The increasing importance of retailers' inventories

Paula R. Worthington

Introduction and summary

Economists and business analysts alike have long recognized the central role played by swings in inventory accumulation during cyclical contractions in the economy. The importance of understanding inventory behavior cannot be overstated when analyzing business cycles. In the United States, for example, declines in inventory investment, defined as the change in inventory levels, have accounted for 76 percent of the peak-to-trough decline in gross domestic product (GDP) in the average postwar recession. In fact, inventories matter throughout the business cycle—although inventory investment has averaged less than 1 percent of the level of postwar GDP, the change in inventory investment has averaged over one-third the size of quarterly changes in GDP in the postwar era.

Although it is easy to see how inventories are important in cyclical fluctuations, other aspects of inventory behavior remain poorly understood. For example, to what extent have firms lived up to much-lauded "just-in-time" inventory management techniques? If inventory holdings truly have fallen, what does this imply about the role of inventories in future cyclical fluctuations? After all, if inventory investment swings are eliminated or lessened by moving to just-in-time techniques, then inventories may no longer remain a crucial link between negative shocks to output and, consequently, employment fluctuations.

Recent research offers several pieces of evidence on these issues. McConnell and Quiros (1997) argue that GDP volatility declined significantly in the early 1980s, and they identify a decline in the volatility of durable goods production as its likely source. Since they find no commensurate decline in the volatility of sales over this period, they conclude that changes in inventory behavior are behind their result. They also suggest that future work could investigate which sectors have used just-in-time inventory techniques and which have contributed the most to the decline in volatility. Ben Salem and Jacques (1996) and Hirsch (1996) find that inventory–sales (IS) ratios have declined in the manufacturing sector, where just-in-time inventory management techniques are believed to be more common, but that ratios have risen in the wholesale and retail trade sectors.

In this article, I review recent developments in inventory behavior, with the following questions in mind. Have the recent, well-publicized changes in inventory management techniques affected inventory behavior at the aggregate level? In particular, have IS ratios declined and, if so, in which sectors? Has the volatility of inventory investment declined in recent years, and if so, has it declined in those sectors in which IS ratios have fallen? Answering these questions is important to policymakers who must establish fiscal and monetary policies for an economy with some inherent volatility to the paths of output and employment.

My research strategy is to take as given the McConnell and Quiros (1997) finding of a one-time decline in GDP volatility in 1984:Q1 and to investigate a variety of inventory-related measures, comparing the pre-1984 period with the subsequent period. Like some previous researchers, I find that IS ratios have actually risen somewhat in the trade (merchant wholesale and retail) sectors of the economy but have fallen in the manufacturing sector, especially among durable goods manufacturers. I also find that, by two separate

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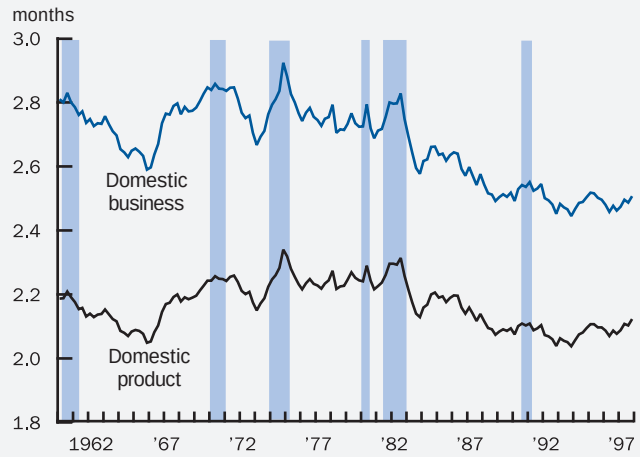
measures, inventory investment volatility has decreased somewhat since 1984. This decrease arises from the manufacturing and merchant wholesale sectors; in retailing, volatility has risen by one measure but fallen, though not in a statistically significant way, by another. Overall, I find little relationship between sectoral changes in average IS ratios and changes in inventory investment volatility.

My results point to three main conclusions. First, though IS ratios have not, on balance, changed that much, inventory investment volatility has declined nonetheless. This suggests that recent changes in inventory management techniques have affected the volatility of inventories at least as much as their average levels. Second, the retail sector has not experienced the volatility declines of the manufacturing and merchant wholesale sectors. This is important, because swings in inventory investment by retailers comprise a big part of total business inventory movements over business cycles. Thus, analysts studying inventories for clues about cyclical turning points and the like may wish to focus more closely on the retail sector. Finally, sectors in which firms successfully decrease their average inventory holdings need not be the same sectors in which inventory investment volatility declines as well. This suggests that new inventory management techniques that focus on forcing IS ratios downward will not completely remove inventory investment fluctuations as factors in future business cycles.

