EVIDENCE ON THE RELATION BETWEEN INVENTORY CHANGES, EARNINGS AND FIRM VALUE

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ABSTRACT

Prior studies contend that an unexpected increase in inventory reflects a firm's difficulty in generating sales and results in negative earnings growth and stock returns. Using a sample with over 85,000 observations for the period of 1950-2005, we confirm the negative relation between inventory changes and firm performance but find that the relation is sensitive to the choice of sample period. Moreover, this relation is somewhat attenuated for firms in the wholesale and retail industry as well as for firms that normally carry low levels of inventory. Our findings suggest that the macroeconomic and industry-specific environments are important moderators of the relation between inventory changes and firm performance.

JEL: G34

KEYWORDS: Inventory; Working capital management

INTRODUCTION

In their survey of research on inventories, Blinder and Maccini (1991) point out that the drop in inventory accounts for 87% of the drop in Gross National Product (GNP) during an average recession in the US. Ramey and West (1997) point out a similar link between inventories and GDP for five of the G7 countries. At the firm level, Thomas and Zhang (2002) find that changes in inventory are the primary driver for the relation between accruals and future abnormal returns. Taken together, they suggest that inventories are important determinants of firm performance and value. Yet, there is very little research that has examined this issue and our understanding of the influence of inventory on firm value remains incomplete. Notable exceptions are the work of Abarbanell and Bushee (1997) and Lev and Thiagarajan (1993). Abarbanell and Bushee (1997) examine the relation between EPS changes and several firm characteristics (including the change in inventories) from 1983 to 1990 and find that an unexpected increase in inventory (to sales) is negatively related to short-term earnings growth measured by one-year-ahead EPS change. Lev and Thiagarajan (1993) examine the relation between inventory changes and stock price returns by examining a large cross-section of firms from 1974 to 1988 and find that unexpected increases in inventory result in lower stock price returns. However, even this evidence is not complete. First, our present understanding of the role of inventory relies disproportionately on a relatively small number of studies that analyze a narrow set of metrics over a small number of years. As a result, it is not clear if the conclusions will hold out of sample. Second, prior research has not delved into potential differences between industries. In particular, inventory management is at the heart of the operations of retailers and wholesalers (in this paper we collectively refer to them as distributors). Therefore, increases or decreases in inventory levels for retailers and wholesalers may be driven by very different considerations than similar changes for firms in any other industries.

In this paper we address these two issues. First, by employing a relatively long 56-year sample period, we examine if the negative correlation between the unexpected changes in inventory and earnings growth holds for all time periods. We also test for the robustness of our conclusions using a number of alternate metrics of firm performance. Second, by further classifying firms by industry, we examine if the negative

correlation holds for all the industries. Similar to Abarbanell and Bushee (1997) and Lev and Thiagarajan (1993), we find that an unexpected increase (decrease) in inventory is followed by a fall (rise) in short term earnings during the 1970s and 1980s. However, this conclusion does not hold for other time periods. We find no significant relation during the 1950s and the 1960s and a weaker relation in the years after 2000. With respect to long term changes in earnings, we find an inverse relation between the unexpected change in inventories and long term changes in earnings for the 1950s and the 1990s but not for the other decades. We also test for the robustness of these results to the use of alternate metrics of firm performance such as return on assets and the market to book ratio. We find negative relations between inventory and the changes in the market-to-book ratio and also between inventory and the change in the return on assets. However, the significance and the magnitude of the relation remain sensitive to the choice of sample period. Finally, in our analysis of industry effects, we find some evidence that suggests that an unexpected increase in inventories is not as negative for wholesalers and retailers. However, this conclusion is also sensitive to the choice of sample period.

Our contributions from this study are twofold. First, in comparison with prior research, we examine a relatively large sample period. As a result, we are better able to assess the relation between the unexpected inventory changes and firm performance and its stability over time. Second, we examine potential problems that may arise from viewing all firms as a homogeneous group. In particular, we test for potential differences in this relation for the wholesale and retail industry. Our results provide a more complete picture of the way in which inventory management affects firm performance. The rest of the paper is organized as follows. Section 2 reviews prior research and presents our hypotheses; section 3 describes our data; section 4 presents our results, and section 5 concludes.

PRIOR WORK AND HYPOTHESES

Inventory management affects firm performance in various ways. As noted by Blinder and Maccini (1991), by holding inventory, firms can improve production scheduling, minimize stock-out costs, reduce purchasing costs by buying in quantity and speculate on price movements. However, there are costs to holding inventory as well. These typically include opportunity cost, cost of space, handling cost, stock obsolescence, insurance, spoilage, pilferage and inventory damage. It is also possible that the stock market may interpret a rise in inventory as an indication of an unanticipated shortfall in sales. Therefore, the stock market could discount firms with high inventory, and so raise the capital costs of firms that carry high levels of inventory. As noted by Lai (2006), better managed firms will signal their superior quality by carrying lower inventory and so distinguishing themselves from firms that are unable to decrease inventory to similar levels. Finally, the motives of managers could also be an important determinant of inventory levels. As shown by Gaur et al (2005) inventory and gross margin are negatively correlated. Therefore, lowering inventory may improve earnings in the short run. However, this could be at the expense of the long-term growth if maintaining high inventory is the optimal strategy. Moreover, as pointed out by Stein (1988), Narayanan (1985) and Niehaus (1989), managers could overemphasize short term earnings growth as their compensation, in the form of bonuses, grants of stock and options holdings are more short-term performance related. In summary, there are several advantages to holding inventory as well as several disadvantages. The net impact of increasing or decreasing inventory on firm performance, therefore, remains an empirical matter.

