

Introduction to Environmental Accounting

SEEE-2012-12 Training

February 2014

Workshop exercise:

Net Present Value (NPV) of environmental assets

Net Domestic Product (NDP) adjusted for depletion of environmental assets





The economy of Mineland is heavily dependent on mining activity. The national accounts of Mineland record Net Domestic Product (NDP)—this aggregate shows the value of production of goods and services *after* deducting an allowance called consumption of fixed capital. Consumption of fixed capital measures the using up of produced capital (machinery, equipment etc.) during an accounting period.

The national accounts do not deduct an allowance for the using up of environmental assets (mineral resources, forests etc.). Some data users are therefore saying the national accounts do not present a sustainable measure of national production.

You have been asked to estimate the value of mineral resources for Mineland.

You will also produce an estimate of NDP—adjusted for the depletion of environmental assets (mineral resources) for Mineland.

The estimation is achieved by completing the

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in Part 1, Part 2 and Part 3 below.

We are presented with the following information:

Data inputs



Mine life = 5 years (expected)

Sales of mineral resources during the year = \$58 million

Intermediate consumption of mining operations during the year = \$30 million

Gross value added from mining during the year = \$28 million

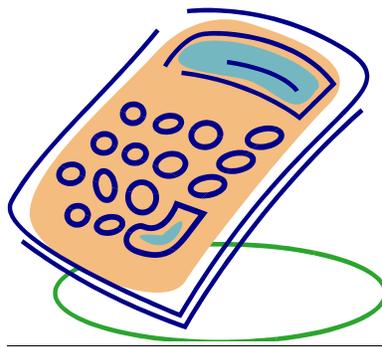
Value of produced capital (machinery & equipment) EOY used in mining = \$50 million

Return on produced capital used in mining = 8% (i.e. excluding return to cover consumption of fixed capital)

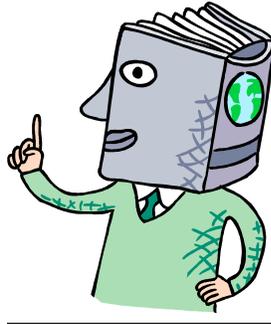
Consumption of fixed capital (produced capital) mining = \$4 million

Gross value added related to produced capital = \$8 million

Return on natural resources used in mining = 5%



Accounting rules



Gross value added = Output (sales etc.) – intermediate expense

Gross operating surplus = Gross value added – compensation of employees

Net value added = gross value add – consumption of fixed capital

Net Domestic Product = Gross Domestic Product – consumption of fixed capital

Environmentally-adjusted Net Domestic Product (NDP_{ea}) equal NDP less depletion natural resources

Gross value added T_{total} = Value added related to produced capital + Value added related to natural resources (i.e. Resource Rent)

Resource Rent (Gross value added related to natural resources) = ‘income’ return on natural resources + ‘depletion’ of natural resources

Depletion of natural resources = fall in value of natural resource caused by its use in production

$$d_t = V_{t-1} - V_t = RR_t - rV_t$$

where: d = depletion, V = net present value, RR = resource rent, r = discount rate

therefore: $RR_t = d_t + rV_t$

i.e. resource rent is made up of a depletion component (d_t) and an income component (rV_t).

Part 1 – deriving inputs to the NPV model



Please complete the Shaded cells

Output (sales) of mineral resources during the year	\$58 million
Intermediate consumption of mining operations during the year	\$22 million
Compensation of employees	\$8 million
A. Gross operating surplus from mining during the year	
Value of produced capital (machinery & equipment) EOY used in mining	\$50 million
Return on produced capital used in mining (excluding a return to replace fixed capital)	8%
Net operating surplus (mining) related to produced capital	\$4 million
Consumption of fixed capital (produced capital) mining	\$4 million
B. Gross operating surplus (mining) related to produced capital	
C. Resource Rent from mining activity during the year = A. - B.	
Return on natural resources used in mining (excl. return to replace fixed capital)	5%
D. NPV of natural resource (mineral resource) PART 2 BELOW	
E. Income component of Resource Rent = D * 5%	
F. Depletion component of Resource Rent = C. - E.	

