



## Corporate holding of finished goods inventories

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### Abstract

This paper investigates the effects of stock out avoidance and market competition on corporate holding of finished goods inventories. We consider two adverse consequences of stock outs: immediate forgone profit and long-run loss of revenue from the shift of customers to more reliable sources of supply. Firms are more inclined to avoid stock outs with greater inventory if the potential for profit is greater. Therefore, we expect inventories to be increasing in the profit margins of firms. In addition, the likelihood of lost revenue from the loss of disenfranchised customers depends upon the alternative sources of supply that are available. If there are good alternative sources, the prospect of long-term revenue loss is greater. The adverse consequence of stock outs is therefore influenced by market competition and we expect the relation between finished goods inventories and the market-power of firms to be negative. In empirical testing, we find evidence consistent with these predictions.

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### 1. Introduction

Firms hold inventories because production and procurement processes cannot instantaneously match product demand. Inventories allow a firm's marketing and production functions to be "decoupled." Inventories accommodate unexpected demand without undue influence

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on production and they accommodate excess production without undue influence on product marketing. Because the discrepancy between demand and production determines incremental inventories, both factors influence corporate management of inventory.

Nonetheless, the academic literature on inventory focuses on production and procurement as the principal determinants of corporate inventory policy and management. For example, the tradeoff between ordering costs (procurement) and holding costs characterizes the transactions approach to inventory management represented by the EOQ and (S, s) models of inventory developed by Harris (1915), Arrow, Harris, and Marschak (1951) and Scarf (1960). These models continue to be modified and refined in the management science literature. The principal focus of the study of inventory in the economics literature is on the macroeconomic role of inventory as a stabilizing or destabilizing factor for production in business cycles (for a review, see Blinder & Maccini, 1991). The production literature investigates process-oriented improvements in inventory such as just-in-time (JIT) methods, integrated materials resource planning (MRP) systems, and supply chain management.

Kallberg and Parkinson (1993, p. 528) conjecture that the reason for focus of the inventory literature on production and procurement is that the “costs” of inventory holding are more easily identified than are the benefits. Notwithstanding this focus, the production and procurement perspective has a number of shortcomings. First, there is no convincing evidence of the economies of scale in inventory management that are characteristic of EOQ and (S, s)-type models. Large firms do not seem to be systematically more efficient at inventory management than are small firms. Further, Cuthbertson and Gasparro (1993) report evidence that the elasticity of inventories with respect to output is not less than one as predicted by these models. Second, in the economics literature, evidence that the variance of production *exceeds* the variance of sales has, in large part, dispelled the view that the primary purpose of inventories is to smooth production in the face of convex costs (see, e.g., Blanchard, 1983). Production cost minimization appears to be an incomplete explanation for corporate inventory holdings. Third, evidence of improving inventory efficiencies arising from computerization and information technologies is mixed. Cuthbertson and Gasparro report some evidence, but Blinder and Maccini (1991) find that inventories are not leaner now than they were decades ago. Despite the revolution in inventory practice brought on by computerization and information technology, the impact on inventory holdings has not, in general, been dramatic.

While production and procurement processes are undoubtedly important for understanding the role of inventory in firms, this perspective is insufficient for a complete understanding. An emerging literature takes the view that the characteristics of a firm’s demand and marketing environments also play an important role in determining optimal corporate inventories. Like the theory of demand in microeconomics that is derived from consumer theory and utility maximization, finished goods inventories (FGIs), in the demand perspective, arise from the benefits that they provide a firm’s customers.

