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Deducing markups from stockout behavior ☆

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ABSTRACT

Stockouts bear an inverse relation to the price markup in models with a stockout constraint on sales because stockouts cost the seller the markup of price over marginal cost. I examine stockouts in micro-CPI data, for goods comprising more than a quarter of consumer expenditures, to deduce the level and cyclicality of markups for 1988–2009. The predictable increase in stockouts, as price declines, over durables' product life implies markups on the order of 15 percent. For much of the sample period stockouts were acyclical, suggesting markups were acyclical. But for the latter part of the sample, including the Great Recession, stockouts are procyclical consistent with countercylical markups.

Business cycle fluctuations exhibit important procyclical movements in hours and consumption. Market-clearing business-cycle models typically generate these opposite movements in leisure and consumption through very procyclical movements in the marginal product of labor. But labor productivity is quite acyclical in the data. This makes it difficult to rationalize hours fluctuations without market features that can drive a cyclical wedge between the marginal physical product of labor and marginal rates of substitution between leisure and consumption. (Shimer, 2009 provides a thorough discussion of these issues.) This observation has helped renew interest in models with wage and/or price stickiness. Prices that are less procyclical than marginal cost can contribute to hours fluctuations by making labor's marginal revenue product more procyclical than its marginal physical product. Goodfriend and King (1997) show how sticky-price models contribute to hours fluctuations by creating countercyclical movements in price markups. Clearly purposeful movements in price markups can serve this role (e.g., Rotemberg and Woodford, 1999).

Judging the behavior of price markups over marginal cost is difficult because we do not observe the shadow price of labor (Kudlyak, 2014; Basu and House, 2015). If it is assumed that labor's marginal product varies in proportion to its average product and that the shadow price of labor is captured by average hourly wages, then fluctuations in the price markup are reflected (inversely) by fluctuations in labor's share of output. Labor's share is not particularly cyclical; so this approach implies little cyclical variation in the markup (Gali et al., 2007; Nekarda and Ramey, 2013; Karabarbounis, 2014). But this measure of the markup can be strongly biased with respect to the business cycle if labor is quasifixed or wages are smoothed by employers across fluctuations (Bils, 1987; Rotemberg and Woodford, 1999; Bils et al., 2015).

Here I exploit information on the frequency that products stock out, derived from micro-data underlying the CPI, to judge the level and cyclical behavior of price markups over marginal cost. Research in inventory behavior has been motivated by

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related questions. This work connects most closely to that by Bils and Kahn (2000), Galeotti et al. (2005), and Kryryvtsov and Midrigan (2012), each of whom use inventory movements to identify the structure of costs and nature of business cycle shocks. Looking directly at stockout behavior has distinct advantages over studying inventories. For one, stockout information is available for many goods for which data on finished inventories are not available.

In the next section I consider the production choice for firms facing a constraint that sales cannot exceed the stock available (as in Kahn, 1987, 1992). By stocking one more good for sale, the seller gains a sale in the event that a stockout occurs. To generate a predictable increase in the probability of stocking out requires: (1) a temporary increase in marginal cost (an increase relative to discounted future marginal cost), or (2) a decrease in the markup of price over marginal cost. Thus, given data on prices and interest rates, the likelihood of a stockout is informative on the behavior of marginal cost and price markups.

I present data on temporary stockouts for 20 distinct consumer goods categories in Section 2. The estimates are derived from information in the CPI Commodities and Services Survey (CPI C&S Survey), the monthly micro-data underlying the Consumer Price Index. To calculate the CPI the BLS tracks a large set of prices of particular products at particular outlets. Only prices for products available for purchase are eligible for use in the CPI. For this reason, the CPI C&S Survey data reveal the occurrence of a stockout.

Ten of the 20 goods categories are durables, including apparel. Prices predictably decline with time on the market for these goods. I examine, in Section 3, how stockouts increase with shelf life, as price predictably declines. From that pattern I can judge the size of price markups over marginal cost for the consumer durables. Overly large markups are not consistent with the substantial increase in stockout rates observed over the product life for most durables. I estimate markups of about 15 percent on average, but over 20 percent for household appliances, electronic equipment, and women's apparel.

My estimates are near the upper end of the range of most estimates in the literature (e.g., Morrison, 1992; Norrbin, 1993; Basu and Fernald, 1997) that are based on examining productivity patterns or estimating cost functions. They are, however, far below those of Hall (1988), who estimates quite large markups based on how output responds to instrumented expansions in inputs.

I examine the cyclical behavior of stockouts in Section 4. I find that stockouts were acyclical for much the sample period, but then become quite procyclical for its latter part. Most notably, the stockout rate dropped nearly a full percentage point during the Great Recession, which represents a decline of about 20 percent relative to the level of the stockout rate. This behavior of stockouts suggests that markups, after being acyclical for much of sample period, became notably procyclical during its latter, more volatile years.

My results for the earlier part of the sample run counter those of both Bils and Kahn (2000) and Kryryvtsov and Midrigan (2012), who estimate countercyclical markups based on very predictably countercyclical patterns in inventory to sales ratios. The concluding section discusses possible reasons for this. For the latter part of my sample, including the Great Recession, stockouts are procyclical, while the inventory–sales ratio remained highly countercyclical.[1] So both approaches point to a countercyclical markup.

1. Predicting stockout rates

Consider the production decision for a firm producing to stock. In a pure production-smoothing model of inventories this is a cost minimization problem–firm's produce more today only if marginal cost is below expected discounted future marginal costs. Here I follow Kahn (1987, 1992), Thurlow (1993), and others by allowing a larger stock for sale to be potentially valuable by reducing the probability of losing a sale because of a stockout.

The firm chooses output to maximize expected discounted profits subject to a constraint that sales cannot exceed the stock available:

$$\max_{y_t} E\left(\sum_{i=0}^{\infty} \beta_{t,t+i}[p_{t+i}s_{t+i} - C(y_{t+i};\ \theta_t, \boldsymbol{w}_t)]|\boldsymbol{I}_t\right) \tag{1}$$

subject to:

(i) $s_t = \min\left[d(p_t, \boldsymbol{z}_t),\ a_t\right]$

(ii) $a_t = i_t + y_t = a_{t-1} - s_{t-1} + y_t$.

An index for the firm's product is implicit. The expectation conditions on a set of variables $\boldsymbol{I}_t$ known when production is chosen for time t. s_t and p_t are respectively sales and price for t. All prices are relative to a numeraire good. p_t is an additional choice variable for the seller. But, I focus on the optimizing choice for output, given the observed price.[2] $C(y_t;\ \theta_t, \boldsymbol{w}_t)$ is the

[1] Bils et al. (2015) discuss the behavior of inventory–sales ratios since 1988. That paper. as well as Hall (2014), also attempts to deduce cyclicality of price markups without measuring the cyclical price of labor. Bils, Klenow, and Malin, based on the behavior of hours for self-employed workers and inputs for intermediate goods, conclude that price markups have been systematically countercyclical for the last 25 years. Hall models the return to advertising, by increasing sales, as proportional to the markup. (Comparable to the benefit of avoiding stockouts here.) He interprets the strong procyclicality of advertising spending as support for a procyclical markup.

[2] If p_t is determined in advance of output then it is contained in the time t information set. Otherwise it is excluded.