FIGURE 1

Inventory–sales ratio, total business



Notes: Raw data are in billions of chained 1992 dollars. Ratios are scaled to equal number of months. Shaded areas denote recessions.

Source: U.S. Bureau of Economic Analysis, 1960:Q1–97:Q4.

The role of inventories in the macroeconomy

Economists care about inventory behavior because, historically, swings in inventory investment have played a prominent role in cyclical fluctuations. In brief, inventory investment is highly volatile and contributes significantly to recessionary declines in GDP. Figure 1, which plots the ratio of economy-wide inventory stocks to final sales of domestic product (final sales of domestic product equals gross domestic product less the change in business inventories), shows that IS ratios are countercyclical, rising during recessions and falling in expansions. In fact, inventory disinvestment is a central part of cyclical contractions. Table 1 reports the average postwar contribution of changes in inventory accumulation ("inventory disinvestment") to the peak-to-trough decline in GDP. The table shows that the decline in inventory investment accounted for 76 percent of GDP's decline in the average postwar recession. Panel A of table 1 reveals three features of the data. First, the manufacturing and retail sectors dominate the wholesale trade sector, accounting for most of the inventory effect. Second, as Blinder and Maccini (1991) found in their earlier survey of research on inventories, finished goods inventories held by manufacturers account for little of the total contribution (6 percent postwar average) despite being the focus of much economic research. In contrast, goods in progress and, to a lesser extent, materials and supplies held by manufacturers are more important. Finally, table 1 shows that unsold (final) goods held by retailers account for one-third (.26/.76) of the contribution of inventories.

Complementary evidence is in panel B of table 1, which highlights the importance of durable goods inventories. Of the manufacturing sector's total average contribution of 35 percent of the peak-to-trough decline in GDP, durable goods manufacturers accounted for 28 percent. In the wholesale trade sector, durable goods firms accounted for the sector's entire share of 5 percent; and in the retail sector, durable goods firms accounted for 23 percent of the sector's 26 percent contribution. Table 1's evidence, on balance, suggests that durable goods inventories held by manufacturers and retailers are key to any analysis of the cyclical behavior of inventories.

TABLE 1

Inventory investment's share of recessionary declines in GDP
(percent)

Panel A	
Total change in business inventories	76
Manufacturing	35
Materials & supplies	9
Goods in progress	20
Finished goods	6
Merchant wholesale	5
Retail	26
Panel B	
Total change in business inventories	76
Manufacturing	35
Durable goods	28
Nondurable goods	7
Merchant wholesale	5
Durable goods	5
Nondurable goods	0
Retail	26
Durable goods	23
Nondurable goods	4

Notes: Raw data are in billions of chained 1992 dollars. Shares are computed by sector for each postwar recession; the mean over all recessions is reported.

Source: Author's calculations using data from U.S. Bureau of Economic Analysis.

Table 2 offers an alternative perspective on the role of inventory investment. The volatility of manufacturing and trade sector inventory investment relative to GDP volatility was about one-third (.365) over the sample period 1960:Q1–97:Q4. By this standard, the retail sector is more volatile than the manufacturing sector, with inventory investment swings averaging 21.8 percent of the quarterly change in GDP, compared with 19.1 percent for the manufacturing sector. Taken together, then, tables 1 and 2 point to the manufacturing and retail sectors as key sectors to analyze.

TABLE 2

Volatility of inventory investment

All inventories	.365
Manufacturing and trade	.342
Manufacturing	.191
Merchant wholesale	.142
Retail	.218

Notes: Raw data are in billions of chained 1992 dollars. Volatility of inventory investment is defined as the ratio of the mean of the absolute value of the change in inventory investment (relative to GDP) to the mean of the absolute value of the change in GDP (relative to GDP). Means are calculated over the 1960:Q1–97:Q4 period.

Source: Author's calculations using data from U.S. Bureau of Economic Analysis.

Theories of inventory behavior

Economists have developed several models of inventory behavior; a recent review is in Fitzgerald (1997). Probably the most familiar model is the production-smoothing model, in which firms are assumed to face increasing marginal costs of production. Under this scenario, firms facing variable demand for their product draw down and build up their inventories as needed, to limit variation in production. Among other things, the model implies that production is less variable than sales and that sales and inventory investment are negatively correlated. As Fitzgerald (1997), Blinder and Maccini (1991), and others have shown, simple correlations from aggregate data are inconsistent with these implications: In other words, production is typically more, not less, variable than sales, and sales and inventory investment are typically positively, not negatively, correlated. Although modifications to the model, including adding cost shocks or staggered price setting behavior, generate predictions more consistent with the data, some economists have argued that pursuing this line of argument is not likely to be fruitful (Fitzgerald, 1997; Hornstein and Sarte, 1998). In fact, the simple production smoothing model's poor empirical performance may simply reflect the observation that the model is best suited to describing the components of inventories that are least important cyclically, namely finished goods held by manufacturers. Consequently, other economists have focused on developing models to describe the components of inventories that seem to pack more of a cyclical punch, namely goods held by retailers and raw materials and supplies held by manufacturers. These two components of inventories have in common that the firms do not "produce" the items and then store them; rather, the firms take delivery of the items and store them. This leads to the second broad class of inventory models, (S,s) models.

