

Green Accounting of China:

Comparison Analysis between 1992 and 1995

COMPTABILITE VERTE DE LA CHINE :

ANALYSE COMPARATIVE ENTRE 1992 ET 1995

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Abstract: On the basis of the general framework of United Nations' "indirect/satellite" accounting system—integrated system of environment & economy accounting SEEA (1992 /2000/2003) (UN,1992/2000/2003) and 93'SNA (UN,1993), the specific objectives of this paper is try to construct one simple, effective and practical integrated system of environment & economy accounting of China (CSEEA), and thereby trial estimate of the 1992/1995 Chinese environmental adjusted GDP (Green GDP) is given, under Chinese National Accounting System's reform practice.

Key words: SEEA, integrated system of environment & economy accounting of China, Green GDP, SNA

Résumé: Sur la base du cadre général du système de comptabilité « indirect/satellite » des Nations Unies-système intégré de comptabilité environnementale et économique SEEA (1992 /2000/2003) (UN,1992/2000/2003) et 93'SNA (UN,1993), l'objectif de l'article présent consiste à construire un système intégré de comptabilité environnementale et économique de Chine (CSEEA) simple, efficace et pratique. Ainsi, l'estimation du PIB vert de Chine 1992/1995 est donné, sous la réforme du Système de Comptabilité nationale de Chine.

Mots-Clés: SEEA, système intégré de comptabilité environnementale et économique de Chine, PIB, SNA

1. INTRODUCTION

The discussion of integrated accounting for environment and economy under the framework of sustainable development has received increased attention by the international society, since the report of the World Commission on Environmental and Development was published in 1987. This heightening interest led to the proposal contained in Agenda 21 of the United Nations Conference on Environmental and Development (Rio de Janiero Earth Summit 1992) to encourage the development of integrated system environmental and economy accounting. In China, such proposal was also contained in the following Chinese Agenda 21 which was put forward in 1993.

In 1993, United Nation revised its traditional 68'SNA and developed one general framework of integrated system environmental and economy

accounting (SEEA) as a part of this revision. Till now, various components of the SEEA have been tested in case studies in the world. The work not only accumulated many good experience of construction of the concrete national SEEA but also demonstrate further that SEEA is an efficient system which can provide a valuable information base for integrated development and planning policy. According to that, revised versions of 1993'SEEA were put forwarded by UN in 2000 (UN, 2000) and 2003 (UN, 2003), respectively.

Under this situation, it's doubtless an urgent and important task to develop a simple, effective and practical integrated system of environment & economy accounting of China (CSEEA), which is consistent with the Chinese SNA framework and capable of assessing the burden of economic activities on the natural resources and environment in China today.

On the basis of the United Nation's General Framework of Integrated System Environ- mental and Economy Accounting (1992/2000/2003)

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(UN,1992/2000/2003) and 93'SNA (UN,1993) and Chinese National Accounting System's reform (1992/2002) practice (CNSB,1992/2002), the specific objectives of this study is try to construct one simple, effective and practical integrated system of environment & economy accounting of China (CSEEA), and thereby estimate the 1992/1995 Chinese environmental adjusted GDP (Green GDP). This study is further research on the basis of our one former works on Green input-output accounting for natural resources-economy-environment (Lei, 1997/1999/2000/ 2003).

All study is based on the marginal opportunity cost theory (Pearce, D.W. and A. Markandya, 1989) for natural resources pricing and Chinese National Accounting System's reform (CNSB,1992/2002).

2. CHINESE INTEGRATED SYSTEM OF ENVIRONMENT-ECONOMY ACCOUNTING (CSEEA)

In our CSEEA matrix, there are 27 rows which be divided into 7 parts (Opening Stocks (1 row), Use of Economy Natural Assets (8 rows), Supplies & Value Add (8 rows), Use of Non-Economy Natural Assets (5 rows), Green Value Add (1 row), Other Adjustments (3 rows) and Closing Stocks (1 row)) and 28 columns which be divided into 6 parts (Domestic Production (3 columns), Final Consumption (3 columns), Foreign Trade (3 columns), Economy Assets (14 columns), Non-Economy Assets (4 columns) and Total (1 column)).