Part 2 - Using the Net Present Value (NPV) model

Please complete the Shaded cells

	Year 1	Year 2	Year 3	Year 4	Year 5	
Expected Resource Rent	20	20	20	20	20	
Discount rate 5%	r^1	r^2	r^3	r^4	r^5	
Discount	1.05^1	1.05^2	1.05^3	1.05^4	1.05^5	
$RR / (1 + r)^n$ = depletion \$mill	19.05	18.14				
Sum of expected resource rents (discounted) = NPV of mineral resource \$million						

Questions:

What is the value of the mineral resource at the end of the first year of mining activity?

What is the value of depletion in the first year of mining activity?

Resource rent is expected to be \$20 million in each year until the mine is empty. But what do you notice about the income and depletion proportions of resource rent as we approach the end of the mine life?

Note: The estimated value of the asset at the start of its life equals the sum of expected annual depletion amounts over the life of the mine.

Part 3 - Environmentally-adjusted NDP and industry value added

Please complete the

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National Accounts of Mineland	Year 1	\$ million
<i>For the whole economy</i>		
Gross Domestic Product (GDP)		\$117 million
Consumption of fixed capital		\$19 million
Net Domestic Product (NDP)		\$98 million
Less depletion of mineral resources		
Net Domestic Product - environmentally-adjusted (NDPea)		

	Year 1	\$ million
<i>For the mining industry</i>		
Industry Gross Value Added (mining)		\$28 million
Consumption of fixed capital (mining)		\$4 million
Industry Net Value Added (mining)		\$24 million
Less depletion of mineral resources		
Net Domestic Product - environmentally-adjusted (NDPea)		

Part 1 – deriving inputs to the NPV model SOLUTIONS



Output (sales) of mineral resources during the year	\$58 million
Intermediate consumption of mining operations during the year	\$22 million
Compensation of employees	\$8 million
A. Gross operating surplus from mining during the year	\$28 million
Value of produced capital (machinery & equipment) EOY used in mining	\$50 million
Return on produced capital used in mining (excluding a return to replace fixed capital)	8%
Net operating surplus (mining) related to produced capital	\$4 million
Consumption of fixed capital (produced capital) mining	\$4 million
B. Gross operating surplus (mining) related to produced capital	\$8 million
C. Resource Rent from mining activity during the year = A. - B.	\$20 million
Return on natural resources used in mining (excl. return to replace fixed capital)	5%
D. NPV of natural resource (mineral resource) PART 2 BELOW	\$86.6 million
E. Income component of Resource Rent = D * 5%	\$4.3 million
F. Depletion component of Resource Rent = C. - E.	\$15.7 million

Part 2 - Applying the Net Present Value (NPV) model SOLUTIONS

	Year 1	Year 2	Year 3	Year 4	Year 5	
Expected Resource Rent	20	20	20	20	20	
Discount rate 5%	r^1	r^2	r^3	r^4	r^5	
Discount	1.05^1	1.05^2	1.05^3	1.05^4	1.05^5	
$RR / (1 + r)^n$ = depletion	19.0	18.1	17.3	16.5	15.7	
Sum of expected resource rents (discounted) = NPV of mineral resource						\$86.6 mill

Questions and answers:

What is the value of the mineral resource at the end of year 1?

= opening value – value of depletion in first year
= \$86.6 million - \$15.7 million = \$70.9 million

What is the value of depletion in the first year of mining activity?

= \$15.7 million (it appears as 'Year 5' in the NPV calculations because it is the depletion component of the expected resource rent 5 years before the resource is exhausted)

Resource rent is expected to be \$20 million in each year until the mine is empty. But what do you notice about the income and depletion proportions of resource rent as we approach the end of the mine life?

As the resource approaches the end of its life, the 'income' proportion of the expected resource rent declines and the depletion proportion increases. This is a function of our NPV method of estimating resource value and related depletion.

Note: The estimated value of the asset at the start of its life equals the sum of expected depletion amounts over the life of the mine.

Part 3 - Environmentally-adjusted NDP and industry value added SOLUTIONS

National Accounts of Mineland

<i>For the whole economy</i>	
Gross Domestic Product (GDP)	\$117 million
Consumption of fixed capital	\$19 million
Net Domestic Product (NDP)	\$98 million
Less depletion of mineral resources	\$15.7 million
Net Domestic Product - environmentally-adjusted (NDPea)	\$82.3 million

<i>For the mining industry</i>	
Industry Gross Value Added (mining)	\$28 million
Consumption of fixed capital (mining)	\$4 million
Industry Net Value Added (mining)	\$24 million
Less depletion of mineral resources	\$15.7 million
Net Domestic Product - environmentally-adjusted (NDPea)	\$8.3 million