In these alternative models, sometime called threshold models, firms are willing to let their inventories fluctuate between (optimally chosen) lower bound s and upper bound S; once stocks break through the limits, firms adjust production (orders) "all at once" to return inventories to their desired range; that is, firms place new orders for goods. These models are typically based on the assumption that firms face some fixed cost in adjusting their production

(delivery) levels. Given this fixed cost, the model implies that firms will "bunch up" their deliveries, and its implications directly counter those of the production-smoothing models: Deliveries will be more volatile than sales, and inventory investment and sales will be positively correlated.

Several recent papers develop and test the implications of these models. For example, Fisher and Hornstein (1998) embed an (S,s) model into a general equilibrium business cycle model and find that inventories can propagate certain kinds of shocks, though only when the (S,s) model is combined with general equilibrium entry of new firms and feedback pricing behavior by firms. McCarthy and Zakrajsec (1997, 1998) present empirical evidence on cost functions that is consistent with the use of (S,s)-type inventory policies.

Before turning to the data analyzed here, it is useful to review recent arguments made in the business press regarding changes in inventory management techniques. Many press accounts have centered on the manufacturing sector, in which efforts to reduce inventories are viewed as part of a move toward "lean manufacturing." In the retail sector, the equivalent of lean inventories is often described as a "quick response" system. According to press accounts, many retailers have exploited new technologies, such as bar coding and point of sale scanning, which have enabled them to cut inventory holdings. Further, more coordination between retailers and their suppliers based on techniques such as shared sales data and business documents has allowed some retailers to cut the time needed to restock their shelves. One interpretation of these developments is that they decrease the fixed costs of ordering goods. In the (S,s) model framework, developments which lower the fixed cost of ordering will tend to smooth out orders more, as firms let their inventory levels fluctuate in narrower bands than before. If U.S. manufacturing and retailing firms have truly embraced new techniques and "smoothed out" their production and restocking behavior, we should see some evidence of this in the aggregate data.

Inventory behavior before and after 1984

McConnell and Quiros (1997) offer some evidence that the role of inventories in output fluctuations has declined since the early 1980s. They present informal evidence that postwar GDP volatility declined in the early 1980s, and they specifically find evidence of a one-time decline in the volatility of postwar GDP in 1984:Q1. McConnell and Quiros rule out a simultaneous decline in the volatility of sales, and consequently point to a decline in the share of inventory investment in GDP fluctuations as the source of the output volatility decline.

Here, I investigate this issue by examining inventory and output data for the manufacturing and trade sectors between 1960 and 1997. Because manufacturing and retail are the key sectors for cyclical purposes, and because much previous research has focused exclusively on manufacturers' inventory patterns, I consider a fairly detailed breakdown of the retail sector. In particular, I first consider evidence on IS ratios and determine which, if any, sectors, show declines in IS ratios at the point identified by McConnell and Quiros (1997). Next, I construct two alternative measures of inventory investment volatility and compare the early and later period measures. Finally, I relate sectors' change in IS ratios to their change in inventory investment volatility. I find that IS ratios have risen in the trade sectors but fallen in manufacturing, but I find little evidence that the sectors in which the decline in IS ratios is most pronounced are those in which inventory investment volatility has declined the most. The retailing sector stands out as a cyclically important sector in which IS ratios have risen and inventory investment volatility has, at best, not increased, pointing to a more significant role in future cyclical fluctuations.

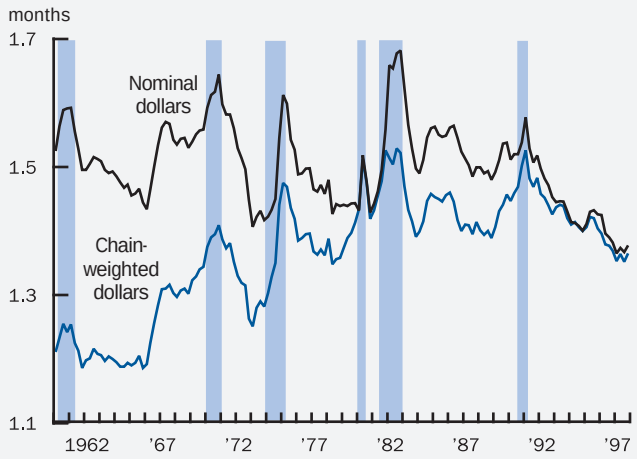
Inventory–sales ratios

Despite the impression generated by the business press, the evidence on declining IS ratios is mixed. Figure 1, which plots the economy-wide ratio of inventories to final sales of domestic product, shows little obvious trend since the 1970s. Figure 2, which plots the IS ratio for the manufacturing and trade sector, illustrates the importance of using price-adjusted, as opposed to nominal, measures of inventories: The nominal data show a much steeper decline in the IS ratio since the 1981–82 recession than do the chain-weighted data. In this article, I use the chain-weighted data.

