Regional Economic Analyses. Regional Development

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Abstract: *One of the goals of the national development policy is to support the sustainable economic and social growth of regions territorially balanced in Romania, in order to reduce economic and social inequalities among regions. The presence of multiple functional links in regional economy among processes being variable in time and space leads to the use of panel data models. Such models include regression equations where one uses series that are a combination of time series and cross-sectional data series. This paper presents theoretically the main elements of panel data analysis.*

Keywords*:* regional development; sustainable development; panel data models

Introduction

In regional analyzes, an important place is taken by mathematical and statistical tools, which simulate certain evolutions in order to assess territorial influences, interactions between internal and external factors, to identify alternative ways of managing in an optimal way the necessary resources. These analytical tools, generically called econometric models, aim at examining aggregates and their relationships, while other models assess in an integrated manner a potential future state of system development or address specific issues (occupied population, income, infrastructure, environment, etc.).

Complex models are built on a variety of models, and can be applied both nationally and regionally, depending on the availability of statistical data and information.

Due to its rigorous side, economic modeling is a managerial tool for optimizing (material, human, financial) resources with objectives set in a given period of time, offering the opportunity to make the best decision under certain given conditions without distorting the reality.

In turn, the models presented above can be descriptive and normative. The descriptive ones represent a simplification of reality, while the normative ones allow for the future behavior of the economic phenomenon. Econometric methods that use mathematical formulas to analyze a particular economic phenomenon are built on a logical and coherent sequence of operations and formulas, known as algorithms. The result of the model obtained with the algorithm is analyzed and if it is considered to be convenient it can be the basis of a decision. Also, any econometric system is based on various exogenous and endogenous variables.

Region or territory can be regarded as a system of relations and processes. In general, regional systems are characterized by a series of relationships that address certain aspects, as follows:

1. Aspects related to natural potential (natural resources, location, influences of different infrastructure elements, etc.);
2. Aspects regarding accessibility / transport / mobility level;
3. Elements of technological nature (investment, entrepreneurship, clusters, etc.);
4. Operational aspects (regional sales relations, services, etc.).

Any region may be defined by the interaction of the above-mentioned aspects, which work within a general system (national, community one). The region can be approached and analyzed as a complex subsystem, defined by a series of specific or general variables. These variables may be input, state (characterizing the behavior of the subsystem at a given time or for a specified period) and output (determined). The multitude of characteristics of such a subsystem determines its state (the region has a functional, socio-economic structure that allows its further development but at the same time it is in connection with other development regions, influenced by them and influencing them, in turn, through the inputs and outputs into and from the system to which it belongs).

At present, the complexity of the problems faced by regional systems implies a new type of approach, based in particular on the analysis of the characteristics and interactions between them by means of econometric techniques and models, increasingly appealing to the statistical-mathematic (and even informatics) instrument that provides the possibility of viable predictions and conclusions that can contribute to a better substantiation of regional policies and strategies.

There are a multitude of econometric models developed for the analysis of a territorial system (classical models, basic economic models, input-output models, matrix-models of social accounting, econometric integrated and input-output models, general equilibrium models, etc.). Of these, a special place is held by panel analysis, which can render individual peculiarities, invariant structures of a certain statistical unit at a given moment in time; thus distortion induced by the aggregation of data can be reduced or eliminated.

Panel analysis brings an increase in information by capturing individual variability, reducing the multi-collinear type of variables, increasing the number of degrees of freedom - and, implicitly, the power of the tests, thus the degree of confidence in the obtained results. Also, panel analysis increases the efficiency and consistency of econometric estimates and allows constructing and testing more complex behavioral models than models based on time series or cross-sectional analysis. This panel analysis allows for a better analysis of the dynamics of structural adjustments (Jula D., 2011).

This paper intends to perform a theoretical approach to panel analysis, presenting the main elements that characterize it and how it can operate at regional level.

General aspects of panel data econometrics

Panel data analysis (also known as longitudinal or transverse analysis of time series data) is an analysis on a set of data in which entity behavior is observed over time. These entities may be states, companies, individuals, regions, countries, etc. Data from the panel analysis are as follows:

Region	Year	x	y
Region 1	2000	6,0	7,8
Region 1	2001	4,6	6,7
Region 2	2000	9,1	9,3
Region 3	2001	8,1	8,7
Region 3	2002	9,7	10,1
Region 3	2003	9,8	10,3

Panel data allow for a control over some variables that cannot be used, so that they meet or measure as factors, differences, or variables. It counts for individual heterogeneity. Using panel data, variables can be included at different levels of analysis (i.e., districts, regions, states) for multi-level modeling or hierarchies. Some of the drawbacks of the analysis are data collection (i.e. sampling, design, coverage), non-responses or correlations .

Data analysis involves an analysis of fixed effects and an analysis of random effects.

Fixed data analysis (the covariance model within the estimator, Dummy variable model, Square variable model).

Fixed effects assume the relationship between the predictor variable and the result of an entity (country, person, company, etc.). Each entity has its own individual characteristics that may or may not influence prediction variables (e.g. men or women) and may influence opinion on a particular issue. When using fixed effects, we assume that something can have an impact or a result, and this must be controlled. This involves the correlation between the entity's error term and the predictor variables. Fixed effects can eliminate the effect of those invariant time characteristics so they can evaluate the net effect of a predictor on the result variable.

Fixed effects are invariable time characteristics, unique to the individual / entity and should not be related to other features. Each entity is different; therefore, the entity's error and constant (capturing individual characteristics) should not be correlated with the others. If the terms of error are correlated, then the fixed effects are not appropriate because they may not be correct and this relationship should be modeled (probably using random effects). This is also called the main rationale of the Hausman test.