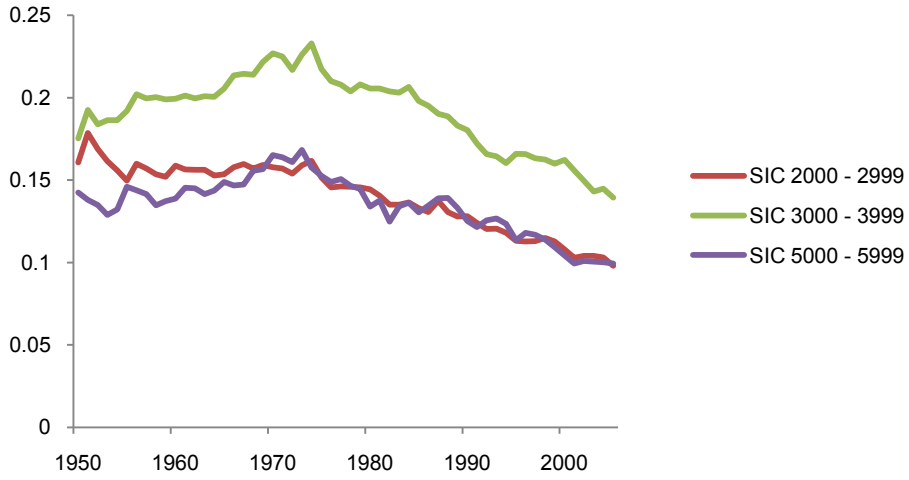
The relatively sparse evidence on this topic has mostly supported a negative relation between inventory and firm performance. With respect to stock market based measures of firm performance, Lai (2006) finds that firms with less inventory are better regarded by the stock market as evinced by a higher Tobin's Q. Chen et al (2005) find that stocks of firms holding less inventory earn superior returns. However, they note that their conclusion does not hold for firms with the lowest inventory levels. Finally, Lev and Thiagarajan (1993), Abarbanell and Bushee (1998) and Bao and Bao (2004) document a negative relation between stock returns and changes in inventory. The only comprehensive study using accounting

measures is by Abarbanell and Bushee (1997). They examine the relation between earnings per share (EPS) change and a series of firm characteristics from 1983 to 1990 and find that changes in inventory are negatively related to short-term earnings growth as measured by one-year-ahead EPS change. However, they do not find any relation between changes in inventory and long-term growth in earnings measured by five-year geometric mean growth in EPS. In a related study, Weiss et al (2008) find that between 1990 and 2000 inventory changes are significant predictor of future earnings.

Although the evidence largely supports a negative relation between inventory and firm performance, there are reasons to believe that it is incomplete. First, the most comprehensive studies outlined above pertain to the period from the 1970s to the 1990s. As can be seen from Figure 1, the overall inventory management policies of all listed firms seem to have changed over time. In particular, the period from the 1970s to the 1990s were characterized by declining inventory levels and it is possible that the negative relation between inventory and firm performance during that time was an artifact of the then prevailing economic environment rather than a more general relation. Second, and to a lesser extent, a more comprehensive set of metrics of firm performance could help us test for the robustness of the observed relation. In summary, our first hypothesis is as follows:

Hypothesis 1: Firm performance, as measured by earnings, return on assets and market valuation will be negatively related to changes in inventories.

Figure 1: Profile of Inventory-to-sales Ratio from 1950 to 2005



The sample consists of all firms in the primary products (SIC 2000-2999), manufacturing (SIC 3000-3999), and wholesale and retail industry. (SIC 5000-5999) in the annual Compustat database from 1950 to 2005.

Our first hypothesis implies that any change in inventory that is greater than the corresponding change in sales stems from an unplanned change in the volume of sales. However, an increase in inventory for the wholesale and retail industry could be driven by other considerations. The wholesale / retail industry has several unique features, differentiating it from other sectors. First, the interpretation of an unexpected increase in inventory to sales as bad news stems largely from the role of inventory in smoothing production. Unlike manufacturers, wholesalers and retailers do not produce any goods, and so this motive does not exist in the wholesale and retail industry. Moreover, dealing with a large number of customers on a daily basis may provide distributors with more market feedback on their products. As a result, they might better able to predict market demand, and therefore adjust inventory in anticipation of future changes in the product market. As a result, a sudden increase in inventory for a distributor is relatively

more likely to be the response to a predicted change in future demand than the result of an unanticipated change in current demand. Finally, it has become increasingly common for distributors to develop collaborative partnerships with their suppliers on inventory protection in case of obsolete items and unfavorable price changes, substantially reducing their risks of holding inventory. The inventory protection mechanism is expected to offset the negative effect of the inventory increase by hedging against price risk and obsolescence risk.

Vendor-managed inventory (VMI) is one of the most widely discussed supplier/vendor programs in the wholesale and retail industry and it was popularized in the late 1980s by Wal-Mart and Procter & Gamble. As noted by Waller et al (2001), through VMI the vendor transfers financial responsibility for the inventory partly to the supplier. Thus, holding more inventory works like a call option. When prices rise, distributors benefit from the change. However, their losses are limited when prices go down. Overall, retailers and wholesalers enjoy unique benefits from holding inventory. Therefore, our second hypothesis is as follows:

Hypothesis 2: The negative general relation between an unexpected increase in inventories and firm performance will be smaller for firms in the wholesale and retail industries.

DATA AND METHODOLOGY

We collect data on firm characteristics from the Compustat database. In addition, we collect data on nominal GDP growth rate, the three month T-bill rate, and the Producer Price Index (PPI) from Federal Reserve Economic Data (FRED) made available by the Federal Reserve Bank of St. Louis. As indicated by Abarbanell and Bushee (1997) inventory data are meaningful in the context of our study only for industries that maintain a stock of raw materials or finished goods. Therefore, we only include firm-year observations from the primary products (SIC codes from 2000 to 2999), manufacturing (SIC codes from 3000 to 3999), and wholesale and retail (SIC codes from 5000 to 5999) sectors. We follow prior research in defining our sample in this fashion as it is difficult to interpret inventory holdings for other sectors – a similar industry specification for the sample has been followed by Lai (2005), Lai (2006) and Abarbanell and Bushee (1997).

We mainly follow Lev and Thiagarajan (1993) and Abarbanell and Bushee (1997) in defining our variables and the details of these are provided in Table 1. We avoid problems due to outliers by winsorizing the extreme 1% observations of the predictor variables. The final sample consists of 7,821 firms that we follow for the 56 years from 1950 to 2005. In order to explore the relation between inventory changes and firm value or earnings we run a number of ordinary least squares (OLS) regressions of the form:

$$\textit{Performance metric} = \beta_0 + \beta_1 * \textit{Inventory change} + \Sigma\, \beta_i * \textit{Control variable}_i$$

Our dependent variable is one of several performance metrics and based on earnings and firm value. Similar to Lev and Thiagarajan (1993) and Abarbanell and Bushee (1997), we measure short term changes in earnings by CEPS1 and long term changes in earnings by CEPSL. We also measure the operating performance using changes in the return on assets (ROA). Finally, we measure value changes using changes in the market-to-book ratio. We define our independent and dependent variables in Table 1.