2.1 Rows of CSEEA

2.1.1 Part I & Part VII

(01) Opening Stocks/ (27) Closing Stocks

-stock of tangible assets at the beginning/end of period that consist of man-made assets i.e. inventory stock, fixed assets, and natural assets i.e. cultivated assets, and non-produced tangible assets such as land, timber tracts, etc..

2.1.2 Part II

(02) Use of Economy Natural Assets

-consumption of natural assets that can yield economic profit when the reserves have been proven;

(03) Use of Produced Natural Assets

-monetary valuation of quantitative changes (depletion) and qualitative changes (degradation) of natural assets which can be re-produced by human being i.e. cultivated assets which are artificially produced biological assets.. They are one part of the

cost called imputed environmental costs, are subtracted from net domestic product to reach EDP. This is broken down into two items, i.e., (04), depletion of these natural assets caused by over-exploitation/over-used etc. i.e. forest, grass etc., and (05), degradation of these natural assets caused by residuals, i.e. forest, grass etc.;

(05) Degradation

-monetary valuation of recovering of cultivated assets;

(06) Use of Non-Produced Natural Assets

-monetary valuation of quantitative changes (depletion) and qualitative changes (degradation) of natural assets which cannot be re-produced by human being i.e. subsoil mineral assets. They are also one part of the cost of imputed environmental costs, are subtracted from net domestic product to reach EDP. This is also broken down into two items, i.e., (07), depletion of these natural assets caused by over-exploitation/over-used etc. i.e. subsoil resources, cultivated land, and (08), degradation of these natural assets caused by residuals i.e. cultivated land;

(07) Depletion

-monetary valuation of extraction of subsoil resources;

(09) Restoration of Non-Produced Assets

-costs for cultivation/exploitation of recovering these natural assets.

2.1.3 Part III

(10) Supplies

-gross products of goods and services;

(11) Use of Products

-goods and services that are produced and delivered to intermediate consumption for production activities, final consumption, formation of produced assets and exports;

(12) Use of Economy-Produced Man-made Assets

-consumption/Depreciation of man-made produced tangible fixed assets (13);

(14) Value Add/Net GDP

2.1.4 Part VI

(18) Use of Non-Economy Natural Assets

-consumption of the other else natural assets which beyond the economy assets;

(19) Use of Non-Produced Natural Assets

-monetary valuation of quantitative changes (depletion) and qualitative changes (degradation) of these natural assets i.e. air, water, etc.. They are also one part of imputed environmental costs, and, are subtracted from net domestic product to reach EDP. This is broken down into two items, i.e., (20), depletion of these

natural assets, and (21), degradation of these natural assets caused by residuals.

(21) Degradation of natural assets caused by residuals

-monetary valuation of environmental pollution, such as air and water pollution caused by residuals from economic activities.

(22) Restoration of non-produced assets

-costs for elimination of residuals from environmental media such as air, water, etc. and for restoration of ecosystems

2.1.5 Part V

(23) Environmentally Adjusted Net Domestic Product

-net value added after subtracting the imputed environmental costs, which are not evaluated in the market, from net domestic product (NDP). NDP is the value added after subtracting the consumption of fixed assets, i.e., the depreciation of accumulated assets, from gross domestic product (GDP). The imputed environmental costs are monetary evaluation of depletion and degradation of all natural assets (both economy natural assets and non-economy natural assets), hence are to be subtracted from NDP in order to reach net welfare which takes into account the burden on the environment of economic activities.

2.1.6 Part VI

(24) Others Adjustment

-adjustment due to price change and volume change of both economy assets (main);

(25) Revaluation

- revaluation of economy man-made and natural assets. This revaluation is due to changes in price;

(26) Volume Changes

-changes in amount due to such factors as war, natural disaster, new discovery, i.e. discovery of natural assets, changes in land use, natural growth of cultivated assets and so on.

