(4201-420)

Advanced Policy Analysis Modelling

Introduction to Policy Analysis and Policy Modelling
- Part II -

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Lecture notes and further information:
http://www.uni-hohenheim.de/apo

STEPS IN EMPIRICAL RESEARCH

⇨ In order to design a research project, you may wish to ask yourself the following series of questions:

1. PROBLEM STATEMENT, PURPOSES, BENEFITS
- What exactly do I want to find out?
- What is a researchable problem?
- What are the obstacles in terms of knowledge, data availability, time, or resources?
- Do the benefits outweigh the costs?

2. THEORY, ASSUMPTIONS, BACKGROUND LITERATURE
- What does the relevant literature in the field indicate about this problem?
- To which theory or conceptual framework can I link it?
- What are the criticisms of this approach, or how does it constrain the research process?
- What do I know for certain about this area?
- What is the history of this problem that others need to know?

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3. VARIABLES AND HYPOTHESES

– What will I take as given in the environment?

– Which are the independent and which are the dependent variables?

– Are there control variables?

– Is the hypothesis specific enough to be researchable yet still meaningful?

– How certain am I of the relationship(s) between variables?

4. OPERATIONAL DEFINITIONS AND MEASUREMENT

– What is the level of aggregation?

– What is the unit of measurement?

– How will the research variables be measured?

– What degree of error in the findings is tolerable?

– Will other people agree with my choice of measurement operations?

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5. RESEARCH DESIGN AND METHODOLOGY

– What is my overall strategy for doing this research?

– Will this design permit me to answer the research question?

– What other possible causes of the relationship between the variables will be controlled for by this design?

– What are the threats to internal and external validity?

6. SAMPLING

– How will I choose my sample of persons or events?

– Am I interested in representativeness?

– If so, of whom or what, and with what degree of accuracy or level of confidence?

7. INSTRUMENTATION

- How will I get the data I need to test my hypothesis?
- What tools or devices will I use to make or record observations?
- Are valid and reliable instruments available, or must I construct my own?

8. DATA COLLECTION AND ETHICAL CONSIDERATIONS

- Are there multiple groups, time periods, instruments, or situations that will need to be coordinated as steps in the data collection process?
- Will interviewers, observers, or analysts need to be trained?
- What level of inter-rater reliability will I accept?
- Do multiple translations pose a potential problem?
- Can the data be collected and subjects' rights still preserved?

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9. DATA ANALYSIS

- What combinations of analytical and statistical process will be applied to the data?
- Which will allow me to accept or reject my hypotheses?
- Do the finding show numerical differences, and are those differences important?

10. CONCLUSIONS, INTERPRETATIONS, RECOMMENDATIONS

- Was my initial hypothesis supported?
- What if my findings are negative?
- What are the implications of my findings for the theory base, for the background assumptions, or relevant literature?
- What recommendations can I make for public policies or programs in this area?
- What suggestions can I make for further research on this topic?

SECONDARY DATA ANALYSIS

- The term "secondary data" refers to data that were collected for other studies.
  - For the first researcher they are primary data, but for the second researcher, they are secondary data.
- There are enormous amounts of data that are collected every day by government agencies, universities, private organizations, non-profits, think tanks, public opinion polls, and students.
- In order to use secondary data for your research, you need to
  1) locate the data;
  2) evaluate the data; and
  3) verify the data.

1. LOCATE THE DATA

- Secondary data can be located by using printed indices, data bases, previous studies etc.

SECONDARY DATA ANALYSIS

2. EVALUATE THE DATA

Evaluating secondary data is similar to doing a critique of a published research report. Everything about the original project that produced the data should be scrutinized to ensure that the project had high validity and reliability, such as:

- theoretical or conceptual model used
- variables and hypotheses posited
- operational definitions of variables and measures employed
- the population, sample frame, sampling design, and sample obtained
- the data collection strategy and response rate obtained
- quality control measures employed
- data coding, data entry, and data analysis procedures
- factors which could have affected the study, such as current events

3. VERIFY THE DATA

If the data seem valid and reliable, you need to make sure that you have an accurate copy of the data, especially if you obtained it through an electronic medium.

This includes verifying that you:

- have proper documentation
- have the correct number of observations or cases
- have the correct number of variables
- have the correct coding scheme
- can reproduce the original summary statistics

WHY USE SECONDARY DATA?

- It can be less expensive than gathering the data all over again.
- It may allow the researcher to cover a wider geographic or temporal range.
- It can allow for larger scale studies on a small budget.
- It does not exhaust people's good will by re-collecting readily available data.