The principal benefit to customers of FGIs is product availability. The importance of product availability is clearly acknowledged in the marketing, management-science, and economics literatures. First, in the management science literature, there is growing recognition of the customer service component of corporate inventory holdings. Both Ernst and Powell (1995) and Urban (1992) investigate optimal corporate inventories when the level of inventory influences demand. Further, Ernst and Powell recognize that, in practice, stock out costs are difficult to

determine because they reflect a long-term loss of demand arising from inadequate service. Research on product availability in the marketing literature examines customers' responses to stock outs. In large part, the impact of stock outs is indeterminate because of uncertainty as to the reaction of the customer. In a survey of head-office buyers for retail and wholesale firms, [Christopher, Schary, and Skjott-Larsen \(1979, chapter 4\)](#) find that product availability is the most important factor influencing buyers' evaluation of suppliers and hence likely to determine the level of their purchases. [Dion and Banting \(1995\)](#) and [Dion, Hasey, Dorin, and Lundin \(1991\)](#) report that stock outs often cause costly production disruptions and that corporate buyers often seek alternative suppliers or products in the face of a stock out. In the retailing environment, the consequence of a stock out appears to differ for retailers and manufacturers. [Emmelhainz \(1991\)](#) finds that, in general, a manufacturer is not as likely as the retailer to lose a sale if the manufacturer's brand is out of stock. In the event of a stock out, purchasers might substitute products, temporarily switch retailers, become permanently lost customers to the retailer, or simply postpone their purchase. [Motes and Castleberry \(1985\)](#) find that customer reaction when there are multiple brands is even less certain because consumers can also switch brands when faced with a stock out of their favorite brand. In the economics literature, [Kahn \(1987, 1992\)](#) incorporates stock out avoidance and stock out costs in economic environments without convex production costs to explain the empirical regularity that the variance of production is greater than the variance of sales.

If, in fact, corporate holding of inventories is a service to a firm's customers that affects the long-term demand for the firm's products, then firms are likely to use inventory as a competitive tool to maximize profits. The implication of this observation is that the competitive nature of a firm's product market environment affects corporate inventory holding. In the current paper, we study this hypothesis.

In his review of inventory models, [Porteus \(1990\)](#) notes that "one of the most fascinating but understudied topics in stochastic inventory theory is competition." A number of recent studies investigate the impact of competition on corporate inventory holding. [Rotemberg and Saloner \(1989\)](#) argue that in oligopolistic markets, other things equal, firms hold greater inventories as a strategic threat to maintain collusive pricing arrangements. Higher inventories allow firms to punish price deviations of cheaters more strongly by flooding the market with product, which has similarly been reduced in price. On the other hand, [Balachander and Farquhar \(1994\)](#) argue that, in some market environments, to avoid price competition, oligopolistic firms might use lower inventories. They show that both of the firms in a duopoly can maintain high prices and minimum stock, if, upon being stocked out, customers find that prices are also high at the rival firm. Their model has the unattractive feature that product availability is independent of customer demand. [Lippman and McCardle \(1997\)](#) study a competitive version of the classic "newsboy" inventory problem, but they do not allow for price competition. Despite the advances in these papers, they are all incomplete.

A model of the effect of competition on corporate inventories should include a number of essential features.<sup>1</sup> First, unexpectedly high product demand should adversely affect product availability and the opportunity cost of stock outs should be recognized. In other words, foregone profit should be a deterrent to stock outs. Second, stock out costs and the effect of competition on stock out costs should be represented. The potential for lost revenue from the loss of disenfranchised customers depends upon the alternative sources of supply that are available. If there

are good alternative sources of supply, the potential for long-term loss of revenue is greater. The adverse consequence of stock outs to a firm is therefore influenced by market competition. Third, price competition between rival suppliers of the product being inventoried should be recognized.

The impact of competition on optimal corporate inventories depends upon its relative effect on profit margins and stock out costs. Other things equal, increased competition reduces profit margin and reduces the incentive to hold inventory as a hedge against lost profits. On the other hand, increased competition increases stock out costs because there are better alternative sources of supply, which, therefore, increases the value to holding inventory.