2.2 Columns of CSEEA

2.2.1 Part I

[01] Domestic Production

-costs of production activities that consist of intermediate inputs, consumption of fixed capital, indirect taxes and subsidies, compensation of employees and operating surplus. This is broken down into [02], environment-related, and [03], others, and environment-related production activities include activities delivering environment protection-related goods and services to other establishments, households and so on, such as production of environmental protection equipment, sewerage, disposal of wastes,

environment assessment services, etc. and activities that are executed inside individual establishments;

2.2.2 Part II

[04] Final Consumption

-the final consumption is divided into two parts,

[05] government and [06] households;

2.2.3 Part III

[07] Foreign Trade

-goods and services in foreign trade which is also broken down into [08], environment-related, and [09], others, and environment-related goods and services such as production of environmental protection equipment, sewerage, disposal of wastes, environment assessment services, etc. ;

2.2.4 Part IV

[10] Economy Assets

-this is broken into [11], produced assets and [17], non-produced assets;

[11] Produced Assets

-this is broken into [12], man-made assets, such as inventory, structures, machinery and equipment, and [13], natural assets/[14] cultivated assets, which are artificially produced biological assets, that be further divided into [15] cultivated forest and [16] cultivated grass;

[17] Non-produced natural assets

-this consists of land use, [18]/cultivated land [19], subsoil resources [20] which is divided into coal [21], oil [22], natural gas [23].

2.2.5 Part V

[24] Non-Economy Asset

-this only consists of non-produced natural assets [25] which is further divided into air [26], water [27].

2.2.6 Part VI

[28] Total

3. DATA

Due to data limitation, only the following aspects are focused in construction:

1st. Natural assets: there eight kinds of natural assets i.e. forest, grass, cultivated land, coal, oil, natural gas, air and water be considered;

2nd. Depletion of resources: the costs of extraction of the most important sub-soil resources,

such as coal, oil, and nature gas be considered;

3rd. Degradation of natural assets caused by residuals: qualitative deterioration of natural assets, such as environmental pollution caused by economic activities will be evaluated in monetary terms. The imputed environmental costs for the following items be considered by source and type of natural assets: Air pollution (SO₂, Dusty) and Water Pollution: Sewage (BOD, COD).

4th. Destruction of ecosystem: ecosystem function loses of several kinds of resources will be considered by type of natural resource (i.e. forest, grass, cultivated land).

The data used in this study come from Chinese Statistics Year-Book (CNSB, 1993-1997), Chinese Input-output Table (CNSB, 1996/2000), Chinese Environmental Statistics Year-Book (CNSB, 1993-1997), the relevant materials (papers, reports and government documents etc.) on Chinese natural resources and environmental and the relevant research reports on natural resources pricing and accounting etc.

4. ESTIMATION METHODOLOGIES

The external cost (exhaustion/damages) brought by economy activities is composed of two main parts. One is depletion of resources caused by the over-exploitation of nature resources, which mainly refers to the temporary or eternal exhaustion of physical resource in amount, or in the other words, is a disappearance of some kinds of physical resources temporarily or eternally. The other is degradation of natural assets caused by residuals and destruction of ecosystems caused by the pollutant emission produced in the process of economy activities, which mainly refers to the quality decreasing of environmental resources (worsened in quality), means the service-quality of environmental falls down.

Environmental deterioration associated with economic activities were evaluated in monetary terms and regarded as the cost of economic activities. Environment-related external diseconomies were measured in monetary terms. The methodologies to arrive at imputed environmental costs are based on the theory of marginal opportunity cost and the method of maintain cost.

4.1 Framework of Marginal Opportunity Cost (MOC)

According to marginal opportunity cost (MOC) theory (Pearce, D.W. and A. Markandya, 1989), marginal opportunity cost refers to the costs not only the production cost but full costs formed in the process of human activities. It's a useful tool to measure of the

results of resource exhaustion and pollution emission from the perspective of economics, or, in the other words, it's an efficiency evaluation method to evaluate human economy activities in the point of society view.

