Ecological Economics

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Course notes

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Contents

"As economists we only see a part of the picture"

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1 Warming up

1.1 Constanza et al (2015) Time to leave GDP behind

by Costanza, R., I.Kubiszewski, E. Giovanini, H. Lovins, J. McGlade, K.E. Pickett, K.V. Ragnarsdóttir, D. Roberts, R. de Vogli & R. Wilkinson (2014), Nature (link)

GDP measures "everything except that which makes life worthwhile"

Robert F. Kennedy

GDP is a good measure for tne flow of everything that has a market price - mot as an indicator of well-being or environment. **Alternative measures** should take into account

- Happiness
- Prosperity
- Environment
- Development

1.2 Rodrik, D. (2015) Economics Rules: The Rights and Wrongs of the Dismal Science

An economist should have as many different models as possible in her toolbox
→ choose the better model(s) for the specific research question.
Our models are partial, thus, our conclusions are partial.

1.3 The four laws of thermodynamis

1st Law of thermodynamis: Energy can neither be created nor destroyed, but can change formms and flow from one place to another.

2nd Law of thermodynamis: The irreversibility of natural processes, and, in many cases, the tendency of natural processes to lead towards spatial homogeneity of matter and energy.

Important works on environmental economics

- Pigout (1920): Taxing externalities.
- Coase (NPE 1991): Contracting between parties.
- Elinor Ostrom (NPE 2012): Some communities use other mechanisms than the market for allocations etc. - and it's better than the market!
- Richard H. Thaler (NPE 2017): Behavioral economics (interests of firms).
- William Nordhaus (NPE 2018): For integrating climate change into long-run macroeconomic analysis.

1.4 Environmental Economics vs. Ecological Economics

> "We cannot solve our problems with the same thinking we used when we created them"
>
> *Albert Einstein*

Ecological Economics

- Sustainability of the world as a whole.
- Looking at the world as a whole, i.e. no such thing as externalities.

Environmental Economics

- Sustainability: Of the economy.
- Negative externalities: To the economy (the core).
  - Uncompensated (adverse) impact of one person's action on the wellbeing of a bystander.
  - Causes markets to be inefficient, and thus to maximize total surplus, e.g. pollution.
  - Coase theorem: if private parties can bargain without cost over the allocation of resources, they can solve the problem of externalities on their own.
  - Government action: Regulations (permits) or taxations (market correcting solution).

The Climate:
Average weather conditions that can be observed locally regionally or globally. Changes with or without human impact.

Global warming:

- This is what is important!
- Designates the increase of average temperature
- **Global public good:**
  Standard solutions to tragedy of the commons:
  - Price market-based policy: Carbon tax: Arthur Pigou (1920) *The Economics of Welfare*
  - Quantity market-based policy: Cap-and-trade system: Ronald Coase (1920) *The problem of social cost*
  - Alternative methods: Polycentric approach (consensus): Elinor Ostrom (2012) *GLobal Environmental Commons* (NP, 2009).

  Options to manage the "global common"
  - Free rider problem: Westphalian nature of the current system of nations
  - Problem of responsibiilty

History of international climate negotiations
1987: Montreal: Agreement about the Freon gas - the only succesfull negotiation.

2 The economy as an open system

Using Input-Output analysis to answer the questions.

2.1 Growth, technology and the environment

Environmental Kuznets Curve

- Classical Kuznets Curve: Inequality will rise with GDP growth - but will fall again.
- Evidence about the existence of an is not conclusive (papers for and against).
  - For: Looking at Freon and other CFCs, HCHCs and HFCs (Montreal, 1987).
  - Against: Most work on GHGs.
  - Increased international trade.
  - Delocalization of CO_2: Moving industries → can increase emission intensity, but not true for all sectors!

What has been the role of:

- Technology?
- Population growth?
- Level of consumption per capita?
- Composition or structure of the consumption?
- Changes in trade structure?

Insert graph of main determinants of change in global GHG in CO2-equivalents, s. 139! What about non-GHG? Insert: Drivers of emission growth for Spain 1995-2000, s. 143!

Innovation - examples:

- Energy (fuel) efficiency:
  - Reduction of related emissions
  - Rebound effect: Direct and indirect (sectors providing inputs to the sector)
  - Jevons Paradox: Fuel is more effective → cheaper → more car-driving
- Electric car:
  - Reduction of local emissions
  - Benefits for population health
  - Provision of additional electric demand: coal vs. renewal? (a mix)
- 3D printing
  - Reduction of scrap or production waste.
  - Reduction of emissions from transport.
  - But: Do we end up with more consumption and end-of-life waste?

You cannot think about the economy and the environment in linear terms!

2.2 Inequality, consumption & environment

Demand-graph

Does a more equal distribution increase pollution?

- China: Middle-class increase consumption and pollution
- India: Religion plays a big role, e.g. vegetarian
- Engel Curve: The consumption changes from neccesities towards luxuries with income.

Policy maker: It is important to design

- Climate policies does not increate economic inequalities
- Inequality reduction policies that do not increase GHG emissions.

Households' role is partially hidden in environmental statistics

- Statistics based on territorial or production based-approach.
- Only *direct* household emissions are considered (e.g. driving, cooking, painting).

insert two graphs from Serrano (2008) *Economic activity and atmospheric pollution in Spain: An Input–Output Approach*

Disaggregating the consumption vector

- Expenditure versus income?
  - How does savings/investments pollute?
- Different size or compusition of households?
  - Per-capita expenditure and emissions
  - Equivalent expenditure and emissions
  - Grouping households according to their size
  - Multivariate regressions
- Across countries
  - E.g. consumption's share of health and education is not recorded if provided for free.
- Bridge matrices?
  - Different classifications, different criteria (micro data on households cannot be aggregated to the whole population)

Difference between households

- Income
- Expenditure
- Settlement, i.e. municipality size
  - 2050: 2/3 of global population is expected to live in cities
- Development related to growth etc.?