To sort out the independent effects of foregone profit and stock out costs, we turn to empirical analysis in [Section 2](#) of this paper. There have been few empirical studies of the microeconomic determinants of inventories. Rather, the economics literature has focused on the macroeconomic role of inventories in business cycles. An exception, is [Rotemberg and Saloner \(1989\)](#), who show that the commonly identified positive association between corporate inventories and sales is greater for more concentrated industries. They argue that this result is consistent with their hypothesized strategic motive for corporate inventory holdings. They do not, however, undertake any direct tests of the determinants of corporate inventory holdings. In the current paper, we investigate profit margin and industry concentration ratios as determinants of FGIs using pooled time-series and cross-sectional industry data. Because regression analysis estimates the independent influence of the explanatory variables, profit margin represents the forgone profit associated with stock outs independent of the influence of the competitive environment on profit margins. Concentration ratios represent the effect of the competitive environment on inventory through stock out costs. We expect the sign on profit margin to be positive because higher inventory reduces the likelihood that profits are lost to stock outs. We expect the sign on concentration ratios to be negative because an increase in concentration represents lower competition and a reduction in stock out costs. Last, inventory is expected to be greater when expected demand is greater.

## 2. Empirical analysis

### 2.1. *Data and descriptive statistics*

Our empirical analysis uses corporate financial data for individual firms from the Compustat annual file for the years 1976–1995. Firms are included that were listed on the New York Stock Exchange, the American Stock Exchange or the over the counter market. Excluded from the sample are financial firms, classified in industries with SIC codes between 6000 and 6999, and firms in industries with insignificant inventories. We impose the requirement that each industry has at least five firms for each of the 20 years of the datafile. These selection criteria lead to the 24 industries described in [Table 1](#).

For individual firms, Compustat collects and reports finished goods, work in progress, and raw materials inventories. We investigate the determinants of FGI because of the demand orientation of this paper. Work-in-progress and raw materials inventories are derived from the holdings of FGIs. In addition, production and procurement processes are more likely to affect

Table 1  
Ratio of FGI to invested capital by industry

Industry	SIC code	Average # firms 1976–1995	Average ratio of FGI to invested capital, 1976–1995	Average ratio of FGI to invested capital, sub-period 1976–1985	Average ratio of FGI to invested capital, sub-period 1986–1995
Food and kindred products	2000	64	0.131	0.148	0.114 <sup>†</sup>
Textile mill products	2200	35	0.176	0.175	0.177
Apparel and other finished products	2300	37	0.327	0.362	0.291 <sup>†</sup>
Lumber and wood products, without furniture	2400	14	0.140	0.134	0.145
Furniture and fixtures	2500	24	0.155	0.172	0.138
Paper and allied products	2600	29	0.100	0.097	0.103
Printing, publishing, allied products	2700	35	0.097	0.140	0.053 <sup>†</sup>
Chemical and allied products	2800	139	0.129	0.139	0.119 <sup>†</sup>
Rubber, miscellaneous plastic products	3000	44	0.203	0.213	0.192 <sup>†</sup>
Leather and leather products	3100	11	0.423	0.330	0.516 <sup>†</sup>
Stone, clay, glass concrete	3200	24	0.108	0.114	0.102 <sup>†</sup>
Primary metal industries	3300	33	0.075	0.080	0.070
Fabricated metal	3400	55	0.158	0.169	0.147 <sup>†</sup>
Industrial, commercial machinery, computer	3500	186	0.116	0.125	0.108 <sup>†</sup>
Electronics, electrical equipment,	3600	169	0.136	0.150	0.122 <sup>†</sup>
Transportation equipment	3700	62	0.156	0.158	0.154
Measuring instrument, photo, watches	3800	135	0.152	0.153	0.151
Miscellaneous manufacturing	3900	34	0.190	0.202	0.177 <sup>†</sup>
Communications	4800	7	0.048	0.037	0.038
Durable goods—wholesale	5000	30	0.322	0.325	0.318
Nondurable goods—wholesale	5100	118	0.357	0.278	0.435 <sup>†</sup>
Miscellaneous retail	5900	8	0.471	0.307	0.636 <sup>†</sup>
Business services	7300	29	0.073	0.104	0.043 <sup>†</sup>
Engineering, accounting, research management, services	8700	10	0.104	0.105	0.104

Notes: “average # firms” is the average number of firms in the industry by year over the 20 years in the Compustat Annual Industrial datafile. The industry FGI to invested capital ratio is FGI by industry divided by industry invested capital. The symbol (†) denotes statistical significance at the 1% level in the test that the mean value of this ratio differs between the 1976–1985 sub-period and the 1986–1995 sub-period. Invested capital is short-term debt plus long-term debt plus the par value of preferred shares plus the stated value of common share plus contributed surplus plus retained earnings plus minority interest.

work-in-progress and raw materials inventories. FGIs, therefore, allow for a cleaner test of our hypotheses.

