CHAPTER 4
PERSISTENCE, ASYMMETRIES AND INTERRELATION IN MANUFACTURING STRUCTURES, EQUIPMENT AND LABOUR DEMAND
An application to six OECD countries

4.1 Introduction

In this chapter investments and labour demand with rich interrelations are explained by profit maximizing behaviour under uncertainty. In contrast with chapter 3, first order conditions are estimated directly. The derivation of a closed form solution, like done in chapter 3, is hardly possible because of the rich interrelations together with long gestation lags for structures. The instrumental estimation method used here is also adopted, among others, by Burda (1991), Gordon (1992), Pfann and Palm (1993) and (using the dual, cost minimizing approach) Pindyck and Rotemberg (1983a,1983b) and Bresson, Kramarz and Sevestre (1993).

Three main differences with these studies exist.

Firstly, in line with the q studies of investments (see Hayashi (1982)) this chapter explains business investments whereas factor demand studies usually explain the physical capital stock. Investments and variations in physical capital stock differ in timing if lead times, delivery lags and/or construction lags, exist. Following Pindyck et al. (1983a), Lichtenberg (1988), Altug (1989) and the previous chapter structures and equipment are here separately included in the model. As the existence of lead times is confirmed by evidence for plants (including equipment) by Mayer (1960) and time-to-build appears to be of a great importance for structures (see chapter 2), Kydland and Prescott's specification is here incorporated\(^38\). The time-to-build specification is adopted in addition to adjustment costs.

Secondly, in the dynamic specification accounting for time-to-build and adjustment costs, two asymmetries are introduced. One asymmetry concerns the 'irreversibility' of investments. Capital projects require a gestation period (that is rather long for structures), but there is no possibility to withdraw plans in execution. Productive capital can become idle but no market exists to sell used capital goods, by which capital only depreciates or 'evaporates'. Another asymmetry is built in the 'internal' adjustment costs.

\(^{38}\) For the comparison of time-to-build according Kydland and Prescott (1982) and adjustment costs dynamics in factor demand models, see Rossi (1988) who compares non-nested posterior odds, or chapter 3.
costs specification for labour by assuming that hiring costs and firing costs of labour are not necessarily equal. This approach is also adopted in Bentolila and Bertola (1990), Bresson et al. (1993) and Pfann and Palm (1993).

As a third difference, external investment adjustment costs are specified; they result from the (Granger) causality from investment demand to investment prices. For example Uzawa (1964) and Brechling (1975) pay attention to these costs.

The aim of this chapter is to investigate the importance of various kinds of factor dynamics, in particular persistence, asymmetries and interrelation. Persistence in capital and labour that is often interpreted as resulting from adjustment costs, is here investigated together with persistence resulting from technological innovations and construction lags (or time-to-build).

Persistence in this context is defined as high serial correlation. As models can be dynamic having only lagged exogenous variables (in for example a factor demand model for capital stock without even adjustment costs, see Brechling (1975)), the term 'persistence' is here preferred to 'dynamics'. In this context persistence should not necessarily be associated with non-stationarity.

Contrary to the model in chapter 3, rich interrelations of investments and labour is assumed in both the production and in the adjustment costs function. As interrelations in capital and labour exist, already emphasized by Nadiri and Rosen (1969), Pindyck and Rotemberg (1983b) and appendix 1.A, the marginal productivity of capital (labour) is assumed to depend on the average weekly numbers of hours worked (capital).

Interrelated costs ensued from simultaneously investing in capital and recruiting or dismissing labour, is far less frequently found in the literature. The two asymmetries in relation with these dynamics, the irreversibility of investments and asymmetric labour adjustment costs mentioned above, are also incorporated.

The outline is as follows.
Summary statistics of the manufacturing industry data of six industrial countries are presented in section 2. Section 3 specifies a model for a representative firm and presents the first order conditions. Estimation results are presented in section 4. Section 5 summarizes the main results, compares results with related studies and highlights the main shortcomings.

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Uzawa uses a model with a consumption and a capital sector. In one example the consumption sector faces external investment adjustment costs because in comparison with the capital sector, this sector is more capital intensive.