.5%	1.6%
Switzerland	..	154379	157208	..	0.4%
Syrian Arab Republic	21280	28501	34235	2.8%	3.7%
Tanzania	3947	5186	6572	3.0%	4.9%
Thailand	93636	232214	294998	7.0%	4.9%
Trinidad and Tobago	6649	4003	4498	-2.3%	2.4%
Tunisia	22482	..	40499	3.5%	..
Turkey	156150	276936	346920	4.8%	4.6%
Ukraine (92-)	..	158944	44930	..	-22.3%
United Arab Emirates	39366	..	..	..	..
United Kingdom	665006	873777	1022408	2.6%	3.2%
United States	4119103	5445370	6534575	2.8%	3.7%
Uruguay	18680	19064	23505	1.4%	4.3%
Venezuela, RB	82396	97705	101646	1.2%	0.8%
Yemen, Rep. (90-)	..	6813	8525	..	4.6%
Zambia	3414	3489	4470	1.6%	5.1%
Zimbabwe	12493	17357	23400	3.8%	6.2%

Table 4: GDP, by country in selected years

Country	GDP (million of 1995 int'l $) 1980	1992	1997	Average annual change (%) 1980-97	1992-97
Algeria	104885	130958	137130	1.6%	0.9%
Angola	..	24922	17681	..	-6.6%
Argentina	326134	342046	419578	1.5%	4.2%
Armenia (92-)	..	6714	7652	..	2.6%
Australia	252666	335330	402954	2.8%	3.7%
Austria	134140	169347	182395	1.8%	1.5%
Azerbaijan (92-)	..	25324	15737	..	-9.1%
Bangladesh	77879	130859	162582	4.4%	4.4%
Belgium	183352	218181	231776	1.4%	1.2%
Benin	2942	..	..	..	..
Bolivia	13383	14138	17215	1.5%	4.0%
Brazil	857917	934044	1099282	1.5%	3.3%
Bulgaria	43879	45458	38638	-0.7%	-3.2%
Cameroon	15414	19214	20169	1.6%	1.0%
Canada	496221	621095	698111	2.0%	2.4%
Chile	52446	87181	128058	5.4%	8.0%
China	747860	2174560	3605809	9.7%	10.6%
Colombia	168916	132602	247529	2.3%	13.3%
Congo, Rep.	..	2695	2692	..	0.0%
Costa Rica	..	17364	20086	..	3.0%
Cote d'Ivoire	17608	..	..	..	..
Croatia (92-)	..	25901	29823	..	2.9%
Cyprus	5608	10852	12623	4.9%	3.1%
Czech Republic (92-)	..	118103	131189	..	2.1%
Denmark	90761	108647	125503	1.9%	2.9%
Dominican Republic	20474	..	..	..	..
Ecuador	26009	33631	38257	2.3%	2.6%
Egypt, Arab Rep.	79487	148693	181489	5.0%	4.1%
El Salvador	18336	18850	23834	1.6%	4.8%
Ethiopia	..	24835	35745	..	7.6%
Finland	..	88087	103313	..	3.2%
France	929272	1146673	1215101	1.6%	1.2%
Gabon	5508	6099	7259	1.6%	3.5%
Germany (91-)	..	1701793	1781394	..	0.9%
Ghana	19960	26019	30807	2.6%	3.4%
Greece	114522	133740	142530	1.3%	1.3%
Guatemala	26544	30192	36240	1.8%	3.7%
Haiti	12950	..	..	..	..
Honduras	9215	11810	14608	2.7%	4.3%
Hong Kong, China	57958	117052	147293	5.6%	4.7%
Hungary	99753	91545	99131	0.0%	1.6%
Iceland	4680	5746	6597	2.0%	2.8%
India	796832	1425843	1929288	5.3%	6.2%
Indonesia	212799	443201	610044	6.4%	6.6%
Iran, Islamic Rep.	189990	278292	314647	3.0%	2.5%
Ireland	33450	49269	73355	4.7%	8.3%
Israel	51257	79872	100467	4.0%	4.7%
Italy	924941	1124946	1176520	1.4%	0.9%
Jamaica	7241	9020	8777	1.1%	-0.5%
Japan	1904045	2833428	3044237	2.8%	1.4%
Jordan	7147	10006	15499	4.7%	9.1%
Kenya	17526	25295	28345	2.9%	2.3%
Korea, Rep.	186508	487371	668653	7.8%	6.5%
Kyrgyz Republic (92-)	..	13807	10544	..	-5.2%
Latvia (92-)	..	14500	13634	..	-1.2%

Lithuania (92-)	..	24807	22823	..	-1.7%
Macedonia, FYR (92)	..	9994	8362	..	-3.5%
Malaysia	65134	129906	192829	6.6%	8.2%
Malta	2201	3467	8321	8.1%	19.1%
Mexico	517504	642045	708917	1.9%	2.0%
Moldova (92-)	..	14898	9233	..	-9.1%
Morocco	54811	78689	86715	2.7%	2.0%
Mozambique	..	8332	11918	..	7.4%
Nepal	12350	20529	26001	4.5%	4.8%
Netherlands	242904	301619	337474	2.0%	2.3%
New Zealand	48800	55528	66398	1.8%	3.6%
Nicaragua	8578	..	..	..	..
Nigeria	63519	84627	94212	2.3%	2.2%
Norway	73413	95382	115234	2.7%	3.9%
Pakistan	91838	189874	219944	5.3%	3.0%
Panama	9267	12033	14039	2.5%	3.1%
Paraguay	..	..	..	..	..
Peru	83988	78494	108379	1.5%	6.7%
Philippines	195353	220887	269825	1.9%	4.1%
Poland	223239	231988	283305	1.4%	4.1%
Portugal	94477	129607	141877	2.4%	1.8%
Romania	168620	129018	138505	-1.2%	1.4%
Russian Federation (92-)	..	1411444	1000727	..	-6.6%
Saudi Arabia	179934	203054	..	..	..
Senegal	7409	9807	11245	2.5%	2.8%
Singapore	22547	49001	76142	7.4%	9.2%
Slovak Republic (92-)	..	41759	50496	..	3.9%
Slovenia (92-)	..	22848	27439	..	3.7%
South Africa	293302	310587	351733	1.1%	2.5%
Spain	434202	570873	618611	2.1%	1.6%
Sri Lanka	26414	41555	53801	4.3%	5.3%
Sweden	147212	167879	179030	1.2%	1.3%
Switzerland	..	177499	179089	..	0.2%
Syrian Arab Republic	27900	37461	43662	2.7%	3.1%
Tanzania	8791	12031	14579	3.0%	3.9%
Thailand	119905	285970	368104	6.8%	5.2%
Trinidad and Tobago	9695	8272	9394	-0.2%	2.6%
Tunisia	26338	..	48345	3.6%	..
Turkey	186630	320311	397589	4.5%	4.4%
Ukraine (92-)	..	329905	164466	..	-13.0%
United Arab Emirates	44732	..	..	..	..
United Kingdom	857207	1039605	1184159	1.9%	2.6%
United States	5200190	6565883	7752312	2.4%	3.4%
Uruguay	23266	23562	27472	1.0%	3.1%
Venezuela, RB	106670	129313	137066	1.5%	1.2%
Yemen, Rep. (90-)	..	9555	11519	..	3.8%
Zambia	6297	6538	7123	0.7%	1.7%
Zimbabwe	18185	25442	30640	3.1%	3.8%