Table 1 reports industry averages of the ratio of finished good inventories to invested capital for the period 1976–1995 and the sub-periods 1976–1985 and 1986–1995. Invested capital is the sum of common equity, long-term debt, minority interest, and preferred stock. Loosely speaking, invested capital measures the total amount that the firm has invested into business activity and that has been financed, directly or indirectly, by the sale of financial assets. FGIs by year are summed over firms in an industry and this sum is then divided by the sum of invested capital for the same year for the industry. These industry ratios of finished goods to invested capital are then averaged over the period or sub-period, as appropriate. The results are reported in Table 1.

In some industries the ratio of FGIs to invested capital is lesser in the 1986–1995 sub-period than in the 1976–1985 sub-period. However, in other industries, the difference appears immaterial. While computerization and information technology might be important factors leading to a downward trend in industry inventory holdings, apparently they are not the only factors. In several industries, the ratio of FGIs to invested capital is greater in the second sub-period than in the first.

We report additional industry descriptive statistics in Table 2. Industry gross margin is calculated as industry sales for the year less industry cost of goods sold divided by industry sales. Invested capital turnover is industry sales divided by industry invested capital. The two-firm concentration ratio is the average of the yearly sales for the two largest firms in the industry (by sales) divided by the industry average of sales.<sup>2</sup> Each of these measures is calculated by industry and by year over the period 1976–1995. The temporal averages are reported in Table 2.

## 2.2. *The determinants of finished goods inventories*

The indeterminate effect of competition on inventory holding is resolved in empirical testing by including both profit margin and a measure of market power in a multiple regression analysis. We use the two-firm concentration ratio, described above, as our measure of market power for the industry. In regression analysis, coefficient estimates represent the effect of *independent* variability of the explanatory variables on the dependent variable. Because both profit margin and the industry concentration ratios are included in the regression, the coefficient on profit margin represents the effect of profit margin on inventories independent of the competitive environment. The competitive environment is controlled by the inclusion of concentration ratios in the regression. Profit margin, therefore, represents the effect of forgone profit from stock outs, and we expect the sign of the coefficient estimate to be positive. On the other hand, the coefficient on the concentration ratio represents its effect on inventories independent of the common association with profit margin. Variability of the concentration ratio, independent of profit margin, represents the impact of the competitive environment on inventories solely through stock out costs (because the effect of profit margin is held constant in the regression). Because an increase in the concentration ratio represents a decrease in competition, we expect the sign on concentration ratio to be negative.

Third, we include the invested capital turnover ratio as an explanatory variable. The primary source of variability in invested capital turnover is sales variability because invested capital

Table 2  
Descriptive statistics: gross margin, invested capital turnover, and industry concentration

Industry	SIC code	Average # firms 1976–1995	Gross-margin	Invested capital turnover	Two-firm concentration ratio
Food and kindred products	2000	64	0.360	2.205	8.005
Textile mill products	2200	35	0.232	1.874	4.867
Apparel and other finished products	2300	37	0.311	2.449	4.973
Lumber and wood products, without furniture	2400	14	0.222	2.440	2.871
Furniture and fixtures	2500	24	0.292	2.231	5.332
Paper and allied products	2600	29	0.322	1.447	5.286
Printing, publishing, allied products	2700	35	0.422	1.534	5.843
Chemical and allied products	2800	139	0.450	1.655	11.205
Rubber, miscellaneous plastic products	3000	44	0.282	2.075	11.006
Leather and leather products	3100	11	0.356	2.607	3.523
Stone, clay, glass concrete	3200	24	0.283	1.469	4.418
Primary metal industries	3300	33	0.202	1.290	6.622
Fabrication metal	3400	55	0.339	1.855	7.168
Industrial, commercial machinery, computer	3500	186	0.398	1.779	28.266
Electrical, electrical equipment	3600	169	0.330	1.900	26.638
Transportation equipment	3700	62	0.183	2.969	10.454
Measuring instrument, photo, watches	3800	135	0.461	1.631	20.374
Miscellaneous manufacturing	3900	34	0.435	2.038	5.011
Communications	4800	7	0.357	1.213	2.590
Durable goods—wholesale	5000	30	0.247	2.221	5.480
Nondurable goods—wholesale	5100	118	0.240	3.352	2.730
Miscellaneous retail	5900	8	0.344	3.126	3.085
Business services	7300	29	0.352	1.896	6.328
Engineering, accounting, research management, services	8700	10	0.255	2.769	3.543

