Tasks with solutions for Introductory Econometrics

1. Econometrics and Empirical Economic Research

1.1 Explain the constitutional elements of econometrics!?

Solution:

- Econometrics is an intersection of economic theory, mathematics and statistics. Economic theory is formalized by mathematics and verified by inductive statistical methods. In the verification of economic hypotheses and models, econometrics independently develops estimation and test procedures called econometric procedures..

1.2 Differentiate the Ätialprinzip from the causal principle!

Solution:

Explanation of terms

- Causal principle: According to the causal principle, the change in an influencing variable has a clear effect on the dependent variable.
- Ätialprinzip (weak, statistical form of the causal principle): A change in an influencing variable leads with a certain probability to a certain expression of the dependent variable.

Reasons why the causal principle is not adequate in econometrics:

- In economics, there are a large number of influencing variables that cannot all be taken into account.
- Economic entities (consumers, producers, etc.) do not have complete information.
- Non-economic reasons for the behaviour of economic agents are difficult to assess.

1.3 Use the tax revenue function
(1) $T = t \cdot Y$
to show the aggregation problem. T is the tax revenue and Y is the income.

Solution:

The income-dependent tax T_i of the i-th household results for an income of Y_i from

(2) $T_i = t_i \cdot Y_i$.

In (2) ti is the marginal tax rate of the ith household.

If one aggregates (2) over all N households of the national economy, one obtains

$$\sum_{i=1}^{N} T_i = \sum_{i=1}^{N} t_i \cdot Y_i ,$$

from which to calculate with the total tax revenue

$$T = \sum_{i=1}^{N} T_i$$

the relationship

(3) $$T = \sum_{i=1}^{N} t_i \cdot Y_i$$

is maintained. In the special case of an equal marginal tax rate for all N households, t1 = t2 = ... = tN=t, which in reality is unrealistic, the macroeconomic tax revenue function (1) would be obtained directly by aggregating the microeconomic tax functions (2):

(4) $T = t \cdot Y$ with $Y = \sum_{i=1}^{N} Y_i$.

In this case, the average tax rate t corresponds to the marginal tax rates ti of households. In general, the marginal tax rate t_i increases with increasing household income Y_i. With the share a_i of household income Y_i in national income Y, $a_i = Y_i/Y$, the following is true

$$Y_i = a_i \cdot Y.$$

Thus,

$$\sum_{i=1}^{N} t_i \cdot Y_i = \sum_{i=1}^{N} t_i \cdot a_i \cdot Y ,$$

so that the aggregated tax revenue function can be used in the form of

(5) $$T = \left(\sum_{i=1}^{N} a_i \cdot t_i \right) \cdot Y$$

can be written. This shows that the average tax rate t contained in the tax revenue function (1) is the weighted arithmetic mean of the microeconomic marginal tax rates t_i

(6) $$t = \left(\sum_{i=1}^{N} a_i \cdot t_i \right).$$

The marginal tax rates t_i are weighted with the income shares a_i.

On the basis of (6) it becomes clear that the macroeconomic tax rate t is based on a certain income distribution. If the income distribution changes, then the overall economic tax rate t

generally also changes, and thus the tax revenue T also changes for the same national income Y.

1.4 Which variable types can be distinguished in an econometric (multi-equation) model?

Solution:

- endogenous variable: variable declared within the model by another variable. In an econometric equation model it is the variable to be explained; in an econometric multi-equation model it can also be used to explain other economic variables.
- exogenous variable: a variable that is intended to explain one (or more) other variable in a model, but is itself considered to be predetermined
- disturbance: Random variable that reflects unsystematic influences on the variable to be explained in a model
- predeterminated variable: delayed endogenous or exogenous variable.

1.5 Use two economic examples to discuss the necessity of using interdependent models!

Solution:

Interdependent models: Endogenous variables influence each other.

Exemple:

a) The basic Keynesian model:

Macroeconomic consumption function:

$$C_t = \beta_1 + \beta_2 \cdot Y_t + u_t$$

definition equation:

$$Y_t = C_t + I_t$$

Private consumption C rises with rising income Y, whose rise in turn increases income, etc. (multiplier effect).

b) Aggregated demand function

In equilibrium, the demand for money corresponds to the supply of money:

$$m_t^d = m_t^s$$

Demand for money is influenced by interest rate i and income (output) y:

$$m_t^d = m_t = \beta_1 \cdot y_t + \beta_2 \cdot i_t + u_t$$

At the same time, the money supply - in addition to government expenditure G and taxes T - influences aggregate demand (see e.g. Blanchard, 2006, Macroeconomics):

$$y_t = f(m_t^s, G, T) + v_t .$$