The aggregate IS data of figures 1 and 2 mask considerable differences across the three broad sectors analyzed here, manufacturing, merchant wholesale, and retail. In manufacturing (figure 3), the most dramatic swings have been in the durable goods sector, where IS ratios have fallen sharply since their 1981–82 peak. In the two trade sectors (figures 4 and 5), the dominant patterns come from the nondurable goods sector, where ratios have steadily risen since the 1974–75 recession. Since we know from table 1 that inventory swings by durable goods manufacturers play a prominent cyclical role, it is surely worth

FIGURE 2

Inventory–sales ratio, manufacturing and trade



Notes: Raw data are in billions of nominal dollars and billions of chained 1992 dollars. Ratios are scaled to equal number of months. Shaded areas denote recessions.

Source: Author's calculations using data from U.S. Bureau of Economic Analysis.

noting that declining IS ratios are most obvious for that group of firms. In contrast, inventories as a share of sales held by durable goods retailers have varied in the same (narrow) range since 1960.

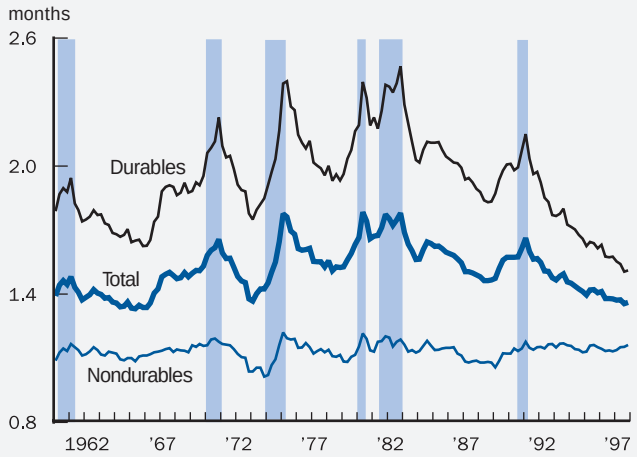
A closer look at the retail sector is presented in figure 6. Three of the four groups of durable goods retailers (lumber and building stores; furniture and furnishings stores; and the residual "other" category) appear to show declining IS ratios. Though IS ratios have fallen since 1991 in the fourth group (automotive), the decline may be more cyclical than secular. Among nondurable goods retailers, the story is quite different, as expected given figure 5. For example, food retailers and department stores have experienced steadily rising IS ratios over much of the sample period. This seems somewhat at odds with the business press view of at least selected department store retailers. For example, in 1996 the *Wall Street Journal* (Berner, 1996) reported that Sears' IS ratio fell from 2.28 months in 1994 to 2.12 months in 1995. According to the article, Sears management centralized many aspects of the ordering and distribution system and demanded that suppliers meet Sears' standards for package size, delivery times, and so on. Similarly, Wal-Mart has been praised for its inventory management practices. By the same token, analysts have asserted that poor inventory management techniques contributed to the recent demise and bankruptcy filing of the venerable Woolworths discount store chain.

On the other hand, figure 6 shows that apparel store ratios seem to have varied in a lower range since the 1981–82 recession, and IS ratios at retailers in the general merchandise group (excluding department stores) have also declined sharply since peaking in the mid-1980s. One example from the apparel industry is Mothers Work, Inc., which owns several chains of maternity clothing shops. According to an article in the *Wall Street Journal* (Bird, 1996), this firm closely monitors sales on a real-time basis, makes quick decisions on restocking, and pressures suppliers to respond quickly to new orders. As a result, the firm's supply cycle, from design to store shelves, is much shorter than those of many of its specialty retailer competitors. Further, the firm is left with less unpopular merchandise to discount, keeping profit margins high.