BUT: WHAT WERE THE CONDITIONS THAT LED TO THEIR PRODUCTION?

- Data may have been originally gathered to persuade, justify, or otherwise convey a particular point of view.
- Data may have been intended for consumption by particular groups, which differ from the present project
- Data may have decayed over time, been censored or purged

SECONDARY DATA ANALYSIS

POTENTIAL DRAWBACKS WITH SECONDARY DATA

- Secondary data are only as good as the research that produced them
- Must assume what the author(s) meant by the terms they used
- There may be sub-culture references, jargon, or idiomatic expressions
- Data may be neither valid nor reliable
- Instruments or data collection methods may have changed over time
- Data may have been modified by the researcher already (e.g., weighted)
- Poor documentation of the secondary data set
- Electronic format incompatibilities
- Limited access to the data, e.g., on-site only
- Confidentiality considerations that lessen its usefulness
- Substantial purchase or loan cost

THE USE OF MODELS in POLICY ANALYSIS

Before start using a model for policy analysis, ask yourself:

- *What kind of research do you want to carry out?*
- Where do research ideas come from? It may be curiosity; experience; need for deciding or acting; job; school; building on or contesting existing theory; available funding; etc.
- **Begin with stating the *research question*, the *purpose of the research*, the *resources needed*, and *a plan for the research*.**
- **Write a *preliminary research proposal* (in one or two pages) that:**
  a. states the research question,
  b. states the purpose of the research,
  c. sketches the initial model,
  d. discusses (explains) the initial model,
  e. identifies pertinent background literature (bibliography).

THE USE OF MODELS in POLICY ANALYSIS

- *A model* shows how different elements are linked by relationships
- *A model is a simplified representation of a system* (of the real world).
  - ⇨ The economic reality is complicated
  - ⇨ it can only be mirrored by being simplified and abstracted
  - ⇨ we apply theoretical economical models to simplify and give a theoretical image of the economic reality.
- ⇨ Economic models are by definition simplified representations used to understand a complex economic reality.
- ⇨ We construct models in order to explain and understand.
- Why do we want to explain reality?
  a) pure curiosity
  b) to know what could happen if something changes
  c) to learn, how we can influence the system to come near an optimal solution

VARIABLES and HYPOTHESES

- The elements of the model are *variables*.
- Variables are measurable characteristics or properties of people or things that can take on different values.
- In contrast, characteristics that do not vary are *constants*.
- A *hypothesis* states a presumed relationship between two variables in a way that can be tested with empirical data.
- A hypothesis may take the form of a cause-effect statement, or an "if x,...then y" statement.
- The *cause = the independent variable*; and
- the *effect = the dependent variable*.
- But: what is the cause and what is the effect? Example...

VARIABLES and HYPOTHESES

Relationships between variables can be of several forms

- *direct or positive relationship:* values of both variables increase together or decrease together (i.e., if one increases in value, so does the other; if one decreases in value, so does the other).

- *inverse or negative relationship*: the values of the variables change in opposite directions (i.e., if the independent variable increases in value, the dependent variable decreases; if the independent variable decreases in value, the dependent variable increases).

- *non-linear relationship*: there is no easy way to describe how the values of the dependent variable are affected by changes in the values of the independent variable.

- If there is *no identifiable relationship* between two variables: they are said to be unrelated, or to have a null relationship (i.e., changes in the values of the variables are due to random events, not the influence of one upon the other).

VARIABLES and HYPOTHESES

- To establish a causal relationship between two variables, you must establish that four conditions exist:
  1) time order: the cause must exist before the effect;
  2) co-variation: a change in the cause produces a change in the effect;
  3) rationale: there must be a reasonable explanation of why they are related;
  4) non-spuriousness: no other (rival) cause for the effect can be found.

- To establish that your causal (independent) variable is the sole cause of the observed effect in the dependent variable, you must introduce *rival or control variables.*

- If the introduction of the control variable does not change the original relationship between the cause and effect variables, then the claim of non-spuriousness is strengthened.

VARIABLES and HYPOTHESES

Example for control variables:

- Consider the placement rates for three training programs. The independent variable is the type of training, and the dependent variable is the placement rate.

- Vocational education has a placement rate of 30%; on-the-job training has a rate of 40%; and work-skill training has a rate of 35%.
  - ⇨ It would appear that on-the-job training is the best program, followed by work-skill training, with vocational education last.

- However, when education is introduced as a control variable, it can be seen that the effect of the independent variable (type of training) on the dependent variable (placement rate) is quite different for people with different levels of education.