Notes: “average # firms” is the average number of firms in the industry by year over the 20 years in the Compustat Annual Industrial datafile. Industry gross-margin is industry-sales for the year less industry-cost-of-goods sold divided by industry sales. Invested capital turnover is industry sales divided by industry invested capital. The two-firm concentration ratio is the average of the yearly sales for the two largest firms (by sales) in the industry divided by average sales for the entire industry. Each of these measures is calculated by industry and by year over the period 1976–1995 and the temporal average results are reported in the body of the table.

is relatively stable. We use ex-post sales realization as a proxy for expected sales, which is a determinant of inventory holding. Because inventories are positively related to expected sales, we expect the coefficient estimate on invested capital turnover to be positive.<sup>3</sup>

Of the 25,650 annual financial reports summarized in the Compustat Annual file between 1976 and 1995, for firms that reported non-zero inventory holdings, 55% used *First In, First Out*, (FIFO) as their primary choice for inventory accounting, 28.5% used *Last In, First Out*, (LIFO) while the remainder used other methods. In order to ensure that any results that we obtain do not arise from inventory accounting choices, we include in the regression a variable for the primary inventory accounting method used in the industry.

In addition, to ensure that our results do not arise from unrepresented industry effects we include industry dummy variables in the regression. The industry dummies correspond to SIC industries 2000, 3000, 4000, 5000, 7000 and 8000, respectively.

Finally, a time index,  $t$ , where 1976 is 1, and 1995 is 20, is included as an explanatory variable to represent process improvements in inventory management arising from information technology and computerization. The expected sign on the time index is negative.

The regression model is:

$$\begin{aligned} \tilde{FGI}_{i,t} = & \gamma + \beta_1 \text{MAR}_{i,t} + \beta_2 \text{TURN}_{i,t} + \beta_3 \text{CR}_{i,t} + \beta_4 \text{ACC}_{i,t} + \beta_5 t + \alpha_2 d_2 + \alpha_3 d_3 \\ & + \alpha_4 d_4 + \alpha_7 d_7 + \alpha_8 d_8 + \tilde{\varepsilon}_{i,t}, \quad i = 1, 24, t = 1, 20, \end{aligned} \quad (1)$$

where,  $i$  refers to the industry,  $t$  is the year index,  $\text{FGI}_{i,t}$  is the FGI to invested capital ratio,  $\text{MAR}_{i,t}$  is the industry gross-margin,  $\text{TURN}_{i,t}$  is the invested capital turnover ratio,  $\text{CR}_{i,t}$  is the two-firm concentration ratio and  $\text{ACC}_{i,t}$  is the fraction of firms for industry  $i$  in year  $t$  that use FIFO as their primary method of inventory accounting. Because FIFO leads to greater recorded inventory amounts than LIFO when product prices are generally increasing, we expect the sign of the estimated coefficient on  $\text{ACC}_{i,t}$  to be positive.<sup>4</sup>

The five industry dummies,  $d_2$ ,  $d_3$ ,  $d_4$ ,  $d_7$ , and  $d_8$ , correspond to SIC industries 2000, 3000, 4000, 7000, and 8000, respectively. Because a constant is estimated and the dummy  $d_5$  for the retail and wholesale industries is excluded, the estimated coefficients  $\alpha_2$ ,  $\alpha_3$ ,  $\alpha_4$ ,  $\alpha_7$  and  $\alpha_8$  represent the differential inventory holdings in SIC industries 2000, 3000, 4000, 7000, and 8000 compared to 5000 that is not accounted for by the other explanatory variables.