Table 3 on page 9 reports mean IS ratios across sectors for three different periods: 1960:Q1–97:Q4, 1960:Q1–83:Q4, and 1984:Q1–97:Q4. For the overall manufacturing and trade sector, IS ratios averaged 1.33 months in the early sample period and rose to 1.42 months in the latter period, with an overall mean of 1.37. Thus, using the break point suggested

FIGURE 3

Inventory–sales ratio, manufacturing sector

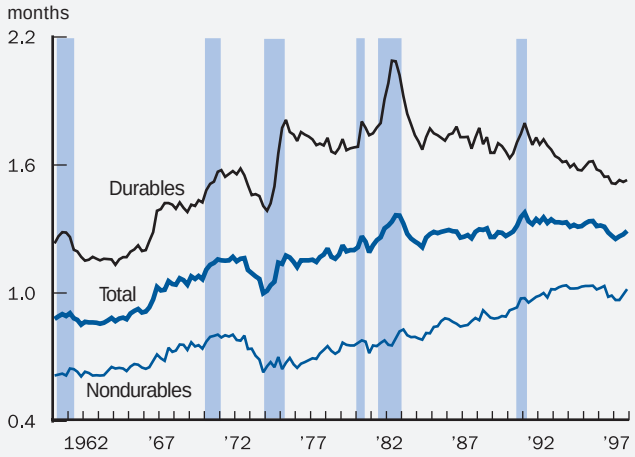


Notes: Raw data are in billions of chained 1992 dollars. Ratios are scaled to equal number of months. Shaded areas denote recessions.

Source: Author's calculations using data from U.S. Bureau of Economic Analysis.

FIGURE 4

Inventory–sales ratio, merchant wholesale sector



Notes: Raw data are in billions of chained 1992 dollars. Ratios are scaled to equal number of months. Shaded areas denote recessions.

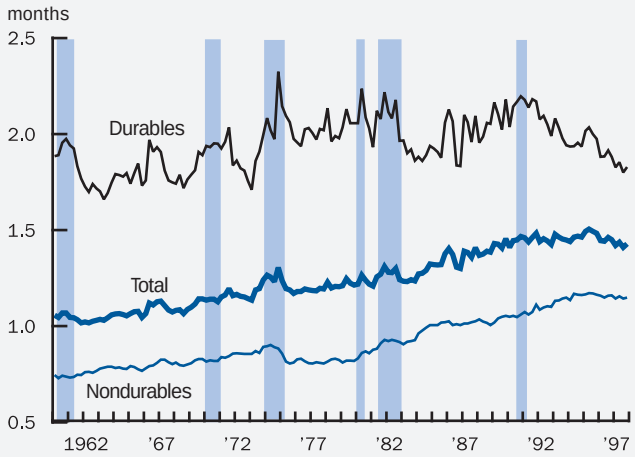
Source: Author's calculations using data from U.S. Bureau of Economic Analysis.

by McConnell and Quiros (1997), we do not see evidence of lower IS ratios overall. Of the three sectors, only manufacturing shows a decline over time, from 1.53 to 1.50 months, and that decline is not statistically significant. For the detailed retail sector, we do see lower mean IS ratios in three of the four durable goods retailer groups (all except automotive) and in three of the five nondurable goods retailer groups, generally consistent with the impressions given by figure 6. Overall, though, even durable goods retailers averaged just slightly higher IS ratios in the later period than the earlier period—not surprising after seeing figure 5, which suggests little overall trend in IS ratios of durable goods retailers.

Before turning to the analysis linking changes in IS ratios with changes in the volatility of inventory investment, I wish to briefly touch on two aspects of retailing that, in principle, offer some perspective on recent changes in inventory behavior in the retail sector. The first development is the substantial industry consolidation that has taken place in recent years. Census data reveal substantial consolidation, increased average firm size, and increased concentration ratios since 1972.[1] For example, between 1972 and 1992, the 50-firm concentration ratio among department store retailers rose by 16.1 percentage points (from 82.1 to 98.2), while among building supplies retailers, that same ratio rose from 13.0 to 35.1. Even food retailers have consolidated significantly, with the 50-firm concentration ratio rising from 40.8 to 49.9 between 1972 and 1992. This increased consolidation among retailers could, in principle, increase incentives of retailers and their suppliers to invest in the technologies needed to better track and control inventories, leading perhaps to lower IS ratios. However, panels B and G of figure 6 imply that story is at best incomplete: Though both building supplies retailers and department stores saw substantially rising concentration ratios between 1972 and 1992, their IS ratios moved in opposite directions over this time period.