Level of Education	Vocational Ed	On-the-job training	Work-Skill Training
Less than high school	30%	20%	50%
High School	60%	45%	15%
More than high school	20%	60%	10%
Overall rate	30%	40%	35%

ENDOGENOUS and EXOGENOUS VARIABLES

Endogenous variable:

= A factor in a causal model or causal system whose *value is determined* by the states of other variables in the system.

- A purely endogenous variable is a factor that is entirely determined by the states of other variables *in* the system.

- A partially endogenous variable is a factor that is partially but not wholly determined by the values of other variables in the model.

Exogenous variable:

= A factor in a causal model or causal system whose *value is independent* from the states of other variables in the system;

- a factor whose value is determined by factors or variables *outside* the causal system under study.

MODELLING TECHNIQUES AND APPROACHES

- *What is an Agricultural Policy Model* (commonly also termed as Agricultural Sector Model)?

⇨ It's "developed specifically to investigate the connection between identified governmental instruments of economic management and the behaviour of part or all of the farming industry, its suppliers or consumers" and "… it includes both analyses of past policy and effort to forecast future policy effects" (Thomson & Rayner, 1984, p.162).

- There is a rich variety of concepts and approaches that are used in constructing policy models and quite a few authors devised different schema for classifying them.

Usual criteria used to classify policy analysis models include:

- the modelling technique (econometric, simulation or programming);
- the structural attributes of a model (static or dynamic);
- treatment of economic equilibrium (partial or general);
- aggregation of results (regional, national or multinational levels).

MODELLING TECHNIQUES AND APPROACHES

The Impact of Time: Static and Dynamic Models

- The temporal causality structure concerns the linkages between variables.

- *Static:* A model is called static if all variables of a behavioural equation allude to the same point in time or the same time period. These models thus imply an infinite adjustment rate between the variables.

- *Dynamic:* If the variables of a behavioural equation refer to differing points in time.

- In other words: if the connections between model parameters all refer to one point in time t, then the model is static.
  If a parameter of the period t depends on another parameter of the point in time t-1, the model is regarded as being dynamic.

MODELLING TECHNIQUES AND APPROACHES

Partial and General Equilibrium Analysis

- The fundamental assumption in equilibrium models is that a balance between consumption and production in an economy is achieved by consumers (providers of factor inputs) and producers (providers of goods and services) by respectively maximising utility and profit.

- These models combine theoretical and analytical constructs with formalised algebraic structures to use "realistic economic data to solve numerically the level of supply, demand and price that support equilibrium across a specified set of markets" (Wing, 2004).

- With advances in computing technologies and economic theory, the construction and use of equilibrium models has gained popularity.

MODELLING TECHNIQUES AND APPROACHES

Partial and General Equilibrium Analysis

- The complete model of *general* equilibrium emphasizes the interrelationship between different sectors of the economic system, which together make up the market economy.
  - The nature of these relationships is specified in a set of demand and supply functions for all factor and commodity markets.

- The *partial* equilibrium method of analysis, clearly disregards all interrelationships between different sectors of the economy (*ceteris paribus*), concentrating instead on the interrelationships between the decision-makers in just one particular sector.

MODELLING TECHNIQUES AND APPROACHES

Partial and General Equilibrium Analysis

- For agriculture, the WTO negotiations have encouraged the use of CGE Models for trade policy analyses.

- The equilibrium models used for agricultural policy analysis tend to be *partial*.

- They all depend on econometrics and require historical and empirical data for estimation of relationships.

- They are characterised by a set of behavioural equations, supply and demand equilibrium relationships, aggregate identities, components for trade and such elements are replicated for agricultural commodities, regions and the country, all linked to assumed world price equilibrium conditions to close the model

MODELLING TECHNIQUES AND APPROACHES

Modelling - which approach to use?

- In methodological terms, there is hardly a single type of model (econometric, mathematical programming or simulation) that serves the purposes of policy analysis on its own, most modelling exercises are *modelling systems* and an increasing *synergy* of these techniques is taking place.

- There is no right or wrong approach to constructing and operationalising models and it all depends on the purposes for which a modelling system is created.

- Quite commonly now *econometric* techniques provide input-data for *programming* models and either of these two approaches, in combination or alone, are used for *simulation* of various scenarios to generate results that inform the policy making process.