We follow Abarbanell and Bushee (1997) and Lev and Thiagarajan (1993) in choosing our control variables. They include the unexpected increase in accounts receivable (AR), the unexpected decrease in capital expenditures (CAPX), the unexpected decrease in the gross margin (GM), the unexpected increase in selling and administrative expenses (S&A), earning quality (EQ), and the change in the number of employees scaled by sales (LF). In each case, the expected change is proxied by the change in sales and

the unexpected change is computed as the difference between the observed change and the expected change. We also control two macro-economic factors, real GDP growth rate (GDPGROW) and nominal interest rate (INTEREST). In general, high real GDP growth and low interest rate provide favorable exterior environment for firms to growth their earnings, so real GDP growth is expected to be positively related to earnings growth while interest rate is negatively related. Our primary dependent variable is the unexpected increase in inventory (INV) and is measured as the percentage change in inventory minus the percentage change in sales.

Table 1: Definition of Variables

Variables	**Measurement** [a]
Inventory (INV)	Δ Inventory - ΔSales
Accounts Receivable (AR)	Δ Accounts Receivable - Δ Sales
Capital Expenditure (CAPX)	Δ Industry CAPX -Δ Firm CAPX
Gross Margin(GM)	Δ Sales - Δ Gross Margin
Selling and Administrative Expense (S&A)	Δ S&A -Δ Sales
Labor Force (LF)	$\left(\frac{Sales_{t-1}}{\#\ Employes_{t-1}} - \frac{Sales_t}{\#\ Employes_t}\right) \Big/ \frac{Sales_{t-1}}{\#\ Employes(29)_{t-1}}$
One-Year –Ahead Earnings (CEPS1)	$[Adj.EPS_{t+1} - EPS_t]/P_{t-1}$ [e]
Long-Term Growth in Earnings ($CEPSL_t$)	$\prod_1^5 CEPSi^{1/5}$ e.g. $CEPS2 = [adjEPS_{t+2} - EPS_{t+1}]/P_t$
CHGEPS	$[Adj.EPS_t - EPS_{t-1}]/P_{t-1}$
CROA	$ROA_{t+1} - ROA_t$
CHGROA	$ROA_t - ROA_{t-1}$
CMtoB	$\frac{M}{B}\ ratio_t - \frac{M}{B} ratio_{t-1}$
GDPGROW	Real GDP growth rate
INTEREST	Nominal interest rate

1)The definitions of the predictor variables are based on Abarbanell and Bushee (1997). The Δ operator represents a percentage change in the variable based on a two-year expectation model; e.g. $\Delta Sales = [Sales_t - E(Sales_t)]/E(Sales_t)$ *where* $E(Sales_t) = (Sales_{t-1} + Sales_{t-2})/2$ *2) The Inventory variable is finished goods when available, total inventory otherwise. 3) Industry Capital Expenditures are calculated by aggregating firm figures for all firms with the same two-digit SIC code. 4) Adjusted EPS refers to adjustments made for stock splits and stock dividends in order to EPS numbers for different years comparable.*

RESULTS

Table 2 provides a descriptive summary of the whole sample as well as the subsample from the wholesale and retail industry. Over the entire sample period, the wholesale and retail industry accounts for 10% to 20% of the total observations. On average, wholesalers and retailers are roughly the same size as firms in other industries but have lower profitability and a higher rate of inventory turnover. Figure 1 highlights further differences between the distributors and firms in other industries. As can be seen in Figure 1, distributors tend to carry significantly less inventory than manufacturing firms and somewhat less than firms that operate in the primary products industries. Overall, Table 2 and Figure 1 suggest potential differences in inventory levels for distributors.

Table 2 Descriptive Summary

Panel A: Full Sample						
	1950s	1960s	1970s	1980s	1990s	2000 -
Number of firm-years	5757	17001	32438	36963	45023	23953
Inventory/Sales	17.29%	18.18%	18.42%	16.78%	14.49%	12.87%
EBITDA/Sales	12.86%	11.08%	9.94%	9.96%	10.62%	10.84%
Asset(mm$)	54.80	29.50	30.90	40.81	69.90	139.59

Panel B: Wholesale and Retail Firms						
	1950s	**1960s**	**1970s**	**1980s**	**1990s**	**2000 -**
Number of firm-years	673	2786	6654	7849	9252	4279
Inventory/Sales	13.50%	14.77%	15.46%	13.41%	11.88%	10.04%
EBITDA/Sales	6.59%	6.16%	6.26%	6.33%	6.28%	7.01%
Asset(mm$)	50.40	24.57	31.10	45.68	104.45	248.57

Overall Relation between Inventory and Firm Performance

Our first set of tests is geared towards understanding the relation between inventory and short term firm performance. We define short term firm performance in two ways. First, and similar to Abarbanell and Bushee (1997), we look at the one year forward change in the earnings per share (CEPS1). Second, we look at the change in the return on assets (CROA) over a similar period. Our primary predictor variable is the change in the inventory - to - sales ratio (INV) in the preceding year and we run regressions of the form:

$$CEPS1_{t,i} = \beta_0 + \beta_1 * CHGEPS_{t,i} + \beta_2 * INV_{t,i} + \sum_j \beta_j * Control_{t,i,j} + \varepsilon_{t,i} \quad (1)$$

$$CROA_{t,i} = \beta_0 + \beta_1 * CHGROA_{t,i} + \beta_2 * INV_{t,i} + \sum_j \beta_j * Control_{t,i,j} + \varepsilon_{t,i} \quad (2)$$

where the observations are for the firm *i* in period *t* with the subscript *j* for the control variables. Similar to Abarbanell and Bushee (1997), we control for one year lagged values of the dependent variable (CHGEPS and CHGROA). We also control for AR, CAPX, GM, S&A, EQ, LF and macro-economic factors including real GDP growth rate and nominal interest rate. Unlike Abarbanell and Bushee (1997), we do not control for the tax rate and earnings quality as there are a large number of missing observations for these variables, especially during the earlier years of our sample. However, their inclusion leaves our conclusions largely unchanged.

Table 3 reports the results of this regression. In Panel A of Table 3 we report the results pertaining to the test of earnings growth. The coefficient estimate for INV is negative and significant from 1970 to 1999. Interestingly, this covers the sample period studied by Abarbanell and Bushee (1997) and Lev and Thiagarajan (1993). Outside of this period, the significance is markedly lower from 2000 to 2005 and the estimate is insignificant during the 1950s and the 1960s. Our results indicate that the relation is sensitive to sample period selection and that the results presented by prior research are limited to the specific samples that they study.

