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Modelling Environmental Tax Reform
in Germany and the United Kingdom
with E3ME and GINFORS

by

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1. Introduction: The PetrE Project

PetrE: Productivity and environmental tax reform in Europe

- ◆ **Central question: What are the effects of ETR on resource productivity and what does this mean for the environment and the economy?**
- ◆ **ETR: Environmental Tax Reform in a broader sense: Any policy that makes use of price instruments to combine meeting environmental and welfare targets.**

1. Introduction: The PetrE Project

◆ **Work package 3 of petrE:**

- ⇒ “Modeling the Single-country, European and Global Environmental Effects of Different ETR Regimes.”
- ⇒ Instruments: Two multicountry economic-environmental models
 - E3ME → Cambridge Econometrics (CE)
 - GINFORS → Gesellschaft für Wirtschaftliche Strukturforschung (GWS)

◆ **Purpose of this paper:**

- introduce the models and show their general ability to give answers to the questions
- discuss similarities and differences of the model structure in relation to the question

2. The Literature on ETR

- ◆ **Extensive theoretical discussion in the 1990s, reviews: De Mooij (2000), Kratena (2002), Ekins and Barker (2001).**
- ⇒ possibility of a double dividend:
 - taxation of the use of the environment or permit selling improves the environment
 - recycling of the tax or auctioning revenue improves the performance of the economy
- ⇒ but:
 - environmental taxation also includes negative effects on the economy
 - result depends on the specific ETR regime and on the relative strength of many counteracting effects

2. The Literature on ETR

◆ Results of model simulation studies

- ⇒ Gaskins and Weyant (1993), results of a model comparison for the USA with 20% reduction of CO₂-emissions in 2010:
 - with reduction of taxes on capital formation: negative effects on GDP significantly smaller than lump-sum recycling
- ⇒ Goulder (1995), Carbon tax of \$ 25/tC in the USA: costs for GDP are about 50% less, if tax revenue is recycled via reductions of marginal income tax rates rather than lump sum
- ⇒ Meyer and Lutz (2002), for G7 countries: recycling revenue via social security contributions increase employment in most countries, but with different intensity

2. The Literature on ETR

- ⇒ Bach et al. (2002), evaluation of the ETR in Germany:
 - increased employment (+250 000)
 - reduction in CO2 emissions (- 2 to -2.5%)
 - negligible effects on GDP

- ⇒ Repetto and Austin (1997), meta analysis for the USA:
 - effects on GDP between -3% and +2.5%
 - 1.2% depend on the recycling assumptions

- ⇒ Barker et al. (2006), meta analysis:
ETR brings about 1 to 2 percentage points in global gross product, if revenues are used to reduce distorting taxes

4. Comparison of E3ME and GINFORS

◆ **Common properties of E3ME and GINFORS**

- ⇒ General modeling philosophy: beyond mainstream neoclassical general equilibrium modeling
 - Behavior of the agents: bounded rationality
 - Markets: non perfect competition
 - Emphasizing institutions
- evolutionary concept

- ⇒ parameter estimation by econometric methods
- ⇒ multicountry model, focusing on countries rather than regions
- ⇒ multisector model, deep disaggregation into about 40 sectors
- ⇒ linking the countries by trade at the sector level

4. Comparison of E3ME and GINFORS

◆ **Data:**

- ⇒ Both models are based more or less on international data, only in some cases the use of national statistics was not avoidable.
- ⇒ Eurostat, OECD and IEA are the preferred data sources, IMF data has been used, if OECD data was not available.

4. Comparison of E3ME and GINFORS

◆ Differences between E3ME and GINFORS

⇒ Country coverage

- E3ME: Model of Europe, 25 EU countries plus Switzerland and Norway
- GINFORS: global model, 50 countries plus OPEC and rest of the world (trade)

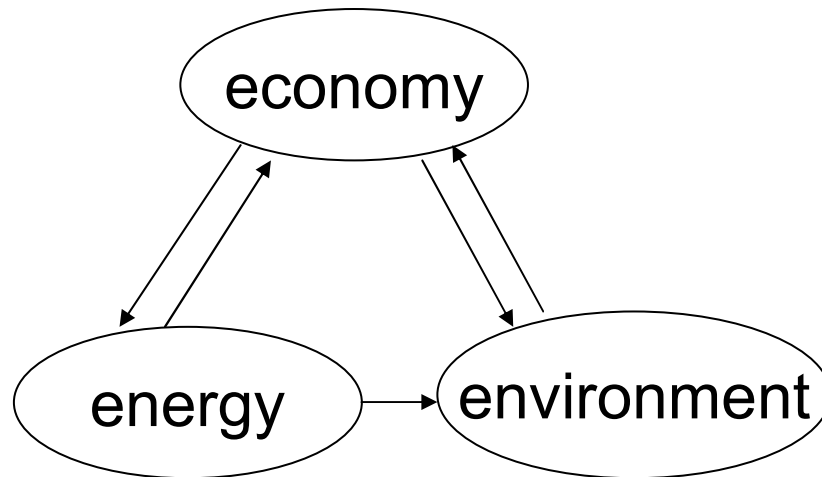
global coverage of 50 countries plus OPEC:
GDP: 95%, CO2-emissions: 94%