MOC is equal to the total traditional production costs in the process of a certain human economy activities plus the social costs originating from its side effects.

The first is marginal production cost (MPC), which refers to labor, capital and the others traditional production material input.

The second is marginal environmental or external cost (MEC), which refers to the loss in environmental ecology (degradation of natural assets caused by residuals and destruction of ecosystems) caused by economy activities. For instance, forest degeneration, results from wood over-cut, can lead to soil erosion and deposition of rivers and reservoirs, which will further have adverse effects on agricultural output, power generation and water quality.

The third is marginal user cost (MUC), which has something to do with our consideration for the future. The exploitation of non-renewable resources with limited reserves means their exhaustion in the future--depletion of resources. In other words, the utilization of per unit of resource at present implies the decrease of one unit of resource in the future. Therefore, a cost for scarcity should be complemented in MOC. The scarcity cost depends on the scale of exploitation, on the proportion of demand for resource in the future to current demand, on the possible substitutions in the future, its cost, and discount rate.

Regarding renewable resources, it is not necessary to add scarcity cost to MOC, apart from MPC and MEC, for the consumption of renewable resources can be made up by natural and artificial regeneration. However, in many countries, many resources were utilized in a way of non-sustainability, some even might cause the depletion of resources. In this case, the renewable resources should be treated as nonrenewable resources while measuring their value.

4.2 Method of Maintain Cost

The method of maintenance cost in principle will compute the imputed environmental costs, which enables the measurement of qualitative and quantitative changes in the environment by estimating the required cost of maintaining the quality and quantity of the environment at a certain level. It will be necessary to assume a specific activity to keep the quality and quantity of the environment at a certain level for each of the natural assets considered.

4.3 Methodologies

4.3.1 Degradation of natural assets caused by residuals

Estimated as cost of reducing one unit of discharge of each substance (air pollution, and water pollution) at the source and then multiply this by the volume of this discharge to get at the estimated value of the degradation of natural assets caused by residuals. This method is used in estimation of use of non-produced natural assets of non-economy natural assets.

For air pollution (SO_x, NO_x) and water pollution (BOD, COD), the cost is the cost of reducing a unit discharge of each substance multiplied by the volume of discharge

4.3.2 Destruction of ecosystem

The costs of the destruction of ecosystem due to land development will be set equal to the value added that will be lost if the development is terminated. The costs of the destruction of ecosystem in cultivated forests are estimated by the MEC of live wood. It's same to the destruction of ecosystem in grass. The costs to cultivated forest and grass destruction due to man and nature caused (forest fires and logging damages) will be set to the value of production lost corresponding to the damaged cultivated forests. This method is used in estimation of use of produced natural assets of economy natural assets.

4.3.2 Depletion of Natural Resources

It's mainly refers to the use of non-produced natural assets of economy natural assets. For the produced natural assets of economy natural assets such as forest, costs due to excess felling of felling will be set equal to the value of production corresponding to excess felling, i.e. felling in excess of its natural growth. This cost is estimated by the user cost:

$$UC=Y-R, Y/R=1-\{1/(1+r)^{n+1}\}$$

where, UC is user cost, Y is real income, R is royalty fee (=revenue-cost), r is discount rate, n is period of natural resources using (exploitation). (S. El Serafy, 1989)

Consumption of non-renewable resources may eventually require a substitute to be found for them at some future date. For example, consuming a ton of coal now means that there will be one ton less available at some future date. The lost benefits due to future use forgone are known as the user cost, or depletion premium. Optimal exploitation of appreciation in the value of the asset is less than the rate of interest.

For extraction of sub-soil resources, the cost is the difference between the actual revenue from exploitation and the constant eternal revenue.

4.4 Environmentally Adjusted Net Domestic Product (EDP)

Environmentally adjusted net domestic product (EDP) is the value added obtained by subtracting the imputed environmental costs (use of economy assets and use of non-economy assets) from Net Domestic Products (NDP). NDP is the value added obtained by subtracting consumption of fixed capital from gross domestic product (GDP). Consumption of fixed capital is the required cost of restoring the stock of fixed capital used in production activities to its opening level and therefore it is excluded in obtaining the net value added generated by economic activities. The imputed environmental costs are the costs of depletion, degradation and destruction of the natural assets due to economic activities and should be excluded in computing the environmentally adjusted net domestic product.