Table 3 Panel A: Changes in Short Term Earnings

	1950-2005	50-59	60-69	70-79	80-89	90-99	2000-05
CHGEPS	-0.106	-0.264	-0.128	-0.122	-0.123	-0.134	-0.056
	(11.43)***	(3.11)***	(1.83)	(5.39)***	(7.00)***	(8.37)***	(2.98)***
INV	-0.011	-0.008	-0.004	-0.021	-0.016	-0.006	-0.007
	(8.33)***	(1.13)	(1.42)	(6.24)***	(7.77)***	(2.60)***	(1.91)*
AR	-0.008	0.022	0.003	-0.003	-0.014	-0.012	0.005
	(3.72)***	(3.59)***	(1.20)	(0.53)	(3.52)***	(3.06)***	(0.71)
CAPX	0.011	-0.001	0.001	0.010	0.009	0.012	0.015
	(16.19)***	(0.51)	(1.84)	(7.54)***	(8.51)***	(9.92)***	(6.24)***
GM	0.024	-0.026	-0.004	0.036	0.027	0.012	0.026
	(6.40)***	(1.65)	(0.53)	(2.83)***	(4.05)***	(2.08)**	(3.05)***
S&A	0.032	-0.010	-0.005	0.013	0.028	0.029	0.054
	(7.39)***	(1.41)	(0.92)	(1.09)	(3.57)***	(3.87)***	(4.53)***
EQ	0.009	-0.000	0.000	0.003	0.005	0.017	0.027
	(5.45)***	(0.09)	(0.27)	(0.90)	(1.64)	(5.34)***	(3.72)***
LF	-0.021	0.047	0.002	-0.013	-0.018	-0.018	-0.040
	(4.81)***	(2.55)**	(0.56)	(0.98)	(2.52)**	(2.45)**	(3.32)***
GDPGROW	0.002	0.001	0.002	0.002	0.004	0.000	0.011
	(8.31)***	(2.27)**	(7.48)***	(4.35)***	(6.65)***	(0.32)	(7.49)***
INTEREST	-0.004	-0.017	-0.003	-0.004	-0.001	-0.007	-0.009
	(11.17)***	(8.64)***	(7.70)***	(2.98)***	(0.91)	(3.86)***	(5.47)***
CONSTANT	0.034	0.049	0.011	0.050	0.005	0.046	0.020
	(11.98)***	(7.67)***	(4.55)***	(5.52)***	(0.63)	(4.10)***	(2.12)**
Observations	85226	1470	5412	19333	22037	25100	11874
R-squared	0.03	0.21	0.05	0.04	0.04	0.03	0.03

*The sample consists of all firms with SIC codes from 2000 to 3999 and from 5000 to 5999 in the annual Compustat database from 1950 to 2005. The table provides estimates of equation 1 where the dependent variable is the one year forward change in EPS (CEPS1). The second column provides estimates for the full sample while the remaining columns provide estimates for the subsamples for each decade. Figures in parentheses are robust (White) t-statistics. Significance at 10%, 5%, and 1% level are marked by *, **, and *** respectively.*

Table 3 Panel B: Changes in ROA

	1950-2005	**50-59**	**60-69**	**70-79**	**80-89**	**90-99**	**2000-05**
CHGROA	-0.223	-0.150	-0.116	-0.167	-0.255	-0.244	-0.182
	(17.76)***	(3.26)***	(4.16)***	(6.58)***	(11.54)***	(11.37)***	(5.94)***
INV	-0.009	0.001	-0.005	-0.009	-0.009	-0.008	-0.009
	(8.74)***	(0.26)	(1.78)*	(6.03)***	(4.94)***	(4.15)***	(3.16)***
AR	0.001	0.020	0.005	0.002	0.002	-0.002	-0.001
	(0.50)	(4.62)***	(1.72)*	(0.91)	(0.75)	(0.56)	(0.18)
CAPX	0.005	0.001	0.002	0.003	0.004	0.007	0.009
	(13.14)***	(0.91)	(3.18)***	(5.23)***	(6.43)***	(8.17)***	(5.41)***
GM	0.007	0.011	0.014	0.026	0.009	0.001	-0.000
	(2.55)**	(1.60)	(3.01)***	(4.88)***	(1.86)*	(0.19)	(0.02)
S&A	-0.007	0.004	0.004	0.000	-0.015	-0.015	0.011
	(2.16)**	(1.22)	(1.17)	(0.02)	(2.22)**	(2.37)**	(1.19)
EQ	-0.003	0.001	-0.001	0.000	-0.004	-0.004	-0.003
	(5.07)***	(0.49)	(0.77)	(0.11)	(3.31)***	(3.71)***	(1.41)
LF	-0.009	0.023	0.001	-0.002	-0.011	-0.004	-0.026
	(3.05)***	(2.28)**	(0.30)	(0.28)	(1.89)	(0.76)	(2.94)***
GDPGROW	0.001	0.001	0.002	-0.000	0.001	-0.001	0.001
	(8.04)***	(3.26)***	(9.39)***	(1.78)	(4.99)***	(2.65)***	(0.79)
INTEREST	-0.001	-0.014	-0.005	-0.005	-0.001	-0.004	-0.008
	(10.24)***	(10.24)***	(10.40)***	(11.04)***	(3.86)***	(4.48)***	(9.73)***
CONSTANT	0.003	0.026	0.008	0.034	0.002	0.021	0.016
	(2.82)***	(5.68)***	(2.94)***	(9.62)***	(0.49)	(3.86)***	(4.63)***
Observations	95511	2188	6159	23026	24419	27177	12542
R-squared	0.05	0.18	0.08	0.06	0.07	0.06	0.05

*The sample consists of all firms with SIC codes from 2000 to 3999 and from 5000 to 5999 in the annual Compustat database from 1950 to 2005. The table provides estimates of equation 2 where the dependent variable is the one year forward change in ROA (CROA). The second column provides estimates for the full sample while the remaining columns provide estimates for the subsamples for each decade. Figures in parentheses are robust (White) t-statistics. Significance at 10%, 5%, and 1% level are marked by *, **, and *** respectively.*

It is possible that the growth in earnings is related to an expansion in the asset base. In order to get a cleaner measure of the change in the performance for a given firm, we replace EPS change with ROA change. Panel B of Table 3 reports the results for the tests using ROA as a measure of firm performance. As in Panel A, we control for one year lagged values of the dependent variable as well as AR, CAPX, GM, S&A, EQ, LF, and real GDP growth rate and nominal interest rate. As in the previous case, we exclude the tax rate and the earnings quality from the list of control variables. However, our conclusions remain qualitatively unchanged when we include them. Our conclusions are as before: INV is negatively related ROA but the relation is sensitive to the choice of the sample period.