FIGURE 5

Inventory–sales ratio, retail sector



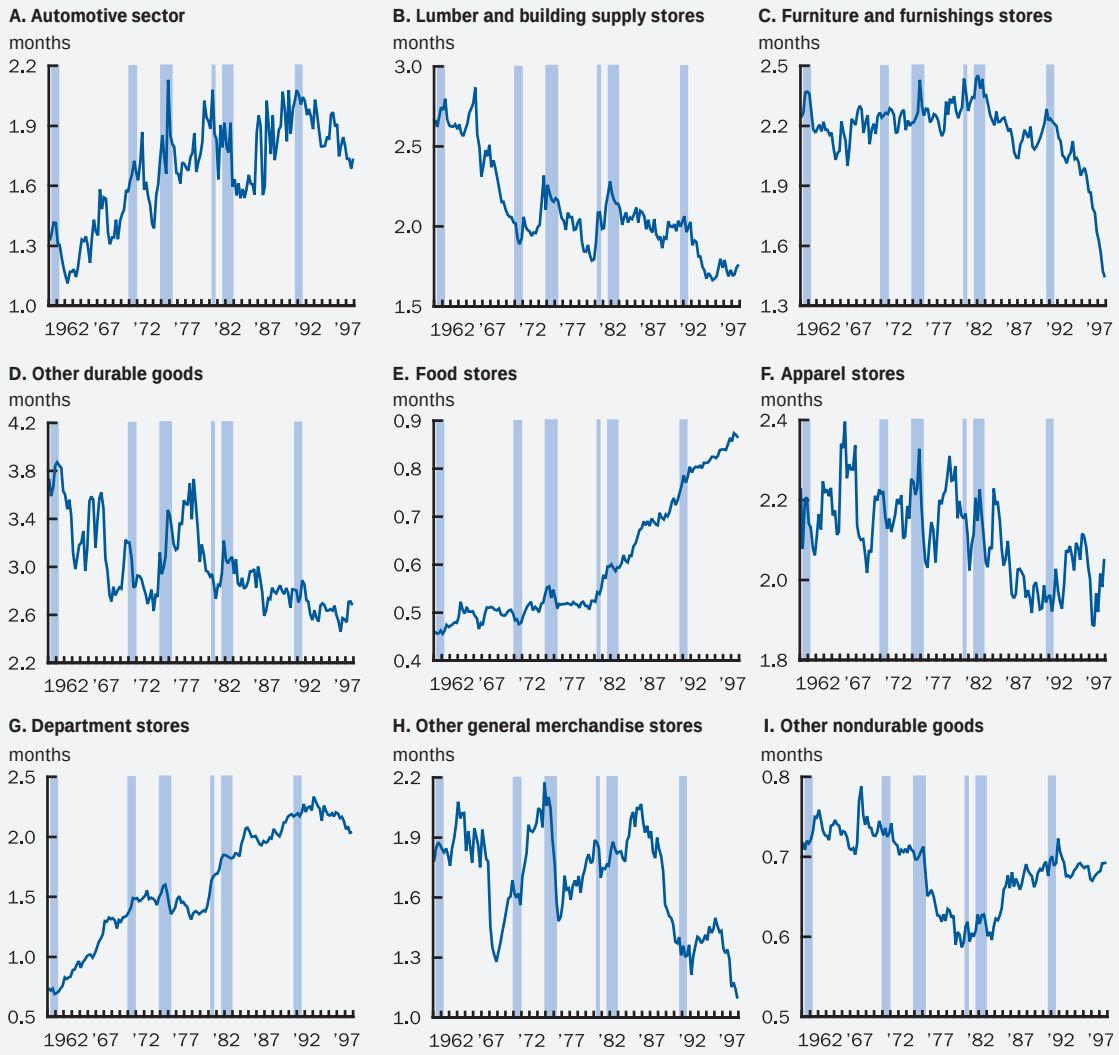
Notes: Raw data are in billions of chained 1992 dollars. Ratios are scaled to equal number of months. Shaded areas denote recessions.

Source: Author's calculations using data from U.S. Bureau of Economic Analysis.

A second recent development is the increased array of products offered by retailers. The Census reports, by sector, the share of sales for each of many lines of merchandise. From these shares, I construct a product variety index, defined as the sum of squared shares, summing over the top five product lines in each sector. This index, which in principle ranges from 0 to 1, takes on large values when a sector is "undiversified," that is, when most of its sales are in a small number of product lines. Similarly, the index takes on small values when a sector sells a large variety of merchandise. By this measure, product variety increased substantially in retailing between 1977 and 1992. For

FIGURE 6

Inventory–sales ratio, retail sector



Notes: Raw data are in billions of chained 1992 dollars. Ratios are scaled to equal number of months.
Shaded areas denote recessions.

Source: Author's calculations using data from U.S. Bureau of Economic Analysis.

example, the index for building supply stores fell from 0.43 to 0.29, while that for food stores fell from 0.74 to 0.53. Again, a simple story relating increased product variety to increased IS ratios does not jump out from the data, as building supplies retailers show falling IS ratios (panel B of figure 6) while food retailers (panel E of figure 6) show rising IS ratios.

The volatility of inventory investment

Next, I compare inventory investment volatility measures before and after 1984:Q1, the point at which McConnell and Quiros (1997) find a one-time decline in GDP volatility. I then relate these volatility measures to the IS ratios described in the previous section. I consider two alternative measures of volatility, one based on the absolute value of the change in inventory investment and the other based on the unexplained variance in the growth rate of inventory stocks.

