

ISSUES ON CHOOSING A FLEXIBLE FUNCTIONAL FORM FOR MODELING ENERGY SUBSTITUTION: REGULARITIES VS.CHARACTERISTICS?

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Overview

In energy sector analysis and modelling, a flexible functional form can be used to investigate substitution relationships between energy and other production factors. A flexible functional form can approximate an arbitrary elasticity of substitution, which tells us the direction and the degree of substitution between energy and other factors. Modelling energy substitution is very important to figure out causes of change in energy demand and to establish energy outlook. Therefore, it is needed to choose a proper flexible functional form for accurate energy sector analysis.

There are so many studies that modelled energy substitution using flexible functional forms ([4], [7]). However, much of these studies frequently failed to satisfy the appropriate theoretical curvature conditions, i.e., regularities, which are necessary to meet the duality requirements. To overcome this problem, much scholarly work ([5], [2], [6]) has been done on the topics of theoretical regularities, but no attempt has yet been made to consider characteristics of an individual economy. Meanwhile, Kim (2009) ([8]) suggested the possibility that the characteristic of an individual economy such as an economic shock could affect choosing a theoretical desirable functional form. Our study starts from this question: Is there any possible relationships between regularities and characteristics of an individual country in choosing a proper flexible functional form?

This study addresses the question of whether characteristics represented as economic dynamics have an influence on determining the proper flexible functional form in estimating the cost function of an industry. To answer this question, we apply both empirical analysis and literature review. First, we approximate the cost function of Korean manufacturing using KLEM data over the period from 1970 to 2005 which includes the 1998 Korean financial crisis. We also present an empirical comparison and evaluation of the five well known flexible functional forms: translog, generalized Leontief, generalized box-cox, generalized McFadden, minflex laurent function. Then we discuss which form is most desirable to approximate Korean manufacturing considering the financial crisis during the latter half of the 1990s. Second, we review several studies which analyzed manufacturing sector of European countries using flexible functional forms. We try to find a significant relationship between characteristics of these countries and the degree of satisfying regularities or choice of functional form.

Methods

1) Empirical analysis: estimation of five well-known flexible cost functions – translog ([9]) generalized Leontief ([9]), generalized box-cox ([3]), generalized McFadden ([5]), and minflex laurent function ([1]).

2) Literature review: the U. K., Turkey, Finland, and Greece cases.

Results

1) Empirical analysis: a translog cost function satisfied all regularities in sample period and also showed the highest value of the log likelihood function among five flexible cost functions. The main reason for this result is that a translog function has a form which can modify sudden changes in the value of variables. This makes it possible to reflect the economic dynamics of Korean manufacturing.

2) Literature review: the authors employed a translog function in the majority of cases because it is most popular functional form. Also we can observe a tendency to adopt a translog function in developing countries rather than developed countries.

Conclusions

In this study, we find that a translog cost function is most desirable considering regularities and the value of the log-likelihood function to analyze an individual economy which experienced economic shock for instance the case of Korea. Also we find that a translog function is most widely used in analyzing manufacturing sector of European countries. Moreover, the tendency of adopting a translog function is frequently observed in developing countries. From the results of this study, we can suggest the possibility that characteristics of an individual economy have an effect on the degree of satisfying regularities, and the choice of functional forms finally.

This implies that a translog cost function, which can modify sudden changes in the value of variables, is thought to be desirable in analyzing an individual economy. Because most economy experienced economic dynamics, the employment of a translog function can be a good way to satisfy theoretical conditions and to reflect characteristics of an individual economy. The result of this study is expected to contribute to the problem of choosing a proper flexible functional form which is very important to measure the exact substitution relationships between energy and other production factors.

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