In order to assess if the effects of a change in inventory pertain more to the longer term, we run the following tests. First, we recognize that the market to book ratio of the firm will capture all future expected changes and so will proxy for longer term changes in the performance of the firm. Our second measure of long term performance changes is based on earnings. We use the five-year geometric mean of changes in EPS as our measure of the long term changes in earnings per share (CEPSL). These two measures of firm performance are our dependent variables in the next set of tests. We estimate OLS regressions as follows:

$$CMtoB_{t,i} = \beta_0 + \beta_1 * INV_{t,i} + \sum_j \beta_j * Control_{t,i,j} + \varepsilon_{t,i} \quad (3)$$

$$CEPSL_{t,i} = \beta_0 + \beta_1 * CHGEPS_{t,i} + \beta_2 * INV_{t,i} + \sum_j \beta_j * Control_{t,i,j} + \varepsilon_{t,i} \quad (4)$$

Table 4 Panel A: Changes in the Market to Book Ratio

	1960-2005	60-69	70-79	80-89	90-99	2000-05
INV	-0.077	0.004	-0.034	-0.075	-0.090	-0.103
	(10.63)***	(0.06)	(3.48)***	(6.56)***	(6.86)***	(5.05)***
AR	-0.044	-0.120	-0.068	-0.081	-0.025	-0.001
	(4.14)***	(2.44)**	(4.54)***	(4.63)***	(1.31)	(0.04)
CAPX	0.036	0.021	0.004	0.025	0.053	0.062
	(11.92)***	(1.37)	(1.23)	(5.37)***	(8.79)***	(6.02)***
GM	-0.111	-0.466	-0.070	-0.123	-0.114	-0.091
	(7.32)***	(2.75)***	(2.59)***	(4.86)***	(4.14)***	(2.64)***
S&A	-0.112	-0.492	-0.045	-0.059	-0.167	-0.126
	(5.48)***	(4.12)***	(1.36)	(1.72) *	(4.57)***	(2.50)**
EQ	-0.057	-0.001	-0.053	-0.069	-0.018	-0.083
	(14.17)***	(0.08)	(9.34)***	(9.62)***	(2.11)**	(6.36)***
LF	0.033	-0.112	-0.017	0.035	0.040	0.044
	(2.01)*	(1.33)	(0.61)	(1.26)	(1.41)	(1.09)
GDPGROW	0.019	0.072	0.034	0.005	0.019	0.028
	(26.87)***	(8.05)***	(32.99)***	(2.91)***	(6.33)***	(6.39)***
INTEREST	-0.001	-0.058	0.042	0.008	0.012	-0.070
	(1.36)	(2.94)***	(17.16)***	(3.61)***	(2.10)*	(12.07)***
CONSTANT	-0.039	-0.049	-0.368	-0.053	-0.128	0.174
	(4.56)***	(0.36)	(18.70)***	(2.11)**	(3.47)***	(7.51)***
Observations	88462	3091	20038	23537	26603	15193
R-squared	0.02	0.17	0.09	0.02	0.02	0.04

*The sample consists of all firms with SIC codes from 2000 to 3999 and from 5000 to 5999 in the annual Compustat database from 1950 to 2005. The table provides estimates of equation 3 where the dependent variable is the change in the market to book ratio (CMtoB). The second column provides estimates for the full sample while the remaining columns provide estimates for the subsamples for each decade. Figures in parentheses are robust (White) t-statistics. Significance at 10%, 5%, and 1% level are marked by *, **, and *** respectively.*

Table 4 Panel B: Changes in Long Term Earnings

	1950-2005	50-59	60-69	70-79	80-89	90-99	2000-05
CHGEPSL	-0.099	-0.057	-0.088	-0.069	-0.069	-0.127	-0.182
	(6.16)***	(2.85)***	(3.86)***	(2.30)**	(2.43)**	(4.85)***	(1.85)*
INV	-0.009	-0.005	-0.003	-0.009	-0.003	-0.008	-0.024
	(3.38)***	(2.27)**	(1.56)	(1.54)	(0.79)	(1.75)*	(1.31)
AR	0.001	0.003	0.001	-0.002	0.002	0.002	-0.015
	(0.20)	(1.55)	(0.72)	(0.18)	(0.22)	(0.22)	(0.62)
CAPX	0.002	-0.000	0.001	0.001	0.002	0.003	-0.003
	(2.00)**	(0.01)	(2.67)***	(0.26)	(1.18)	(1.24)	(0.45)
GM	-0.005	-0.002	0.003	-0.016	0.002	-0.003	-0.005
	(0.76)	(0.45)	(1.03)	(0.82)	(0.15)	(0.30)	(0.13)
S&A	0.000	0.000	0.001	0.003	-0.001	-0.009	0.011
	(0.06)	(0.02)	(0.44)	(0.18)	(0.09)	(0.68)	(0.28)
EQ	-0.019	0.001	0.001	-0.018	-0.019	-0.031	-0.014
	(7.60)***	(1.67)	(0.44)	(3.93)***	(4.12)***	(6.21)***	(0.57)
LF	0.016	0.006	-0.001	0.030	0.001	0.016	0.060
	(2.18)**	(1.26)	(0.55)	(1.52)	(0.12)	(1.23)	(1.52)
GDPGROW	-0.000	0.000	-0.000	-0.001	0.003	-0.003	0.000
	(0.16)	(0.29)	(0.41)	(1.35)	(3.58)***	(1.90)	(0.00)
INTEREST	-0.001	-0.003	-0.001	-0.005	0.006	-0.005	0.000
	(2.04)**	(3.92)***	(1.30)	(2.54)**	(5.44)***	(1.94)	(0.00)
CONSTANT	-0.012	0.010	0.009	0.024	-0.098	0.011	-0.041
	(2.96)***	(5.02)***	(5.48)***	(1.75)*	(7.50)***	(0.63)	(1.97)**
Observations	58614	1452	5217	15787	16105	18373	1680
R-squared	0.01	0.06	0.01	0.00	0.01	0.01	0.02

*The sample consists of all firms with SIC codes from 2000 to 3999 and from 5000 to 5999 in the annual Compustat database from 1950 to 2005. The table provides estimates of equation 4 where the dependent variable is the five-year change in EPS (CEPSL). The second column provides estimates for the full sample while the remaining columns provide estimates for the subsamples for each decade. Figures in parentheses are robust (White) t-statistics. Significance at 10%, 5%, and 1% level are marked by *, **, and *** respectively.*

Panels A and B of Table 4 report the results of these regressions. In Panel A, we consider the relation between changes in the market to book ratio and the changes in inventory. The coefficient estimate for INV is negative and significant from 1970 to 2005, but insignificant in the 1960s. This finding is consistent with Lai (2005). Overall the relation between market valuation and inventory appears to be more robust although it does not manifest during the 1960s.