The correlation structure for the disturbances is: for  $t \geq t'$ ,  $E(\tilde{\varepsilon}_{i,t}, \tilde{\varepsilon}_{j,t'}) = \sigma_{i,j} \rho_i^{t-t'} / (1 - \rho_i \rho_j)$ . Thus, the model assumes that (1) the disturbance for a given industry follows a first-order auto-regressive process that can differ across industries, (2) the variance of the disturbance is heteroscedastic with respect to industries, and (3) the disturbances for different industries are correlated (both contemporaneously and non-contemporaneously). Eq. (1) is a dummy variable fixed parameter model rather than an error components model because we presume that  $\gamma$ ,  $\alpha_2$ ,  $\alpha_3$ ,  $\alpha_4$ ,  $\alpha_7$  and  $\alpha_8$  are fixed and have no random elements.

In the pooled time-series and cross-sectional regression model in equation (1) there are 480 observations: 24 industries by 20 years. The years are 1976–1995 and the description of industries can be found in either Tables 1 and 2. This pooled time-series, cross-sectional regression is estimated with GLS and the results are reported in Table 3. See Judge, Griffiths, Carter Hill, Lütkepohl, and Lee (1985, chapter 13) for a discussion of GLS-estimation with pooled time-series and cross-sectional data.

Table 3

The determinants of FGIs,  $i = 1, 24, t = 1, 20$ ,  $\text{FGI}_{i,t} = \gamma + \beta_1 \text{MAR}_{i,t} + \beta_2 \text{TURN}_{i,t} + \beta_3 \text{CR}_{i,t} + \beta_4 \text{ACC}_{i,t} + \beta_5 t + \alpha_2 d_2 + \alpha_3 d_3 + \alpha_4 d_4 + \alpha_7 d_7 + \alpha_8 d_8 + \tilde{\varepsilon}_{i,t}$

Parameter	GLS-estimate	t-ratio
$\gamma$	0.207	8.74 <sup>†</sup>
$\beta_1$	0.054	2.69 <sup>†</sup>
$\beta_2$	0.052	18.06 <sup>†</sup>
$\beta_3$	-0.0004	-2.28*
$\beta_4$	0.003	0.43
$\beta_5$	-0.001	-4.07 <sup>†</sup>
$\alpha_2$	-0.187	-8.30 <sup>†</sup>
$\alpha_3$	-0.179	-8.01 <sup>†</sup>
$\alpha_4$	-0.239	-9.96 <sup>†</sup>
$\alpha_7$	-0.238	-9.09 <sup>†</sup>
$\alpha_8$	-0.248	-5.96 <sup>†</sup>
$\hat{\rho}$	0.869	
$\hat{\sigma}^2$	0.0012	
Buse (1973) $R^2$	0.535	

Notes: Index  $i$  is the industry,  $t$  is the year. There are 480 observations: 24 industries by 20 years. The years are 1976–1995 and the description of industries can be found in either Tables 1 and 2.  $\text{FGI}_{i,t}$  is the finished goods inventory to invested capital ratio for industry  $i$  in year  $t$ .  $\text{MAR}_{i,t}$  is the gross margin for industry  $i$  in year  $t$ .  $\text{TURN}_{i,t}$  is the invested capital turnover ratio for industry  $i$  in year  $t$ .  $\text{CR}_{i,t}$  is the two-firm concentration ratio for industry  $i$  in year  $t$ ,  $\text{ACC}_{i,t}$  is the fraction of firms for industry  $i$  in year  $t$  that used FIFO as their primary method of inventory accounting. The six industry dummies,  $d_2, d_3, d_4, d_7, d_8$ , correspond to SIC industries 2000, 3000, 4000, 7000 and 8000, respectively. The presumed correlation structure for the disturbances is: for  $t \geq t'$ ,  $E(\tilde{\varepsilon}_{i,t}, \tilde{\varepsilon}_{j,t'}) = \sigma_{i,j} \cdot \rho_i^{t-t'} / (1 - \rho_i \rho_j)$ . The symbols (\*) and (†) denote statistical significance at the 5% and 1% levels, respectively.