My first measure of volatility is similar to the one presented in table 2. I define the volatility of inventory investment as the mean of the absolute value of the change in inventory investment, as a share of GDP. Table 4 reports these figures for the detailed sectors, with separate calculations reported for the full sample and the two periods used in table 3. The first line of table 4 shows that, by this measure, inventory investment volatility was indeed lower in the later period than in the early period, falling from .371 to .289.

TABLE 3

Inventory-sales ratios

	1960:Q1–97:Q4	1960:Q1–83:Q4	1984:Q1–97:Q4
Manufacturing and trade	1.37	1.33	1.42
Manufacturing	1.52	1.52	1.50
Merchant wholesalers	1.16	1.08	1.30
Retail	1.25	1.15	1.41
Retail–durable goods	1.95	1.92	2.00
Automotive	1.67	1.57	1.85
Building materials	2.11	2.22	1.90
Furniture	2.18	2.25	2.06
Other durable goods	3.01	3.17	2.73
Retail–nondurable goods	0.92	0.82	1.08
Food stores	0.62	0.52	0.76
Apparel & accessories	2.11	2.17	2.01
Department stores	1.62	1.32	2.12
Other general merchandise	1.69	1.77	1.56
Other nondurable goods	0.68	0.69	0.68

Notes: Raw data are in billions of chained 1992 dollars. Ratios are scaled to equal number of months.
Source: Author's calculations using data from U.S. Bureau of Economic Analysis.

Volatility fell in the manufacturing and merchant wholesale sectors but rose in the retail sector, especially among durable goods retailers. This suggests an increased cyclical importance of inventory investment swings of retailers since 1984:Q1.

Figure 7 relates table 3's evidence on IS ratios and table 4's evidence on inventory investment volatility. For each sector, I compute two ratios. The first is the ratio of the early period's IS ratio to the later period's IS ratio. For example, from table 3, row 1,

TABLE 4

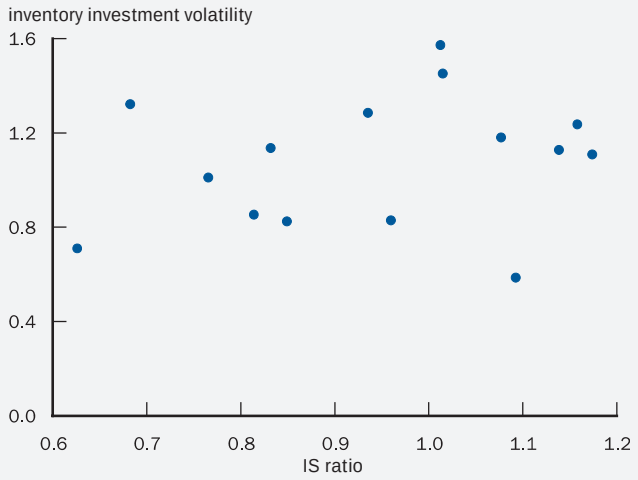
Volatility of inventory investment

	1960:Q1–97:Q4	1960:Q1–83:Q4	1984:Q1–97:Q4
Manufacturing and trade	.340	.371	.289
Manufacturing	.190	.220	.140
Merchant wholesalers	.141	.148	.130
Retail	.217	.204	.239
Retail–durable goods	.189	.176	.212
Automotive	.194	.180	.218
Building materials	.025	.026	.023
Furniture	.018	.014	.024
Other durable goods	.041	.044	.036
Retail–nondurable goods	.074	.075	.074
Food stores	.029	.032	.024
Apparel & accessories	.024	.026	.022
Department stores	.031	.027	.038
Other general merchandise	.019	.020	.018
Other nondurable goods	.037	.042	.029

Notes: Raw data are in billions of chained 1992 dollars. Volatility is defined as the mean of the absolute value of the change in inventory investment as a share of GDP.
Source: Author's calculations using data from U.S. Bureau of Economic Analysis.

FIGURE 7

Inventory–sales ratios and inventory investment volatility



Notes: Raw data are in billions of chained 1992 dollars. Horizontal axis is the ratio of early period to later period inventory–sales ratio; vertical axis is the ratio of early period to later period inventory investment volatility, where volatility is defined as the mean of the absolute value of the change in inventory investment as a share of GDP.

Source: Author's calculations using data from U.S. Bureau of Economic Analysis.

I compute this ratio for the manufacturing and trade sector as 1.33/1.42, or 0.94. The second ratio is based on table 4 and is computed as the early period to later period ratio of volatility measures. If the sectors whose IS ratios have fallen are those whose volatility has declined, then we should see an upward sloping relationship in graphs of the first versus the second ratio. Figure 7 offers little evidence to support this notion. While it is true that, at the broadest level, the manufacturing and trade sectors seem to trace out a positively sloped line, the points pertaining to the disaggregate retail sectors do not follow this pattern. That is, in the retail sector, there seems to be little relationship between industries whose IS ratios have declined and those whose inventory investment volatility has declined.