- In general, econometric approaches are used for estimation of economic relationships from usually macro level empirical data and programming approaches are more common for modelling of decision-making at the micro level.
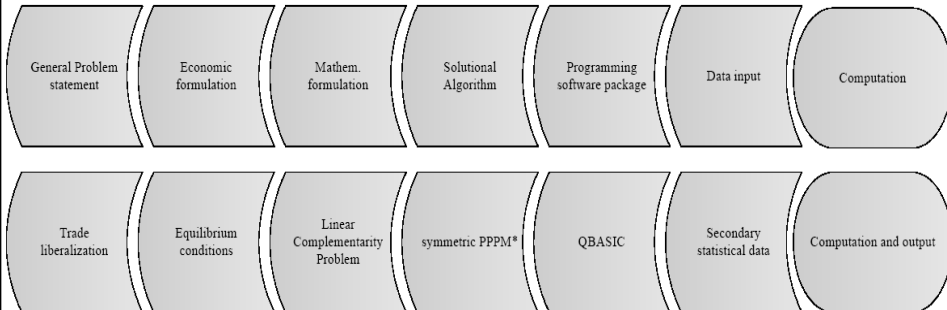
BASIC AND APPLIED APPROACH TO MODEL FORMULATION

- Delineation of the process from a basic problem statement in general to a final computation of the model chosen:

Example:

General Problem statement	Economic formulation	Mathem. formulation	Solutional Algorithm	Programming software package	Data input	Computation
Trade liberalization	Equilibrium conditions	Linear Complementarity Problem	symmetric PPPM*	QBASIC	Secondary statistical data	Computation and output

Source: Bergen (2006); * PPPM stands for Parametric Principal Pivoting Method.

- 1st tube: basic approach to policy formulation
- 2nd tube: applied to the issue of international trade

BASIC AND APPLIED APPROACH TO MODEL FORMULATION

- The line of division between theoretical and applied models can be described as a continuum from "theory" to "theory with numbers" to "numbers with theory" (Francois & Reinert, 1997).

- This, inter alia, involves a detailed policy orientation and a model structure determined by the data, rather than a selective use of data to fit a theoretical structure.

- Repeated processes can be shown within a *general flow path of the model formulation*.

General flow path of model formulation

Example:
Proceeding of an applied equilibrium analysis
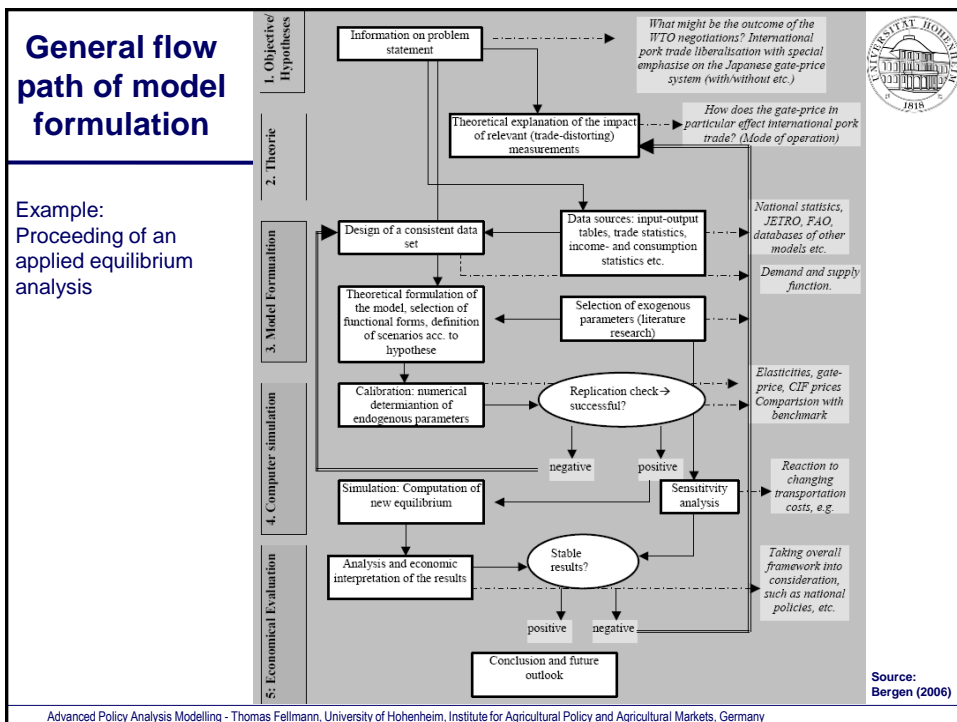
MODELLING TECHNIQUES AND APPROACHES

MODELLING TECHNIQUE - Econometrics

- Econometrics is the field of economics where economic theory and statistical methods combine to express economic relationships in algebraic equation forms for estimation from empirical (usually time series) data for hypothesis testing.

