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Time-to-build, monetary shocks, and aggregate fluctuations ☆

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Abstract

The idea that the investment process takes time to produce finished capital goods was an integral part of Kydland and Prescott's early work on real business cycles, but this feature has been dropped in much recent work, mainly because it seemed to have little effect on macroeconomic dynamics. With a generalization of the "time-to-build" feature that incorporates multiple types of capital, however, a New Keynesian model can produce "u-shaped" responses in output, investment, and inflation to a monetary policy shock. Such responses are not found in many studies that assume no time-to-build friction. In addition, different specifications of the time-to-build structure result in substantially different response patterns for these aggregate variables.

JEL classification: E12; E22; E47

Keywords: Time-to-build; Types of capital; Monetary policy shock

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1. Introduction

Over the past decade numerous examples of optimizing models featuring nominal rigidities have appeared in the literature. They are often called New Keynesian models. Both their theoretical appeal as microfounded models, and their ability to explain the short-run effects of monetary policy, have contributed to their popularity among researchers. However, their dependence on a forward-looking decision making process erodes their capacity to capture some of the business cycle regularities observed in the data. For example, most optimizing models are not very successful in replicating the delay in the responses of output and inflation to a monetary shock.

Precisely, one of the purposes of this paper is to derive an optimizing model to explain why responses of both output and inflation to monetary stimulus reach their maximal impact several quarters after the shock (rather than immediately). This phenomenon has been widely investigated in recent papers using optimizing models featuring frictions in price-setting, wage-setting, or both. A representative list of these should include Chari et al. (2000), and Giannoni and Woodford (2004), and Christiano et al. (2005). In this paper we will show how the introduction of a time-to-build specification for capital accumulation serves to delay the peak responses of output and inflation to a monetary policy shock.

The second purpose of the paper is methodological. Our model represents an extension of the time-to-build setup described by Kydland and Prescott (1982) to include different types of capital, classified according to the length of their time-to-build period. As one earlier notable contribution on this regard, Edge (2000) describes a model with several time-to-build requirements for household capital accumulation but without imposing any time-to-build constraint on the demand for capital of the production sector.

The rest of the paper is divided into five sections. Section 2 describes the model. Calibration of the parameters is done in Section 3. Section 4 discusses the responses to a nominal interest rate shock found in the baseline model and three variants of it with respect to the time-to-build structure. A sensitivity analysis is carried out in Section 5. Finally, Section 6 summarizes the conclusions.

2. The model

The economy is formed by a continuum of households who are also producers. They all share a set of preferences, production technology, capital accumulation conditions, and the same rigidities when setting prices and nominal wages.

2.1. Household preferences

The following constant relative risk aversion (CRRA) utility function ranks preferences of the representative household over period t

$$U(c_t, c_{t-1}, l_t) = (1-\sigma)^{-1}\left[\frac{c_t}{c_{t-1}^h}\right]^{1-\sigma} + \Upsilon(1-\varphi)^{-1} l_t^{1-\varphi}, \tag{1}$$

where $\sigma, \Upsilon, \varphi > 0$, and $0 \leqslant h \leqslant 1$. Utility depends on current consumption c_t, previous period consumption c_{t-1}, and leisure time l_t. Consumption units are bundles of all the