5. SUMMARY OF TRIAL ESTIMATE

On the basis of our calculation of selected items that comprise imputed environmental costs, we arrive at the following estimates.

5.1 Imputed Environmental Costs

Total imputed environmental costs (IEC) per GDP decrease from 1992's 4.9% to 1995's 3.8%, see, table 1. One main reason is growth rate of the imputed environmental costs is slower than that of GDP. The growth rate of imputed environmental costs is about 10.5% from 1992 to 1995 (average annual growth rate is about 3.19%), but the growth rate of GDP is about 28.16% from 1992 to 1995 (average annual growth rate is about 11%). Another reason is both pollution emission per product and natural resources used per product decrease. Cleaning techniques be used and energy efficiencies be promoted.

The structure of imputed environmental costs is obviously changed from 1992 to 1995 too. Proportion of the use of non-economy natural assets the total imputed environmental costs decrease from 1992's 48% to 1995's 45%. Proportion of the use of economy natural assets in the total imputed environmental costs increase from 1992's 52% to 1995's 55%, see, table 1.

Depletion of natural resources becomes worsen than pollution. Proportion of the use of natural resources in the total imputed environmental costs increase from 1992's 25.77% to 1995's 46.67%, in which proportion of water in the use of non-economy natural assets decrease from 1992's 64.84% to 1995's 63.15%. Main reason is the defensive expenditure on water increase faster than that on air.

Defensive expenditure on water increase from

1992's 35% to 1995's 46%, but defensive expenditure on air decrease from 1992's 64% to 1995's 54%, see

table 5.

Table 1

IEC	GDP	NDP	IEC/GDP	IEC/NDP
219.9382849 (RMB ¥ billion)	5944.8076568 (RMB ¥ billion)	5185.232839 (RMB ¥ billion)	3.699670327%	4.24162794%
IEC	GDP	NDP	IEC/GDP	IEC/NDP
129.7018721 (RMB ¥ billion)	2664.42833 (RMB ¥ billion)	2310.69071 (RMB ¥ billion)	4.87%	5.61%
1.0533%	10.7329%			

Table 2

IEC	UENA			NEUA		
		UPNA	UNPNA		water	air
219.93828	120.22778	86.241987	23.6319	99.7105007	62.97105	36.739455
	54.66432%	71.73216%	19.65594%	45.3356726%	63.1539%	36.84613%
IEC	UENA			NEUA		
126.79487		UPNA	UNPNA		water	air
	68.076528	53.136848	9.677007	61.62534388	39.956744	21.6689
	52.49%	81.54%	14.85%	47.51%	64.84%	35.16%

(where UENA is the use of economy natural assets, UPNA is the use of produced natural assets, UNPNA is the use of non-produced natural assets, NEUA is the use of non-economy natural assets)

5.2 Depletion of Natural Resources

Proportion of the depletion of forest resources in the total depletion of natural resources is decreased from 1992's 64% to 1995's 56%. Proportion of the depletion of subsoil resources in the total depletion of natural

resources is increased from 1992's 36% to 1995's 45%, in which proportion of coal and natural gas in the depletion of subsoil resources decrease and that of oil increase. The reason is transfers from non-economy natural assets to economy natural assets of oil decrease from 1992's 73% to 1995's 64%, transfers from non-economy natural assets to economy natural assets of gas increase from 1992's 10% to 1995's 13%, see table 3.