- At its simplest, an econometric model can be a linear equation with one dependent variable and an independent (explanatory) variable, derived by using regression analysis.

- Once estimated, econometric models generate predictions and test hypotheses.

MODELLING TECHNIQUES AND APPROACHES

Econometric Models in Agricultural Policy Analysis

- Largely used in order to measure the impact of specific agricultural policy instruments on farmers' production decisions.
- Mostly focused on some specific tools or commodities.
- Missing: explicit attempts of accounting for a comprehensive set of policies, affecting different commodities, in the same econometric model.
- Further limitation: in most of these models output and input prices are not the result of the simulation, i.e. the impact of policy changes on equilibrium prices has to be postulated exogenously.
- But: parameter/elasticity estimates emerging from econometric models are often used as input for other simulation models, whose size and structure does not allow direct estimation of relevant parameters (as in the case of many partial and general equilibrium models).

MODELLING TECHNIQUES AND APPROACHES

Mathematical Programming Models

- belong to the general class of optimisation models
- A mathematical program is an optimization problem of the form:

  Maximize f(x): x in X, g(x) <= 0, h(x) = 0,

  where X is a subset of R^n and is in the domain of the functions, f, g and h, which map into real spaces. The relations, x in X, g(x) <= 0 and h(x) = 0 are called *constraints*, and f is called the *objective function*.

- Mathematical programming models include linear programming, quadratic programming, and dynamic programming
- In recent years, MP for agricultural policy analysis has evolved considerably, losing the features of a pure farm management instrument.
- Presently, it is an important instrument of policy analysis at the regional, national as well as EU level, with the objective of analysing the impact of ag. policies on supply and on the socio-economic and environmental systems linked to the farming sector.
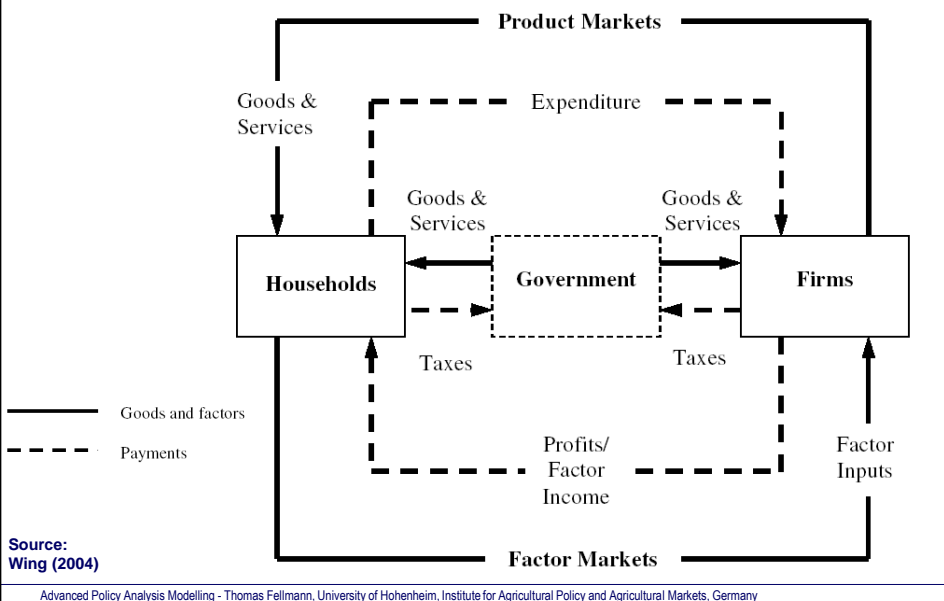
MODELLING TECHNIQUES AND APPROACHES

MODELLING TECHNIQUE - Simulation

- Different definitions of the word 'simulation' in the "Oxford English Dictionary". The one relevant in our context is stating:
"the technique of imitating the behaviour of some situation or process (whether economic, military, mechanical, etc.) by means of a suitably analogous situation or apparatus, … for the purpose of study ..".

- Simulation is essentially about 'mimicking' or 'duplicating' a 'system' and it is used "in formulating, evaluating, and applying models of systems" (Johnson and Rausser 1977, p. 183).

- Typically, simulation models are of mathematical nature, particularly for applications in policy analysis and are characterised by the "what if" purpose, requiring first the definition of a current ('initial conditions') situation and then producing the state of a system for a particular scenario.

⇨ Most models fall into the category of "simulation" and other modelling techniques such as econometrics and mathematical programming methods may well be, and are, used to generate data and parameter values for specifying the initial conditions of a system.

The Circular Flow of the Economy

Source:
Wing (2004)