My second set of inventory investment volatility measures is obtained in a somewhat different fashion. In particular, I start by computing the growth rate of inventory stocks for each sector. I then estimate a simple autoregressive regression model in which the dependent variable is the growth rate of inventories (the rate of inventory investment in percentage terms) and the independent variable is the lagged growth rate of inventories. I then use the residuals from this regression to compute an estimated standard deviation of the growth rate. To see if this standard deviation has changed over time, I simply run a regression of the standard deviation on a dummy variable which divides my sample into two periods, 1960:Q2–83:Q4 and 1984:Q1–97:Q4. If the dummy variable is significantly different from zero, then, by this measure, volatility differed in the two periods. The results of this exercise are in table 5.

TABLE 5

Volatility of inventory investment

	1960:Q1–83:Q4	1984:Q1–97:Q4
Manufacturing and trade	3.12	2.45
Manufacturing	3.53	2.49[b]
Merchant wholesalers	6.17	3.93[a]
Retail	6.27	5.61
Retail–durable goods	11.78	9.40
Automotive	22.94	15.81[b]
Building materials	9.86	7.27[c]
Furniture	7.59	7.72
Other durable goods	14.77	7.80[a]
Retail–nondurable goods	4.43	3.68
Food stores	6.93	5.43[c]
Apparel & accessories	9.41	7.49[c]
Department stores	10.62	7.11[c]
Other general merchandise	15.74	15.11
Other nondurable goods	6.80	5.14[c]

[a]Volatility measure differs at a statistical significance level of 1 percent.
[b]Volatility measure differs at a statistical significance level of 5 percent.
[c]Volatility measure differs at a statistical significance level of 10 percent.

Notes: Raw data are in billions of chained 1992 dollars. Details of calculation are provided in text.

Source: Author's calculations using data from U.S. Bureau of Economic Analysis.

Table 5 shows that, by this measure, inventories are more volatile in the trade sectors than in the manufacturing sector and that inventory volatility is generally lower in the later period than in the earlier period. In broad terms, these results are similar to those contained in table 4. More specifically, the decline in inventory volatility is statistically significant in the manufacturing and merchant wholesale sectors and in several of the disaggregate retail sectors (automotive, building materials, other durable goods, food stores, apparel and accessories, and department stores). A quick return to table 3 shows no obvious

relationship between the movement in average IS ratios and this decline in inventory volatility: Some sectors had rising IS ratios (merchant wholesalers, automotive retailers, food retailers, and department stores), others had falling IS ratios (building supplies retailers, other durable goods retailers, apparel and accessories retailers), and manufacturing's average IS ratio was essentially unchanged between the two periods.

Summing up the results of this section, I find that IS ratios have risen slightly in the trade sectors but fallen somewhat in the manufacturing sector since 1984:Q1. I also find that inventory investment volatility for the overall manufacturing and trade sector has declined somewhat since 1984:Q1, though the difference is not statistically significant (table 5). In the manufacturing and merchant wholesale sectors, the decline in volatility is statistically significant (table 5). In retailing, however, the results are mixed. By one measure, volatility has risen (table 4). By another, however, it has fallen (table 5), though the decrease is not statistically significant. At a minimum, this points to an increase in the relative importance of the retail sector in future inventory fluctuations, and it may point to greater absolute importance as well. Overall, I find little relationship between sectoral changes in average IS ratios and changes in inventory investment volatility. In other words, sectors in which firms successfully decrease their average inventory holdings need not be the same sectors in which inventory investment volatility declines. This suggests that new inventory management techniques that focus on forcing IS ratios downward will not completely negate the role of inventory investment fluctuations in future business cycles.

Conclusion

In this article, I have reviewed recent evidence on IS ratios and inventory investment volatility. I find that IS ratios have, on balance, not changed that much, but that the volatility of inventory investment volatility has declined somewhat since 1984:Q1. This suggests that the recent changes in inventory management techniques have affected the volatility of inventories at least as much as their average levels. I also find that inventory investment volatility has not declined in the retail sector but has declined in the manufacturing and merchant wholesale sectors. Since swings in inventory accumulation by retailers are important factors in business cycles, analysts may wish to focus closely on the retail sector, not just the manufacturing sector, when looking for evidence on cyclical turning points. Finally, since there appears to be little relationship between movements in average IS ratios and inventory investment volatility, analysts should recognize that new inventory management techniques focused on lowering IS ratios will not completely remove inventory investment fluctuations as factors in future business cycles.

NOTES

[1]The following two paragraphs are based on data from the Census of Retail Trade for 1972, 1977, and 1992 (U.S. Department of Commerce, 1972, 1977, and 1992).

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