⇒ Architecture of a country model

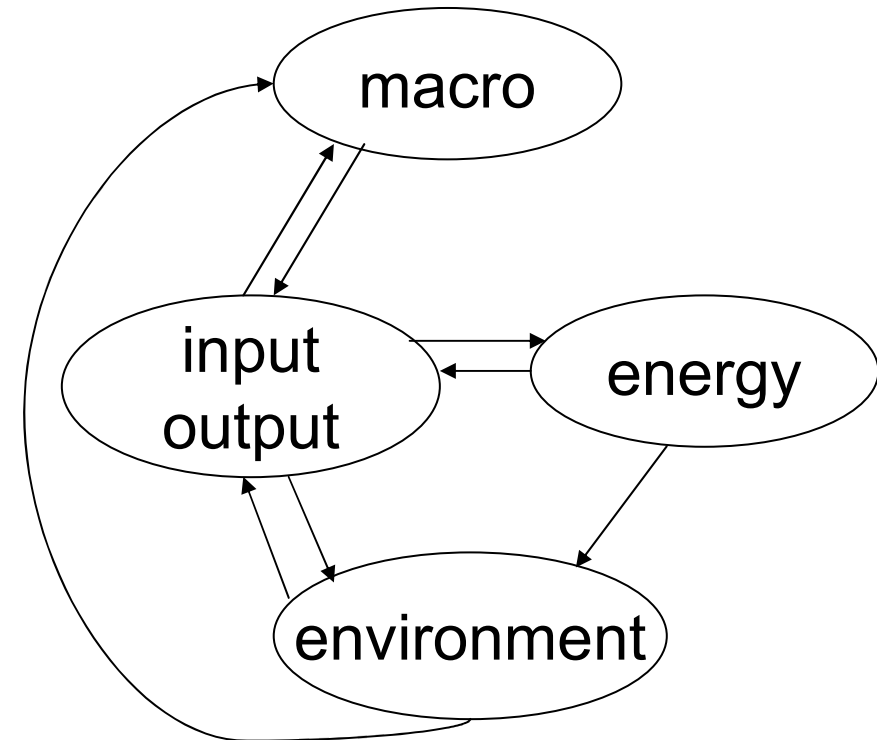
- E3ME: energy, environment, economy
- GINFORS: macro, input-output, energy, environment
input-output model only for 21 countries (coverage at these countries in terms of GDP: 80%)

4. Comparison of E3ME and GINFORS

E3ME



GINFORS



4. Comparison of E3ME and GINFORS

⇒ Trade model:

E3ME: The export and import equations of a country describe the relation of this country to a trade pool for the commodity. The model distinguishes a European and global pool.

GINFORS: Bilateral trade model on the sector level that links all 50 countries and the two regions directly.

All 70 403 trade shares of the exporting countries in the imports of the importing countries are price dependent.

Calculates by definition: export and import prices.

4. Comparison of E3ME and GINFORS

⇒ Technical Progress:

▪ E3ME:

- Explicit calculation of technical progress indicators
- Calculation of a quality adjusted measure of investment using R&D-data.
- Two technical progress indicators for ICT investment in the “new economy” and for all other investment.
- Indicators are explaining variables in the trade and employment functions.

▪ GINFORS:

- Technical progress is modeled implicitly
- Two stage approach:

4. Comparison of E3ME and GINFORS

First stage: Capital, labor, energy, materials: limitational factors.
Price dependency of input coefficients is interpreted as the result of cost push driven technical progress.

Second stage: Substitution of the different energy carriers.

⇒ Structure of consumption

- E3ME: price dependency for all products
- GINFORS: two stage approach:
 - aggregates for energy demand and non energy demand price elastic
 - constant structures inside the two groups

4. Comparison of E3ME and GINFORS

⇒ Parameterization

- E3ME: specific functional form of equation is based on the econometric techniques of cointegration and error correction
- GINFORS: econometric estimation of parameters by OLS. More adequate estimators could not be used by two reasons:
 - In many countries time series are too short
 - The 70304 price elasticities of the trade shares have to be estimated automatically by a simple and robust technique.

5. Conclusions

- ◆ **The models share the most important properties which guarantees that a comparison of simulation results makes sense.**
- ◆ **The differences in the structures of the models reflect a trade off based on data availability: the advantage of global coverage has to be payed with stronger data restrictions per country**

5. Conclusions

- ◆ **The models are ideal complements for the project.**
 - ⇒ E3ME has a more flexible structure for European countries.
 - ⇒ GINFORS gives the full global picture.
 - ⇒ The comparison of the simulation results will in general improve our knowledge on ETR and especially of further developments of the ETS-system.
 - ⇒ The impact of policy scenarios will be discussed
 - Country specific
 - United Kingdom, Germany, United States, China, India,...
 - at the European level
 - at the global level