### 2.3. Empirical results

The results are generally as we hypothesized. First, the estimated coefficient on gross-margin is positive and statistically significant. This result is consistent with profitability being a deterrent to stock outs.

Second, the coefficient on invested capital turnover is positive and statistically significant. This result is consistent with inventories being positively related to expected sales. Inventory tends to increase with greater demand in order to translate this demand into sales rather than stock outs.

Third, the coefficient on the two-firm concentration ratio is negative and statistically significant. This result implies that firms decrease their inventory holdings with an increase in their market power. An interpretation is that a less competitive product market reduces the adverse consequences of stock outs and firms respond by reducing inventories. This result is evidence of the effect of competition on corporate inventory holding.

Fourth, the sign on the accounting variable,  $\text{ACC}_{i,t}$ , which represents the fraction of firms in an industry that use FIFO inventory accounting is positive as predicted, but statistically insignificant. Despite this insignificance, it is important to control for inventory accounting

choice to ensure that the other results that we report arise from the economics of the situation and not an unrepresented accounting phenomenon.

Fifth, the coefficient on the time index is negative and statistically significant. This result, which is consistent with Cuthbertson and Gasparro (1993), is evidence of improving inventory efficiencies over time from computerization and implementation of information technologies.

Last, the coefficient estimates on all of the industry dummies are negative and statistically significant. Despite the influence of the other explanatory variables, inventory holding in the industries with SIC codes 2000, 3000, 4000, 7000 and 8000 are lesser than in the retailing and wholesale industries of SIC 5000. There is an industry effect on inventory that is not completely captured by the set of explanatory variables that we use in Eq. (1).

### 3. Conclusion

This paper investigates the effects of stock out avoidance and market competition on corporate holding of FGIs. We consider two adverse consequences of stock outs: immediate forgone profit and long-run loss of revenue arising from the shift of customers to more reliable sources of supply. Firms are more inclined to avoid stock outs with greater inventory if the potential for profit is greater. Other things equal, therefore, we expect inventories to be increasing in the profit margins of firms. In addition, the likelihood of lost revenue arising from the loss of disenfranchised customers depends upon the alternative sources of supply that are available. If there are good alternative sources, the prospect of long-term revenue loss is greater. The adverse consequence of stock outs is therefore influenced by market competition and we expect the relation between FGIs and the market-power of firms to be negative. In empirical testing, we report evidence that is consistent with these predictions.

### Notes

1. One can develop a model with these features. However, we undertake no formal theoretic model building because the general conclusion is clear that as profit margin and/or stock out costs increase, required inventory levels increase.
2. There are three instances where an industry has exactly five firms, the minimum required to constitute an industry for our study. These are for the two-digit SIC codes 4800 in 1990, 5900 in 1993, and 8700 in 1995. Because we want to measure concentration by a *minority* of firms in the industry, we use the two-digit concentration ratio. By contrast, the three-firm concentration ratio represents a *majority* of firms in these particular industries in these years. Nonetheless, when we estimate Eq. (1) with a three-firm concentration ratio rather than the two-firm concentration ratio, the results, which we do not report, are essentially the same as in Table 3, which uses the two-firm concentration ratio, with the exception that the coefficient on concentration is significant at the 10% level rather than the 5% level.
3. Rather than invested capital turnover, we also estimated Eq. (1) with industry cost of goods sold divided by industry invested capital. Cost of goods sold reflects the expense environment of businesses rather than the demand environment, although, of course,

industry sales and cost of goods sold are related to one another. The results of this alternative regression, not reported, are essentially the same as in Table 3, which uses invested capital turnover, with the exception that the coefficient on industry concentration is significant at approximately the 10% level rather than the 5% level.

4. In addition, with a variant of Eq. (1) we tested for differential relations between FGI and profit margin and between FGI and industry concentration with a dummy variable that identifies industries that predominantly use FIFO accounting. The results, which we do not report, uncover no evidence of differential relations.

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