In Panel B we consider the relation between inventory changes and long term earnings growth. Consistent with Abarbanell and Bushee (1997), no evidence is found in the 1980s that INV will affect long-term EPS growth. However, we find a negative and significant relation during the 1950s and a weaker but similar relation during the 1990s. As with our previous tests, our findings indicate that the relation is sensitive to the choice of the sample period.

Our results till this point pertain to the overall relation between inventory changes and firm performance. Our findings suggest that the relation has changed over time and ignoring this change provides a misleading picture of the nature of this relation. In the following tests we explore the differences between firms that operate in the retail and wholesale industries and those that operate in other industries.

Table 5: Inventory and Firm Performance for the Retail and Wholesale Industries

Panel A: Changes in Short Term Earnings for the Retail and Wholesale Industry							
	1950-2005	**50-59**	**60-69**	**70-79**	**80-89**	**90-99**	**2000-05**
CHGEPS	-0.106	-0.263	-0.128	-0.121	-0.123	-0.134	-0.056
	(11.43)***	(3.10)***	(1.83)	(5.35)***	(6.99)***	(8.37)***	(2.98)***
INV	-0.011	-0.007	-0.004	-0.024	-0.016	-0.006	-0.007
	(8.43)***	(1.02)	(1.18)	(7.48)***	(7.60)***	(2.68)***	(1.99)**
AR	-0.008	0.021	0.003	-0.004	-0.014	-0.012	0.005
	(3.75)***	(3.46)***	(1.21)	(0.76)	(3.52)***	(3.11)***	(0.71)
CAPX	0.011	-0.001	0.001	0.010	0.009	0.013	0.015
	(16.23)***	(0.50)	(1.78)	(7.53)***	(8.51)***	(10.00)***	(6.24)***
GM	0.024	-0.025	-0.004	0.040	0.027	0.012	0.026
	(6.41)***	(1.64)	(0.54)	(3.18)***	(4.05)***	(2.09)*	(3.02)***
S&A	0.032	-0.009	-0.005	0.013	0.028	0.029	0.055
	(7.37)***	(1.31)	(0.94)	(1.14)	(3.57)***	(3.83)***	(4.55)***
EQ	0.009	-0.000	0.000	0.003	0.005	0.017	0.027
	(5.45)***	(0.10)	(0.30)	(0.88)	(1.64)	(5.34)***	(3.72)***
LF	-0.021	0.046	0.002	-0.016	-0.018	-0.018	-0.040
	(4.80)***	(2.53)**	(0.56)	(1.20)	(2.52)**	(2.43)**	(3.32)***
INV×Dist	0.000	-0.023	-0.009	0.017	-0.001	0.000	0.002
	(6.61)***	(0.68)	(1.23)	(4.19)***	(0.71)	(5.50)***	(0.78)
GDPGROW	0.002	0.001	0.002	0.002	0.004	0.000	0.011
	(8.30)***	(2.28)**	(7.46)***	(4.41)***	(6.65)***	(0.30)	(7.49)***
INTEREST	-0.004	-0.017	-0.003	-0.003	-0.001	-0.007	-0.009
	(11.17)***	(8.65)***	(7.57)***	(2.89)***	(0.90)	(3.87)***	(5.47)***
CONSTANT	0.034	0.049	0.011	0.049	0.005	0.046	0.020
	(11.98)***	(7.67)***	(4.50)***	(5.42)***	(0.63)	(4.12)***	(2.12)**
Observations	85226	1470	5412	19333	22037	25100	11874
R-squared	0.03	0.21	0.05	0.04	0.04	0.04	0.03

Panel B: Changes in ROA for the Retail and Wholesale Industry							
	1950-2005	**1950-59**	**1960-69**	**1970-79**	**1980-89**	**1990-99**	**2000-05**
CHGROA	-0.223	-0.150	-0.116	-0.167	-0.255	-0.244	-0.182
	(17.77)***	(3.24)***	(4.17)***	(6.56)***	(11.55)***	(11.38)***	(5.94)***
INV	-0.009	0.002	-0.004	-0.010	-0.009	-0.008	-0.009
	(8.81)***	(0.42)	(1.48)	(6.41)***	(5.16)***	(4.20)***	(3.22)***
AR	0.001	0.020	0.005	0.002	0.002	-0.002	-0.001
	(0.48)	(4.62)***	(1.72)*	(0.76)	(0.79)	(0.58)	(0.18)
CAPX	0.005	0.001	0.002	0.003	0.005	0.007	0.009
	(13.18)***	(0.93)	(3.10)***	(5.17)***	(6.51)***	(8.21)***	(5.42)***
GM	0.007	0.011	0.014	0.027	0.009	0.001	-0.000
	(2.55)**	(1.61)	(3.00)***	(5.00)***	(1.88)*	(0.19)	(0.05)
S&A	-0.007	0.004	0.004	0.001	-0.015	-0.015	0.011
	(2.17)**	(1.21)	(1.16)	(0.08)	(2.19)**	(2.40)**	(1.21)
EQ	-0.003	0.001	-0.001	0.000	-0.004	-0.004	-0.003
	(5.07)***	(0.50)	(0.74)	(0.10)	(3.30)***	(3.71)***	(1.41)
LF	-0.009	0.023	0.001	-0.002	-0.011	-0.004	-0.026
	(3.04)***	(2.22)*	(0.31)	(0.39)	(1.87)*	(0.75)	(2.95)***
INV×Dist	0.000	-0.004	-0.013	0.004	0.002	0.000	0.002
	(3.91)***	(0.95)	(1.63)	(4.10)***	(2.08)**	(11.51)***	(0.85)
GDPGROW	0.001	0.001	0.002	-0.000	0.001	-0.001	0.001
	(8.03)***	(3.26)***	(9.37)***	(1.77)*	(4.98)***	(2.67)***	(0.79)
INTEREST	-0.001	-0.014	-0.005	-0.005	-0.001	-0.004	-0.008
	(10.24)***	(10.25)***	(10.30)***	(11.00)***	(3.87)***	(4.50)***	(9.72)***
CONSTANT	0.003	0.026	0.007	0.034	0.002	0.021	0.016
	(2.83)***	(5.68)***	(2.90)***	(9.57)***	(0.51)	(3.88)***	(4.63)***
Observations	95511	2188	6159	23026	24419	27177	12542
R-squared	0.05	0.18	0.08	0.06	0.07	0.06	0.05

