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What do inventories tell us about news-driven business cycles?

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ABSTRACT

There is widespread disagreement over the quantitative contribution of news shocks to business-cycle fluctuations. This paper provides a simple identifying restriction, based on inventory dynamics, that tightly pins down this contribution. Structural models predict that finished-good inventories should fall when there is an increase in consumption and investment induced by news shocks. A structural VAR with these sign restrictions indicates that news shocks account for at most 20 percent of output volatility. Since inventories comove positively with consumption and investment in the data, shocks that generate negative comovement cannot account for the bulk of fluctuations.

1. Introduction

The sources of business cycles are an enduring subject of debate among macroeconomists. A recent literature argues that news shocks—shocks that change agents' expectations about *future* economic fundamentals without affecting *current* fundamentals—could play a leading role in aggregate fluctuations.[1] The theoretical conditions under which these shocks generate comovement among macroeconomic variables are, by now, well understood. However, no consensus has yet emerged regarding their empirical importance. While some estimates suggest that they account for as much as 60 percent of output volatility, other equally plausible methods obtain values as low as 10 percent.[2]

The goal of this paper is to use a new theoretical insight to pin down more precisely the quantitative contribution of news shocks to business-cycle volatility. This insight builds on the behavior of a business-cycle variable that is highly informative about news shocks but has so far been neglected in the literature: investment in finished-good inventories.

We focus on investment in finished-good inventories for two reasons. First, there is empirical evidence that finished-good inventories are a forward-looking variable that reflects changes in expectations about future economic conditions. For instance, Kesavan et al. (2010) find that finished-good-inventory data help improve forecasts of future sales. Second, finished-good inventories should react differently to changes in fundamentals that occur today than to changes that are expected to take place in the future.

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[1] See Beaudry and Portier (2013) for a review of the contributions to this literature.

[2] For example, Beaudry and Portier (2006) and Schmitt-Grohé and Uribe (2012) estimate that the contribution of news shocks to the business-cycle volatility of output is above 40 percent, while Barsky and Sims (2011) and Khan and Tsoukalas (2012) find much smaller numbers.

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Temporary changes in productivity provide a straightforward illustration of this second claim. When productivity increases today, current income increases, so sales rise. Additionally, firms bunch production today in order to make the most out of the productivity increase. As a result, finished-good inventories also rise. Thus, when productivity changes today, sales and inventories should comove *positively*. On the other hand, when productivity is expected to increase tomorrow, the present value of income increases, which also leads to a rise in sales. However, since firms expect future production to be cheaper than current production, they satisfy this increase in sales not by producing more, but by depleting inventories. Thus, when productivity is expected to change tomorrow, sales and inventories should comove *negatively*. The sign of the comovement between sales and inventories should therefore help to distinguish between current and future expected changes in productivity.

Sections 2 and 3 formalize this intuition in the context of a standard news-driven business-cycle model. The model is identical to that of Jaimovich and Rebelo (2009) and Schmitt-Grohé and Uribe (2012), except that the economy also holds finished-good inventories. In this model, good news about the future indeed leads to a boom in the components of private sales (consumption and investment), but also generates a fall in inventories. The key mechanism behind this result is that good news causes agents to backload production and satisfy the boom in sales via inventory depletion—something they cannot do in an economy without inventories. This result holds across all plausible calibrations, and survives a number of extensions of the baseline model.

Section 4 uses this prediction to assess the quantitative contribution of news shocks to business-cycle volatility. We describe an empirical vector autoregression (VAR) strategy that identifies shocks using sign restrictions on inventories and sales, consistent with theoretical predictions. When applied to quarterly data, this strategy identifies shocks that explain less than 20 percent of the forecast error variance (FEV) of output at business-cycle frequencies. The intuition for this small estimate is that, in the data, inventories and sales tend to comove positively, so that any shock that generates negative comovement must have limited importance over the business cycle.

A cautious interpretation of this result is that it provides an upper bound to the contribution of news shocks to business-cycle volatility, since surprise innovations to other fundamentals could also be generating the comovement pattern.[3] Nevertheless, this result emphasizes that the business-cycle behavior of inventories is a potential challenge to the news view of business cycles.

Related literature: This paper emphasizes that news shocks can trigger intertemporal substitution in *production*, via inventory (dis)investment. This complements a strand of literature that shows how these shocks could cause intertemporal substitution in *consumption*, via capital (dis)investment (Jaimovich and Rebelo, 2009; Christiano et al., 2008). This literature has not analyzed inventory investment thus far.[4]

This paper also contributes to the recent business-cycle literature on inventory dynamics (Bils and Kahn, 2000; Fisher and Hornstein, 2000; Jung and Yun, 2006; Khan and Thomas, 2007; Wen, 2011; Kryvtsov and Midrigan, 2013). Although these models differ in their precise microfoundation for inventory holding, a feature shared by all is that inventories serve to shift production over time. The results of Section 3 help pinpoint the importance of this common mechanism. In particular, these results highlight a key parameter, the elasticity of intertemporal substitution in production (EISP), which summarizes the strength of this mechanism and is common to all these models.

Finally, the empirical approach of Section 4 is based on recent advances in the estimation of sign-restricted VARs (Arias et al., 2013; Moon et al., 2013). While sign restrictions have been used to identify monetary policy shocks (Faust, 1998; Uhlig, 2005), fiscal policy shocks (Mountford and Uhlig, 2008; Caldara and Kamps, 2012), and also news shocks (Beaudry et al., 2011), their application to inventory dynamics is, to our knowledge, new.

2. Inventories in a real business cycle framework

This section describes a simple but general model of inventory dynamics. The model has two main components. First, it borrows most of its structure from the Real Business Cycle (RBC) models of Jaimovich and Rebelo (2009) and Schmitt-Grohé and Uribe (2012). Second, it incorporates a simple inventory block: output produced today can be stored as inventory for use in subsequent periods. We use it as our baseline environment to study inventory dynamics in response to news shocks.

A central feature of inventory management is that it helps smooth out time variation in production costs. At the same time, inventories are costly to hold, both because of depreciation and foregone interest costs. In steady state, production costs are constant and there is no need to smooth them out. Thus, if cost smoothing were the sole purpose of inventory holdings, the steady-state level of inventories should be zero.

Since this is at odds with the large inventory stock held by firms in the data, the inventory literature has proposed various inventory-holding motives, corresponding to different microeconomic frictions. The leading microfoundations are demand for variety, stock-out risk, and inventory-ordering costs. A common feature of these microfoundations is that they

[3] Section 3 shows that surprise shocks to total factor productivity and the labor wedge both generate positive comovement between inventories and sales in the structural models analyzed in the paper, consistent with the intuition outlined above. To the extent that the identified shocks have a non-news component, that component must therefore reflect surprise changes in fundamentals other than total factor productivity and the labor wedge.

[4] To our knowledge, the only exception is Vukotic (2013), where inventories are introduced as a factor of production in the durable sector, and play a role similar to fixed capital investment.