The fixed effects model equation is

$Yit = \beta 1Xit + \alpha i + uit$

Where – αi (i=1….n) is the unknown interceptor for each entity (n entities - specific intercepts). – Yit is the dependent variable (DV), where i = entity and t = time. – Xit is an independent variable, – $\beta 1$ is the coefficient for IV, – uit is error.

We can add the coefficient of time in the entity model and obtain a regression model of the fixed effects:

$Yit = \beta 0 + \beta 1X1,it + \ldots + \beta kX\ k,it + \gamma 2\ E2 + \ldots + \gamma n\ En + \delta 2T2 + \ldots + \delta t\ Tt + uit$ [2]

Where:

Yit is the dependent variable (DV), where i = entity and t = time. Xk,it represents the independent variable (IV), –βk is the coefficient for IV, – uit is the coefficient of error.

E n is the n entity.

If the series is binary (dummies), we have n-1 entities comprised in the model.

And $\gamma 2$ 2 is the coefficient for binary regression (entity) T is the time of the binary variable (dummy), and we have the period t-1. – δ t is the coefficient for the binary time regressor. Controlling effects over time when no variation or special events are expected to affect the result variable.

Random effects pattern (Random interception, partial sharing). The motivation behind the random effects model is that, unlike the fixed-effect model, the variance between entities is assumed to be random and uncorrelated with the predictor or independent variables included in the model: "... the crucial distinction between fixed and random effects is if not observed, the individual effect includes elements that are correlated with model regressors, and not whether these effects are stochastic or not" [Green, 2008]. If there are reasons to believe that differences between entities have a certain influence on the dependent variable then you should use random effects. An advantage of random effects is that it can include invariable time variables (for example, those related to gender). In the fixed effects model, these variables are absorbed by interception. The pattern with random effects is:

$Yit = \beta X\ it + \alpha + uit + \varepsilon it$

Random effects assume that the entity's error term is not correlated with predictors that allow invariant time variables to play a variable explanatory role.

In random effects, you need to specify those individual characteristics that may or may not influence predictor variables. The problem with this is that for some features, variables may not be available, which results in a variable bias in the pattern. This pattern with random effects allows generalizing inferences beyond the sample used in the pattern.

As previously found out, panel data models assume the estimation of regression equations in which series are used, which are simultaneous time series and cross-sectional data. Thus, with this type of model, a single coefficient can be determined which expresses the impact of a macroeconomic variable on the performance of a group of companies.

Models with panel data allow:

1. summing a single coefficient of the impact of a variable on a group of dependent variable time series (group of companies, countries, etc.);

2. estimation of specific coefficients (constant or coefficients of independent variables) for each time series considered as dependent variable - fixed effects;

3. the grouping of the dependent variables into categories and the estimation of the impact of the category from which the variable depends on its evolution.

Panel analysis uses several categories of data, such as the nature of monthly (quarterly, yearly) dynamics, unemployment rate (or earnings, wage earnings, etc.), data on counties or regions (countries), dynamics of industrial production, branches, VAB dynamics by quarter and branch, quarterly dynamics of GDP, on structure of use, foreign direct investment dynamics by country, GDP (inflation, unemployment rate, public debt, etc.) evolution by country or regions.

The increasing interest in panel data, as well as the increasing availability of statistical data, has led to the expansion of different statistical tests for panel data.

The study of data n panel structure requires joint analysis of cross-sectional observations (regions, countries, sectors, households, companies, etc.) over several time periods.

Although advances in space economics provide researchers with new ways to address regression problems associated with spatial dependence in regional data series, most applications consisted of one-equation models. However, for many economic issues, there are both endogenous variables and data on observations interacting in space.

The presence of several functional links in the regional economy between processes, variables in time and space, has led to the use of panel models. Such models include regression equations in which series are used, which are combined across data series and cross-sectional data series. As the situation occurs frequently when analyzing socio-economic aspects and processes, panel models are present in many specialist studies. Fischer, Manki, Romer, Weil, Levine and Renelt have conducted studies that have shown long-term economic growth based on panel-based models using some large samples from countries. Brueckner provides an overview of the strategic interaction between local governments based on two categories of panel models.

Arkadievich Kholodilin, Siliverstovs and Kooths perform a forecast of annual real GDP growth rates in each of the 16 German Landers using dynamic panel data models. Partridge investigates the link between revenue distribution and economic growth in the United States, using state data from 1960 to 2000.

Panel data generally provide more information, more variation, and the collinear type of variables is smaller. The higher the degree of freedom resulting from the use of panel data, the higher the efficiency of the estimate. Specifications on more complicated behavioral relationships that can not normally be addressed using cross-sectional data or time series are possible using panel data (Elhorst, 2003). Thus, the rationale for developing and implementing a spatial model with panel data is to improve the accuracy of hypothesis testing and subsequent deductions on the interdependencies between the fundamental variables of the model.

Conclusions

Panel data analysis can be used successfully to allow building and testing some more complex behavioral models than models based on time series or cross-sectional analysis. This can be used because it has a number of advantages, as follows:

- the analysis can render the individual peculiarities, the invariant structures of a certain statistical unit at some point in time; thus, distortion induced by aggregation of data can be reduced or eliminated;
- it brings an increase in information by capturing individual variability;
- it reduces the phenomenon of multi-collinear type of variables;
- it increases the number of degrees of freedom - and, implicitly, the strength of the tests, and consequently the degree of confidence in the obtained results;
- it increases the efficiency and consistency of econometric estimates;
- it allows for a better analysis of the dynamics of structural adjustments.

It is known that among processes at regional level there are a lot of interdependencies and inter-conditioning, variable in time and space. Highlighting these interdependencies and inter-conditioning can be achieved through panel data analysis that could be useful to central and local governments in order to improve integrated territorial development strategies and link them to national strategies.

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