Table 3

DNR	DSR	Forest		
		Coal	Oil	Natural Gas
46.669391	20.732328	1.96E-177	20.72821	0.0041172
	44.4238%	9.5E-177%	99.9801%	0.01986%
DNR	DSR	Forest		
25.767563		Coal	Oil	Natural Gas
	9.2140503	0.02787133	9.169813	0.0163653
	35.76%	0.3%	99.52%	0.18%

(where DNR is the depletion of natural resources, DSR is the depletion of subsoil resources)

5.3 Degradation of Natural Assets Caused by Residuals

Proportion of water in the degradation of natural assets caused by residuals decrease from 1992's 67.6% to 1995's 65.14%, on the other hand, proportion of air in the degradation of natural assets caused by residuals

increase from 1992's 32% to 1995's 35%.

Main reason is also the defensive expenditure on water increase faster than that on air. Defensive

expenditure on water increase from 1992's 35% to 1995's 46%, but defensive expenditure on air decrease from 1992's 64% to 1995's 54%, see table 4.

Table 4

DNA	DES				DNACR		
		Forest	Grass	CL		Air	Water
152.831	63.204493	59.096411	1.208514	2.899569	89.62647198	31.24731	58.379163
	41.35582%	93.50033%	1.91207%	4.5876%	58.64418%	34.8639%	65.13607%
DNA	DES				DNACR		
		Forest	Grass	CL		Air	Water
91.711608	37.046291	36.564466	0.018869	0.462957	54.66531708	17.7167	36.948837
	40.39%	98.7%	0.05%	1.25%	59.61%	32.4%	67.6%

(where DNA, DES, DNACR are degradation of natural assets, degradation of natural assets caused by destruction of ecosystem, degradation of natural assets caused by residuals, respectively. CL is cultivated land)

5.4 Defensive Expenditures

Defensive expenditure on water increase faster than that

on air. Defensive expenditure on water increase from 1992's 35% to 1995's 46%, but defensive expenditure on air decrease from 1992's 64% to 1995's 54%, see table 5.

Table 5

DE	EA			Non-EA		
		Land	SR		Water	Air
20.437929	10.3539	1.40769	8.94621	10.08402872	4.591882	5.4921463
	50.66022%	13.59575%	86.4043%	49.3397783%	45.5362%	54.46381%
DE	EA			Non-EA		
		Land	SR		Water	Air
12.222699	5.262673	0.855673	4.407	6.9600268	3.00797	3.9521192
	43.06%	16.26%	83.74%	56.94%	35.16%	64.84%

(where DE, EA, Non-EA are total defensive expenditure, economy assets, non-economy assets, respectively. SR is

5.5 EDP and Green GDP

In 1992, there is about 4.9% parts in Chinese GDP of 1992 is gained at cost of sacrificing living environments (natural resource and environments), which belongs to

"virtual value". In 1995, there is about 3.8% parts in Chinese GDP of 1995 is gained at cost of sacrificing living environments (natural resource and environments), which belongs to "virtual value", see fig.1 and fig. 2.

Fig. 1 FDP (unit : RMB¥ Billion)

