
# Inventories, Factor Demand and Capacity Utilization : the Long and Short Run Structure

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Discussion Paper n° 9507

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D/1995/3082/07

# INVENTORIES, FACTOR DEMAND AND CAPACITY UTILIZATION: THE LONG AND SHORT RUN STRUCTURE

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February 1995

JEL-code : C32, D21, D24

IRES

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**Abstract**

An ECM is derived from first order conditions of a factor demand model. Decisions on inventory stock and capacity utilization are (endogenously) modelled, by which a large systems of equations results. Within this system the exogeneity of real factor prices as well as sales is tested. The role of inventory stock in the long run, i.e. as a precautionary measure (according to Holt, Modigliani, Muth and Simon (1960)) and/or as a production factor (Kydland and Prescott (1982), Christiano (1988)) are further investigated by impulse response functions. For French industrial sectors (1970.I-1992.IV) inventory stocks turn out to be both a decision variable as well as a residual. The precautionary measure is not rejected, but a linear-quadratic specification seems not to hold. Further, no strong evidence is found for the inventory stock as a production factor.

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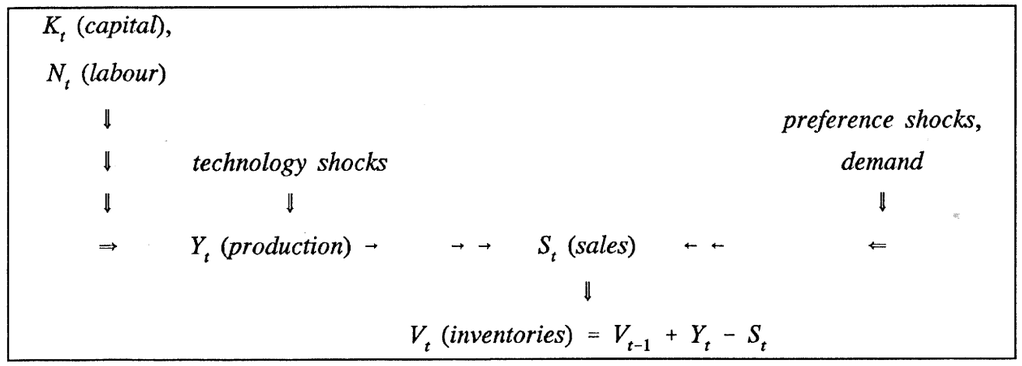
[1] For helpful comments on this paper I want to thank Fati Mehta, Franz Palm, David De La Croix and participants at a seminar at GREQAM (Marseille). For financial support I gratefully acknowledge The Netherlands Organisation for the Advancement of Pure Research (NWO, The Netherlands), the 'Institut de Recherches Economiques et Sociales' (IRES,LLN) and the 'Centre de Recherche en Economie et Statistique' (CREST,Paris).

## 1 Introduction

Inventories of finished goods would (hardly) exist if product demand were known at any time and adjusting production was cheap[2]. After all, perfect foresight about product demand would induce firms to produce exactly the amount of goods needed since holding or not selling goods is costly. In case of perfect foresight also less idle production capacities would exist than in case of demand uncertainty. It makes, in a similar way as holding inventories, no sense to acquire additional production capacity that will not be fully used. Both the level of inventories as well as capacity utilization rate are, however, not only indicators of demand uncertainty but also of technological developments.

Christiano (1988) emphasizes the 'residual' role of inventories.




He adopts a model where *'...elements of precommitment are important in fixed investment and employment decisions, but minor in consumption decisions...'* (page 248). Technology and preference shocks can thus not influence capital and labour decisions. They influence, though, sales. In this way *'...inventories buffer consumption from unexpected disturbances in production and buffer production from unexpected disturbances in consumption...'* (page 248). Inventory investment plays thus a residual role. In addition to this role of inventories, Christiano assumes inventory stock to be a production input that can substitute physical

[2] Adjusting production should be cheap in comparison with inventory costs.

capital stock[3]. Unrealistically, in this model capital capacities are assumed to be always fully utilized.

Instead of inventories as a production factor, the 'precautionary' motive is often mentioned in the literature. Kahn (1992) and Krane (1994), for example, argue that the cost of stock-outs can exceed the holding costs of inventories. Following this line of reasoning, entrepreneurs always want to hold inventory stocks to avoid the possibility of falling short of demand. In these models[4], as well as in the model of Christiano (1988), the stock of inventories is a decision variable that entrepreneurs choose optimally. In the former models, though, a target value is to be specified. This target value is often assumed to be the level of sales, to which inventory stocks are geared (according to Holt, Modigliani, Muth and Simon (1960)).

To model these 'inventory objectives', mainly linear-quadratic specifications are chosen by which simple linear decision rules result. As a consequence of the assumption that inventory stock is a decision variable, i.e. a *production factor* and/or *precautionary measure*, inventory stocks appear in the long run relationships[5].

The major aim of this study is to discover to what extent inventories are important in the long run. They are considered in relation with the capacity utilization rate, materials, labour and capital. An entrepreneur's ease to decide upon these four latter factors can be thought of to be of a decreasing order. Capital investment decisions are often taken first because of, for example, time-to-build considerations. Precommitments concerning labour also exist, but the incumbent labour force seems more easy to vary (by hiring and firing) than the capital stock

[3] Christiano argues further that the high volatility of inventories, corroborated by empirical findings with aggregate United States data, is largely due to the residual role of inventories.

[4] See also production smoothing models, where production and inventories are decision variables. Examples are West (1986) and Ramey (1991). For a criticism on these models and a comparison of a factor demand model with inventories and a production smoothing model, see Peeters (1994,1995a).

[5] Notice that this holds even if product prices are fully flexible.



but, less easy to change than the stock of materials. Utilization rates thereafter seem much more easy to vary. The place of inventories in this ranking order is a question to be answered.

In contrast to many other empirical inventory studies, the demand for different *production factors* (instead of production) in French industrial *sectors* during 1970.I-1992.IV, is analyzed.

Also in contrast to most other empirical studies, that adopt either a (non-linear) structural model -being a theoretical or economist approach- or a linear unrestricted model -being a statistical approach-, both approaches are discussed in this study. Starting from a linear-quadratic structural model, first order conditions are derived and rewritten as an Error Correction Model. This latter model is estimated since it is a 'proper' framework to test for restrictions implied by the theory[6], like the number of cointegration relationships, dynamics, exogeneity and causality.

By adopting this approach time series properties are appropriately accounted for, whereas it remains possible to draw conclusions implied by the theory. Unlike many inventory studies, like Christiano (1988) who derives a steady state model, West (1986) or Ramey (1991) who estimate first order conditions by instrumental estimation methods, a simple but suitable ECM framework is thus adopted.

As a first advantage in comparison with these inventory studies, this framework makes it possible to verify whether *sales can be assumed to be exogenous* for factor demand. Second, whether inventory stock is significant in the long run -hence is an *instrument*- or not -hence is a *residual*- can be investigated. In the former case, a (possible) target value can be discovered. As a third advantage of the framework adopted here, both *inventories and capacity utilization changes in reaction to sales impulses* are easy to investigate. Both short and long run relations are distinguished, by which the assumptions of Christiano (1988) can be discussed. If production factors are precommitted and inventories play mainly a residual role (see Christiano (1988)), inventories do not play a significant role in the long run. In the

[6] See also Dolado, Galbraith and Banerjee (1991) that emphasize the importance of accounting for the time series properties when estimating parameters of the structural model.