International Journal of Innovative Computing, Information and Control
Volume **2**, Number **5**, October **2006**

ICIC International ©2006 ISSN 1349-4198
pp. **943–957**

A DYNAMIC FACTOR DEMAND MODEL UNDER UNCERTAINTY ON JAPANESE GAS FIRMS: APPLICATION OF ITO'S STOCHASTIC DIFFERENTIAL EQUATION

Tatsuo Kinugasa

Department of Economics
Otemon University
2-1-15, Nishi-Ai, Ibaraki, Osaka 567-8502, Japan
kinugasa@res.otemon.ac.jp

Received December 2005; revised June 2006

Abstract. *This paper studies a model of capital adjustment cost and investment behavior of a competitive firm. Our goal here is to characterize the stochastic Euler-Lagrange equation, which is important for understanding both the dynamics of aggregate investment and the impact of various policies on capital accumulation. The framework for this analysis is a dynamic factor demand model. In order to analyze a dynamic cost structure, we use a dynamic model of the production structure with an adjustment process for quasi-fixed input factors. This enables us to analyze both short and long term elasticities. However, this model only leads to a discussion on the deterministic optimal control models. Since actual firms are operated in a stochastic environment, a stochastic Euler-Lagrange equation that controls the firm's objective equation is introduced through Ito's stochastic differential equation in our model. The results are induced from the data of 9 privately owned Japanese gas distribution firms during the period of 1981-1995. Results are as follows: First, the model with the Euler-Lagrange equation of the full stochastic version shows reasonable results. It means that the stochastic style of the dynamic factor demand model is successfully estimated. Second, the adjustment cost associated with changing the capital stock, is not so important in the Japanese gas distribution industry. Third, the Japanese gas distribution industry has small scale economies, which is already cleared by the static translog cost function model. Fourth, the over-identifying test by the J-statistics suggests that a third difference GMM model; so-called GMM (3) is suitable for this estimation.*

Keywords: Factor demand, Dynamic optimization, Stochastic Euler-Lagrange equation, Panel data, Gas distribution industry

1. **Introduction.** In this paper, we develop a stochastic model of the production and investment behavior of a competitive firm and use this model to examine the effects of uncertainty on the optimal rate of investment. The framework for this analysis is a stochastic version of the dynamic factor demand model, that is to say, a stochastic optimal control model. The result is induced from the data of 9 privately owned Japanese gas firms during the period of 1981-1995.

Japanese gas distributors are classified into three groups.

1) The top four major utilities, which cover metropolitan area in Japan. (the top four)

2) The eight backbone utilities, serving major provincial cities and, each have a capital of at least 500 million yen (4.6 million dollars) and 300 employees. (the eight backbones)