Spain 2000: The richer pollute more in absolute terms, but less in relative termns. insert graphs, s.169, 173, 180

2.3 Fragmentation, trade & encvironment

Emissions from **Transport**

- International transport only grew a little
- Within-country transport exploded!

'Value added' measure can account for global value chains (intermediate goods).
Conclusion

- It seems like global trade has little effect on emissions
  - But you need to account for all of the product chain!

3 Price input-output model

3.1 Discussion

Main features of Input-Output analysis:

- 'From craddle to grave'
- Each row can use a different measure (we don't need to translate everything into Euroes).
- Technology (A) is constant within each year.

→ Framework can be used to place the 'responsibility' of all pollution through the production-chain on the final demand.

Assuming perfect competition (and information):

- Tariff on the producer should carry through to the market prices.

→ The reaction of demand should be equal to that of a final goods tariff.

In a 2nd best World:

→ A tax on the producer is not necessarily passed on to the consumer.

→ Lobbies have a lot of power.

→ The consumer doesn't know what's behind the price → would (probably) act more on a tax if reported as a part of the price? (plane tickets?).

→ With barcodes the production and thus pollution of a product can be traced.

3.2 Single Region IO Model: Autarky

Total output:

$$x = (I - A)^{-1} y$$

Where the element x_i for sector i is given by:

$$x_i = \frac{\delta x_i}{\delta ..} \cdots$$

See slide 14 in updated 5_EE
i.e. the output from sector i due to final demand of it's product (including intermediate products from the sector itself) plus the output from sector i due to the demand of intermediate products from sector i to each of the other sectors $j \neq i$.

3.3 Single Region IO Model: Open Economy

Domestic Technology Assumption (DTA):
Assumes imported goods are produced with the technology observed for the relevant domestic sector

- Strong assumption! Some sectors doesn't even exist domestically.
- For single region analysis in OECD-countries it can be preferred though, e.g.
  - Hundreds of different sectors in single-region database;
  - $\sim$ 30 sectors in a global database.

4 International Databases for the economy and the environment

4.1 Structure

Supply and Use Tables:

- The real World
- Covers all kind of producs and industries both produced and used by each industry and for each product.
- Is aggregated to IO-tables.

4 different ways to create IO-tables:

1. Industry by industry
   → E.g. impact on employment
2. Product by product
   → E.g. environmental tariffs
3. Fixed: Techonology.
   → E.g. Economic structure.
4. Fixed: Selling structure (proportion of sales to each sector is not going to change).
   → E.g. If amount of sellings is fixed by trade agreements.

5 Combining Micro and Macro

5.1 Disaggregating the consumption vector

Disaggregating household consumption column in final demand

- Income (different groups)
  - Household composition: Number, age, culture
  - Engel Curve: Food consumption decrease in income, luxury goods (services, medicine, airconditioning) increase in income.
- Gender: Needs to look at non-couples only.
- By municipality / settlement size

Emissions of consumption

- Direct household emissions:
  - Fuel, gas, hot water.
- Indirect household emissions:
  - Consumption of services and goods.

5.2 The price IO model

- A 'long run' or 'supply' price model
- All producers fully pass their costs on to the buyers
  → The consumers pays the cost
- Welfare analysis (of consumption basket)
  - Consumption patterns are fixed (no substitution).
  - Revenues from tax do not contribute to welfare.
  → We calculate the maximum welfare loss.
- The dual approach to consumption base accounting

Read the columns instead of the rows (needs to be in monetary terms).

- The value of the outputs = value of intermediate inputs + input of factors of productions (VA).

$$p_j x_j = p_1 z_{1j} + p_1 z_{1j} + \cdots + p_n z_{nj} + w l_j$$
$$p' = p' A + v'$$
$$p' = v'(I - A)^{-1} = vL$$

5.3 Examples

1. What does a CO2 tax cost consumers?

Monetary cost of CO2

- Low
- Medium
- High

Four scenarios:

I. Kyoto protocol targets

II. I + China same % as USA = 13.3 bT (93% of 1990)

III. I + China same amount as USA = 1.8 bT (130% of 1990)

IV. All non-annex B countries but China same % as the USA (93% of 1990)

Simulated maximum increase in price (%):

	Low tax	High tax
I.	0.08	0.30
II.	0.18	0.69
III.	0.13	0.50
IV.	0.37	1.40

2. Tax rates by type of GHG
Simulation of a policy proposal.

Taking existing national taxes into account:

- If $T_{EU} > T_N$: Analyze tax increase.
- If $T_{EU} \leq T_N$: No tax increase.

3. Unilateral Carbon Border Tax (CBTA)

E.g. EU tax

→ Loss of competitiveness → Outsourcing (emission leakage)

- CBTA on emissions embodied in imports.
  -

5.4 Possible extensions

Elasticities of substitution

- Can be added inside the A matrix (technical coefficients)
- Econometric models (used a lot by the EU)
  - JRC: Different units combining IOT with complex models.
    e.g. the FIDELIO
    * IO w. elasticities
    * Econometrics
    * CGE (macro)

Social Accounting Matrix (SAM)

- Flows of income
  - Taxes
  - Transfers
  - Investments
- Financial SAM - flows from banks
  - Savings
  - Investments
  - Transfers