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Investment shocks and the comovement problem ☆

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ABSTRACT

Recent work based on sticky price–wage estimated dynamic stochastic general equilibrium (DSGE) models suggests investment shocks are the most important drivers of post-World War II US business cycles. Consumption, however, typically falls after an investment shock. This finding sits oddly with the observed business cycle comovement where consumption, along with hours-worked and investment, moves with economic activity. We show that this comovement problem is resolved in an estimated DSGE model when (i) the cost of capital utilization is specified in terms of increased depreciation of capital, as originally proposed by Greenwood et al. (1988) in a neoclassical setting, or (ii) there is no wealth effect on labor supply. The data, however, favors the first channel. Traditionally, the cost of utilization is specified in terms of forgone consumption following Christiano et al. (2005), who studied the effects of monetary policy shocks. The alternative specification we consider has two additional implications relative to the traditional one: (i) it has a substantially better fit with the data and (ii) the contribution of investment shocks to the variance of consumption is over three times larger. The contributions to output, investment, and hours, are also relatively higher, suggesting that these shocks may be quantitatively even more important than previous estimates based on the traditional specification.

1. Introduction

Recent research based on estimated dynamic stochastic general equilibrium (DSGE) models suggests investment shocks are the most important drivers of business cycle fluctuations in the post-World War II US economy. Justiniano et al. (2009) find, using a model with a variety of real and nominal frictions similar to Christiano et al. (2005) and Smets and Wouters (2007), that over half the fluctuations in output and hours, and over 80% of the fluctuations in investment are driven by investment shocks. These shocks may manifest as shocks either to the marginal efficiency of investment, as in Greenwood et al. (1988), or to the investment-specific technology as in Greenwood et al. (1997), and recent work favors the former interpretation (see Justiniano et al., forthcoming). Previously, using a structural vector autoregression methodology, Fisher (2006) found that investment-specific shocks are the dominant source of business cycles in the US.

Despite their quantitative importance, however, one difficulty remains: consumption typically falls (or does not rise immediately) after a positive investment shock in the model. Thus the model economy does not produce comovement

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among macroeconomic variables in response to an investment shock, unlike observed business cycles in which consumption, investment, hours, and output all move together. This lack of comovement is clearly problematic in viewing investment shocks as an important source of business cycles. Early work of Barro and King (1984) pointed out this problem in the neoclassical model. Subsequently, Greenwood et al. (1988) showed that incorporating variable capital utilization in that model can introduce a channel which can potentially lead to a rise in current consumption after an investment shock. In DSGE models with real and nominal frictions, the countercyclicality of markups can, in theory, provide yet another channel that can help alleviate the comovement problem (see Justiniano et al., 2009). But despite the presence of variable capital utilization and countercyclical markups, it is puzzling that the current generation of estimated DSGE models continue to display the comovement problem in the estimated response of consumption to investment shocks.

In this paper we show that a crucial feature behind this failure is the way the cost of utilization is typically modeled in estimated DSGE models. Following Christiano et al. (2005) (hereafter CEE), the cost of increasing capital utilization enters directly in the household's budget constraint as lost consumption. The reason why the cost of utilization is specified in terms of lost consumption goods is that it allows utilization to rise after an expansionary monetary policy shock (see footnote 20 in Christiano et al., 2001). This mechanism prevents a sharp rise in marginal cost and limits the extent to which labor productivity falls in response to a positive monetary policy shock, thereby generating persistent output and inflation responses. The motivation behind this modeling choice is, therefore, the need to be consistent with what happens after a monetary policy innovation. Subsequently, the CEE specification has been widely adopted in the estimated DSGE literature (prominent early examples include Smets and Wouters, 2003; Altig et al., forthcoming; Levin et al., 2005, among others). The downside of specifying the cost of utilization this way, however, is that it shuts down an amplification channel that turns out to be potentially important for the effects of investment shocks. This channel is missing in the CEE specification but it was originally considered by Greenwood et al. (1988) (hereafter GHH) in a neoclassical real business cycle model.

The main objective of this paper is to assess the consequences of the GHH specification and contrast them with those of the traditional CEE specification. To accomplish this task, we estimate an augmented version of the Smets and Wouters (2007) model with the preference structure suggested by Jaimovich and Rebelo (2009), which allows for a varying wealth elasticity of labor supply. This preference structure nests as special cases the standard King et al. (1988) preferences and the one which imply no wealth effect on labor supply (Greenwood et al., 1988). Jaimovich and Rebelo (2009) show that these preferences help generate comovement in response to anticipated shocks. The advantage of considering these preferences in our context is that it enables us to examine the relative roles of the capital utilization specifications and varying wealth elasticity preferences in generating the comovement result. We use quarterly US data on seven macroeconomic time series over the period 1954:3–2004:4 and Bayesian methods to estimate the model and conduct quantitative analysis.

We show that in an estimated DSGE model, when the cost of higher capital utilization is in terms of a higher depreciation rate of capital then comovement occurs. Specifically, after an investment shock, consumption rises along with other macroeconomic variables. The reason behind this finding is that optimal capital utilization under the GHH specification depends on the difference between the rental rate of capital *and* the value of installed capital. A positive investment shock implies that this difference rises and, therefore, boosts utilization. On impact, the fall in the value of installed capital is the primary driver of this difference as the rental rate of capital does not immediately increase. The shock creates strong incentives to build new capital which is more productive relative to current capital stock, therefore, the shadow value of installed capital falls on impact and investment rises. Capital utilization is relatively cheaper which means quicker depreciation of less productive installed capital. It has a direct effect of increasing output on impact. Moreover, capital utilization further amplifies the positive effect of the countercyclical price markup on labor demand, and hence equilibrium hours. The amplification in hump-shaped investment and hours responses leads to an amplification in the output response beyond the first quarter. Consumption rises on impact due to both the larger availability of output on impact and the consumption-smoothing behavior of the households, thereby ensuring comovement. By contrast, under the CEE specification, utilization depends *only* on the rental rate of capital, and the second amplification channel through the value of installed capital is absent. The GHH specification, therefore, provides useful amplification in an estimated DSGE model and overcomes the comovement problem in response to investment shocks. When the wealth effect on labor supply is absent, the CEE specification generates comovement. The data, however, favors the GHH cost of utilization channel to resolve the comovement problem.

We find that the GHH specification has additional implications. First, the empirical fit of the DSGE model with the GHH specification substantially dominates the one with the CEE specification. Interestingly, the responses of real variables to monetary policy shocks remain broadly similar across the two specifications. Second, the contribution of investment shocks to the unconditional variance of consumption growth is over three times larger under GHH relative to CEE. The contributions to the variance of output growth, hours, investment growth, wage growth, nominal interest rate, and inflation are also relatively higher. These findings suggest that investment shocks may be quantitatively even more important than previous estimates based on the CEE specification.

Based on our findings, we conclude that adopting the GHH specification for modeling the cost of utilization in DSGE models may help in better understanding the effects of investment shocks, especially since these shocks appear to be relatively more important than monetary shocks as sources of business cycles.

The rest of the paper is structured as follows. Section 2 describes the model and the two specifications, Section 3 presents the estimation methodology, while Section 4 presents estimation results and Section 5 concludes.