

## **Generalized stochastic frontier models with applications in econometric analysis of productivity and inefficiency**

First formal analyses of productivity and productive efficiency date back to 50's of the previous century. The field, currently known as *Frontier Analysis*, has come a long way since then. It has expanded enormously and found its place in numerous studies, some even outside economics and management sciences. Today *Frontier Analysis* is a key component of many performance-based policies all over the world, including Poland.

Modern econometric approach to analyzing productivity is largely based on Stochastic Frontier Analysis (SFA). Since SFA models can be quite challenging to estimate, their specifications are often motivated by pure computational convenience with little consideration of the empirical relevance or inferential consequences. Thus, the objective of the Project is to develop a class of SFA models, which generalize the assumptions often made in contemporary SFA applications. This inevitably leads to a generalized SFA framework that provides an improved inference about economic processes such as production technology and productive inefficiency. It should be noted that although SFA models, as well as the Project, are primarily anchored in productivity studies their applications often go beyond economics and management sciences.

Our research begins with the generalization of basic SFA specification for cross-sectional data. After that we move on to generalizing SFA models for panel data as well. With the development of estimation techniques the above mentioned stages conclude our formulation of the "basic" generalized SFA framework for cross-section and panel data. In the next step of our research we relax the assumption of common efficiency distribution across observations within the new methodology. This allows us to create new, interesting alternatives to contemporary Varying Efficiency Distribution SFA models (VED-SFA). The new VED framework allows for more subtle shape characteristics of the distribution of inefficiency (e.g., skewness, kurtosis) to be dependent on external factors (i.e., determinants of efficiency). Another stage of the methodology development introduces a generalized dynamic SFA model for panel data. Within this model it is possible to analyze the inefficiency evolution over time based on time series methods. Extensive simulation based analyses and model comparisons are planned at each stage of the above-described research. Next, we deploy the newly developed methodology to real-life examples. Applications are based on well-researched datasets and implement two most commonly used types of SFA models: production and cost. Additionally we plan an in-depth analysis based on more recent data from the banking sector. The final stage of the Project is mostly devoted to knowledge dissemination. It is concerned with the introduction of a fully functional computer program that implements the newly developed methodology along with its website.

Contribution of the research Project is threefold. First, the generalized SFA framework nests contemporary SFA models. This gives a unique opportunity for a more in-depth analysis of economic properties of both the production technology and the inefficiency processes. Consequently, the proposed framework can contribute to serious improvements in terms of reduction of model specification errors. This, in turn, should help in designing more credible performance-based policies in a number of settings (energy economics, healthcare, agriculture, environmental science etc.). Second, the potential field of application is much broader than the empirical scope of the proposal. Theoretically the new methodology can be used in any case where the random error term of the statistical model is nonstandard. Third, the new methodology is numerically challenging to implement. That is why the aim of the Project is also to create a fully functional computer software for generalized SFA estimation. This should provide an effective tool for knowledge dissemination, bringing attention to the Project and possibly developing it even further.