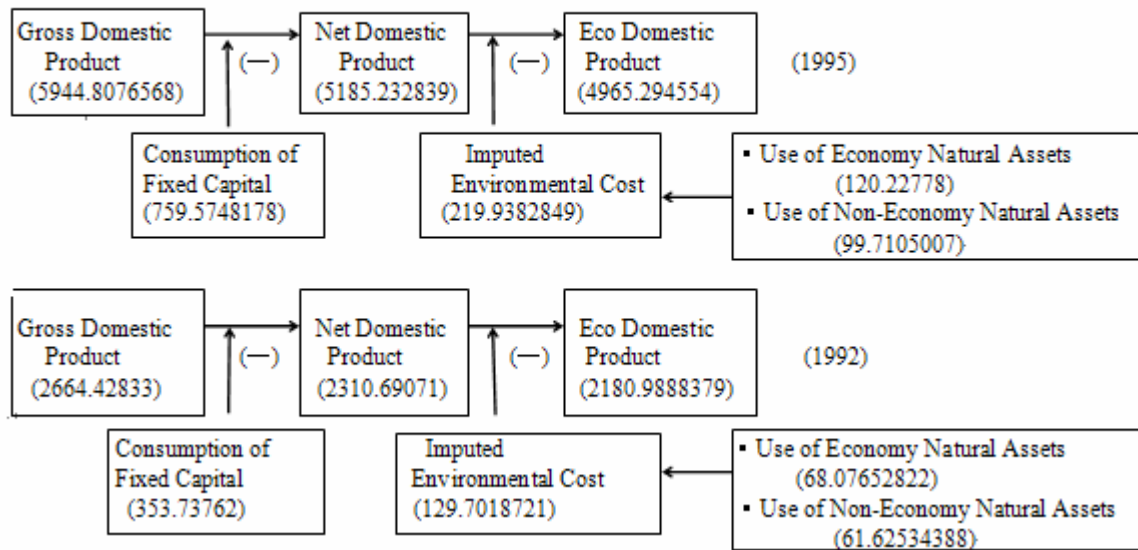
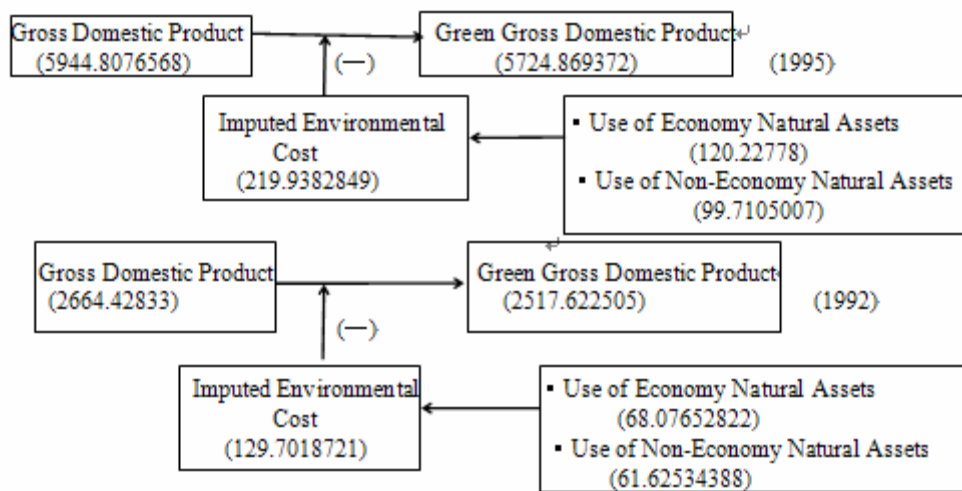


Fig. 2 GGDP (unit : RMB¥ Billion)



5.6 Transfers from Non-economy Natural Assets to Economy Natural Assets

Transfers from non-economy natural assets to economy

natural assets of oil decrease from 1992's 73% to 1995's 64%, transfers from non-economy natural assets to economy natural assets of gas increase from 1992's 10% to 1995's 13%, see table 6.

Table 6

TA	Coal	Oil	Natural
1575.199665	357.3377375 (22.6852345%)	1013.426265 (64.3363687%)	204.4356628 (12.9783968%)
TA	Coal	Oil	Natural
3901.27764	3212.8448 (82.35%)	284.56 (7.3%)	403.87284 (10.35%)

(where TA is total amount)

6. REMARKS

As well-known, since the 1980's, China began to try to transfer her national accounting system from MPS to SNA in order to be suitable to her market-oriented economy reform process began from 1978. Till 1992, one new national accounting system was put forward and was to be spread in all over the country. However, this new national accounting system is still belongs to the traditional SNA (1968) pattern, the natural resources and environmental factor was not considered specially in it. In light of United Nation's 1993'SNA, one new

revised version of Chinese 1992'SNA was put forwarded in 2002. Meanwhile, works on the study on Chinese integrated system of environmental and economy accounting were started.

In this paper, one simple, effective and practical integrated system of environment & economy accounting of China (CSEEA) was set up based on the general framework of United Nations' SEEA (1992/2000/2003) and 93'SNA. We expect that and the further works can make a contribution to China today's national accounting system reform and the works on Chinese integrated system of environmental and economy accounting.

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