*The sample consists of all firms with SIC codes from 2000 to 3999 and from 5000 to 5999 in the annual Compustat database from 1950 to 2005. Panel A provides estimates of equation 5 where the dependent variable is the one year forward change in EPS (CEPS1). The interactive term, INVxDist captures the unique effect of the retail and wholesale industry. The second column provides estimates for the full sample while the remaining columns provide estimates for the subsamples for each decade. Figures in parentheses are robust (White) t-statistics. Panel B provides estimates of equation 6 where the dependent variable is the one year forward change in ROA (CROA). The interactive term, INVxDist captures the unique effect of the retail and wholesale industry. The second column provides estimates for the full sample while the remaining columns provide estimates for the subsamples for each decade. Figures in parentheses are robust (White) t-statistics. Significance at 10%, 5%, and 1% level are marked by *, **, and *** respectively.*

In order to further examine the difference in the impact of inventory changes on firm performance for distributors we create an indicator variable Dist which equals one if a firm's SIC is between 5000 and 5999 and is equal to zero otherwise. We capture the specific impact of inventory changes for distributors by multiplying INV by this new variable. We then re-estimate equations 1 through 4 by introducing this interactive term in addition to the previous variables. Thus, we estimate OLS regressions for the following equations:

$$CEPS1_{t,i} = \beta_0 + \beta_1 * CHGEPS_{t,i} + \beta_2 * INV_{t,i} + \beta_3 * Dist * INV_{t,i} + \sum_j \beta_j * Control_{t,i,j} + \varepsilon_{t,i} \quad (5)$$

$$CROA_{t,i} = \beta_0 + \beta_1 * CHGROA_{t,i} + \beta_2 * INV_{t,i} + \beta_3 * Dist * INV_{t,i} + \sum_j \beta_j * Control_{t,i,j} + \varepsilon_{t,i} \quad (6)$$

$$CMtoB_{t,i} = \beta_0 + \beta_1 * INV_{t,i} + \beta_2 * Dist * INV_{t,i} + \sum_j \beta_j * Control_{t,i,j} + \varepsilon_{t,i} \quad (7)$$

$$CEPSL_{t,i} = \beta_0 + \beta_1 * CHGEPSL_{t,i} + \beta_2 * INV_{t,i} + \beta_3 * Dist * INV_{t,i} + \sum_j \beta_j * Control_{t,i,j} + \varepsilon_{t,i} \quad (8)$$

Table 6 Panel A: Changes in the Market to Book Ratio for the Retail and Wholesale Industry

	1950-2005	60-69	70-79	80-89	90-99	2000-05
INV	-0.077	0.002	-0.033	-0.076	-0.090	-0.109
	(10.60)***	(0.02)	(3.32)***	(6.45)***	(6.84)***	(5.26)***
AR	-0.044	-0.120	-0.068	-0.081	-0.025	-0.003
	(4.13)***	(2.45)**	(4.51)***	(4.63)***	(1.30)	(0.09)
CAPX	0.036	0.021	0.004	0.025	0.053	0.064
	(11.90)***	(1.38)	(1.27)	(5.37)***	(8.76)***	(6.10)***
GM	-0.111	-0.465	-0.071	-0.123	-0.114	-0.092
	(7.33)***	(2.76)***	(2.62)***	(4.86)***	(4.15)***	(2.69)***
S&A	-0.112	-0.491	-0.045	-0.059	-0.167	-0.124
	(5.48)***	(4.13)***	(1.37)	(1.72)	(4.57)***	(2.46)*
EQ	-0.057	-0.001	-0.053	-0.069	-0.018	-0.083
	(14.17)***	(0.09)	(9.34)***	(9.62)***	(2.11)*	(6.35)***
LF	0.033	-0.112	-0.016	0.035	0.040	0.044
	(2.01)**	(1.33)	(0.58)	(1.26)	(1.41)	(1.08)
INV×Dist	-0.000	0.033	-0.007	0.001	-0.000	0.047
	(0.44)	(0.12)	(1.62)	(0.32)	(0.28)	(2.93)***
GDPGROW	0.019	0.072	0.034	0.005	0.019	0.028
	(26.87)***	(8.03)***	(32.98)***	(2.91)***	(6.33)***	(6.40)***
INTEREST	-0.001	-0.058	0.042	0.008	0.012	-0.070
	(1.36)	(2.97)***	(17.14)***	(3.61)***	(2.11)*	(12.06)***
CONSTANT	-0.039	-0.048	-0.367	-0.053	-0.128	0.174
	(4.57)***	(0.36)	(18.68)***	(2.11)**	(3.47)***	(7.50)***
Observations	88462	3091	20038	23537	26603	15193
R-squared	0.02	0.17	0.09	0.02	0.02	0.04

*The sample consists of all firms with SIC codes from 2000 to 3999 and from 5000 to 5999 in the annual Compustat database from 1950 to 2005. The table provides estimates of equation 7 where the dependent variable is the change in the market to book ratio (CMtoB). The interactive term, INVxDist captures the unique effect of the retail and wholesale industry. The second column provides estimates for the full sample while the remaining columns provide estimates for the subsamples for each decade. Figures in parentheses are robust (White) t-statistics. Significance at 10%, 5%, and 1% level are marked by *, **, and *** respectively.*

The results are reported in Tables 5 and 6. In Panel A of Table 5 we report the coefficient estimates from equation 5. The coefficient estimates for the interactive term are positive and indicate that the negative relation between inventory and short term earnings changes is not as strong for the wholesale and retail industry. However, the estimate is statistically significant only for the 1970s and the 1990s. As before, the relation between inventory changes and long term performance is sensitive to the choice of the sample period. In Panel B of Table 5 we report the coefficient estimates for equation 6. The conclusions from using changes in ROA as the dependent variable are similar to those using short term changes in earnings.

Table 6 Panel B: Changes in Long Term Earnings for the Retail and Wholesale Industry

	1950-2005	50-59	60-69	70-79	80-89	90-99	2000-05
CHGEPS	-0.099	-0.057	-0.088	-0.067	-0.069	-0.127	-0.183
	(6.16)***	(2.84)***	(3.86)***	(2.26)*	(2.43)*	(4.85)***	(1.85)*
INV	-0.009	-0.005	-0.002	-0.013	-0.003	-0.008	-0.025
	(3.41)***	(2.14)**	(1.11)	(2.06)**	(0.80)	(1.76)*	(1.31)
AR	0.001	0.003	0.001	-0.003	0.002	0.002	-0.015
	(0.20)	(1.44)	(0.74)	(0.34)	(0.22)	(0.22)	(0.63)
CAPX	0.003	-0.000	0.001	0.000	0.002	0.003	-0.003
	(2.01)**	(0.01)	(2.55)**	(0.05)	(1.18)	(1.25)	(0.41)
GM	-0.005	-0.002	0.003	-0.011	0.002	-0.003	-0.005
	(0.74)	(0.43)	(0.97)	(0.57)	(0.15)	(0.30)	(0.14)
S&A	0.000	0.000	0.001	0.004	-0.001	-0.009	0.012
	(0.06)	(0.11)	(0.40)	(0.22)	(0.09)	(0.69)	(0.29)
EQ	-0.019	0.001	0.001	-0.018	-0.019	-0.031	-0.014
	(7.60)***	(1.64)	(0.46)	(3.93)***	(4.12)***	(6.20)***	(0.57)
LF	0.016	0.006	-0.001	0.026	0.001	0.016	0.061
	(2.18)**	(1.24)	(0.54)	(1.37)	(0.12)	(1.24)	(1.52)
INV×Dist	0.000	-0.009	-0.011	0.020	0.000	0.000	0.011
	(1.30)	(0.81)	(1.74)	(4.22)***	(0.46)	(1.45)	(0.57)
GDPGROW	-0.000	0.000	-0.000	-0.001	0.003	-0.003	0.000
	(0.16)	(0.32)	(0.45)	(1.31)	(3.58)***	(1.90)	(0.00)
INTEREST	-0.001	-0.003	-0.000	-0.005	0.006	-0.005	0.000
	(2.04)*	(3.93)***	(1.22)	(2.47)**	(5.44)***	(1.94)	(0.00)
CONSTANT	-0.012	0.010	0.009	0.023	-0.098	0.011	-0.041
	(2.96)***	(5.01)***	(5.37)***	(1.65)*	(7.50)***	(0.63)	(1.96)*
Observations	58614	1452	5217	15787	16105	18373	1680
R-squared	0.01	0.06	0.01	0.01	0.01	0.01	0.02

*The sample consists of all firms with SIC codes from 2000 to 3999 and from 5000 to 5999 in the annual Compustat database from 1950 to 2005. The table provides estimates of equation 8 where the dependent variable is the five-year change in EPS (CEPSL). The interactive term, INVxDist captures the unique effect of the retail and wholesale industry. The second column provides estimates for the full sample while the remaining columns provide estimates for the subsamples for each decade. Figures in parentheses are robust (White) t-statistics. Significance at 10%, 5%, and 1% level are marked by *, **, and *** respectively.*

Similar to Table 4, In Table 6 we include our interactive term in our tests for the influence of inventory on long term changes in firm performance. In Panel A of Table 6, we report the results from estimating equation 7. The coefficient estimates for the interactive term are largely insignificant with the exception of the years after 2000. This is consistent with the findings of Chen et al (2007) who find that, between 1981 and 2004, inventory is negatively related to firm performance for firms in the retail and wholesale industry. In Panel B, we report results obtained from estimating equation 8. The coefficient estimates for the interactive term are largely insignificant with the exception of the decade of the 1970s. Overall, our results indicate that the relation between inventory changes and firm performance could be different for the wholesale and retail industry. However, the differences, if any, are small and the conclusions sensitive to the choice of the sample period.

Robustness Tests

As noted by Chen et al (2005), the relation between inventory changes and firm value could be different for firms that normally hold low levels of inventory. In order to test for this difference for our sample we create an indicator variable that takes on a value of one if the inventory holdings of a particular firm for a particular year is in the bottom ten percentile of its industry (as defined by two digit SIC code). We then multiply INV by this variable and similar to equations 5 – 8 test for the influence of this interactive term on our four measures of firm performance. In our unreported tests, the coefficient estimates for this interactive term are largely positive and so in agreement with the conclusions of Chen et al (2005). However, as with all reported results, the significance of these tests is also sensitive to the choice of the sample period and differs from one performance metric to another.

Our results till this point indicate that the relation between inventory changes and firm performance is a tenuous one and rather dependent on the time period in question. However, the full sample OLS regressions consistently show a statistically significant and negative relation between inventory changes

in firm performance. In order to explore the robustness of this relation, we include year fixed effects in all our tests for the full sample. We also consider a random a random effects model – however, the Hausman test for each regression is strongly significant and suggests that fixed effect regressions are more appropriate than random effect ones. The results for the regressions with year fixed effects indicate that changes in inventory are statistically significant determinants of firm performance. However, the economic magnitude is even lower than in our earlier OLS tests. The interactive dummy for the wholesale and retail industry is only significant when performance is measured by ROA and its economic magnitude diminishes to the point that it is very close to zero. However, the interactive dummy for firms that carry low inventory remains significant. Overall the tests suggest that there is a negative relation between inventory changes and firm performance but the strength of the relation is sensitive to the sample period. However, this relation, in general does not appear to hold for firms that carry low inventory.

CONCLUSION

Inventory management remains one of the key components of working capital management. However, prior research on the relation between inventory changes and firm performance are limited by their focus on relatively small sample periods and the use of specific measures of firm performance. In this paper, we remedy this shortcoming through a comprehensive examination of this relation using a large sample period and a multiple measures of firm performance. We also test for differences in the nature of this relation between industries.

Our findings can be summarized as follows. Changes in inventory are negatively related to changes in firm performance. However, the strength of this relation is dependent on the time period. Moreover, the relation does not hold for the group of firms that normally hold low levels of inventory and is slightly weaker for wholesalers and retailers. One possible explanation for our finding is the changing nature of inventory management. The past five decades have seen the improvement of inventory management through JIT and VMI techniques. Although operations management researchers have helped us better understand the techniques themselves, their impact on the financial performance of the firm remains unclear. It is also possible that the changing relation between inventory and firm performance is driven by the changing nature of inventory management. Moreover, the uniqueness of the wholesale and retail industry suggests a complex relation between inventory and firm performance that depends on the external economic environment, the evolution of inventory management techniques and the details of specific industries. We look forward to future research that will help us better understand these interactions.

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