

Investing in inventories

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As well as investing in capital, firms invest in inventories or stocks. For some businesses, investing in stocks is crucial for their profitability. Shops are better able to attract consumers if their shelves are full and they can offer a wide variety of products. Manufacturers are more likely to win contracts if their customers can trust them to cope with sudden swings in their orders by holding sufficient stocks. Nevertheless, investment in stocks is actually a very small proportion of total spending in the United Kingdom. On average between 2000 and 2005 it was just 0.4% of GDP. But it is volatile. For example, annual GDP growth slowed from 3.1% in 2004 to 1.8% in 2005. Weaker investment in stocks can account for 0.4 percentage points (or a third) of that slowdown. This article examines firms' motives for investing in inventories in order to understand the role it plays in swings in whole-economy output.

What are inventories?

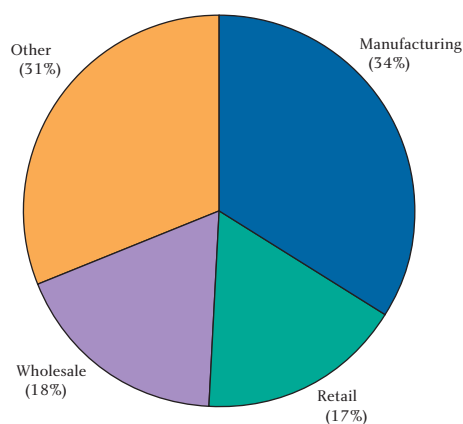
Investment in inventories occurs when a firm puts goods on one side to hold in reserve, rather than immediately sell them or use them in production. For example, if a manufacturer buys steel to use in production that is classed as an input. If the steel is not used, but rather kept in a warehouse in case the supply of steel is interrupted in the future, then it is an inventory.

As defined by the ONS, inventories include many different goods and services. They include stocks of raw materials, and of finished goods, held by manufacturers. They also cover stocks of goods held by retailers and wholesalers, including the produce held on shop shelves. Inventories also include 'work in progress' which can cover either goods or services. For example, if a solicitor's firm puts in hundreds of hours of work on a case, but has not billed the client because the case has not been completed, then that output is measured as an increase in inventories.

The ONS typically refers to 'changes in inventories' when it presents the expenditure components of GDP. That is what we mean by 'investing in inventories'. 'Stockbuilding' is also used by some commentators to denote the same thing. In this article we will use those terms interchangeably. The concept covers increases in inventories, whether due to purchase or internal transfer (ie when a firm allocates some goods it has produced to

stocks). It also includes disposals whether due to sales, internal transfers or if they are simply used up. So, investment in inventories can be negative if firms allow their stocks to run down over a period. Inventories are measured before the deduction of any depreciation, consistent with other types of investment. They are measured by asking firms to assess the change in their inventories in nominal terms, and then deflating those numbers with the appropriate price index to arrive at a volumes measure. In the National Accounts, inventory investment includes the so-called 'alignment adjustment', which is the ONS's residual category used to align different measures of GDP growth. Because that adjustment is not a direct measure of investment in inventories, we remove it from any measures reported here.

Chart 1
Sectoral breakdown of stocks

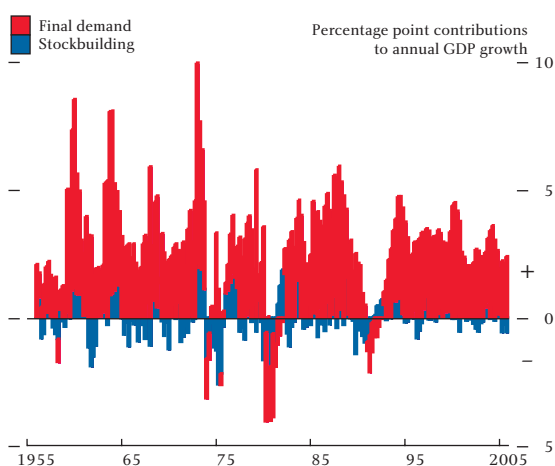


Stock holdings are concentrated in the manufacturing and distribution sectors. Broadly speaking, the manufacturing sector and the distribution sector each account for about a third of all stocks (Chart 1). But each only accounts for a sixth or less of whole-economy output. The remaining two thirds of the economy accounts for just a third of all stock holdings.

Has investment in stocks reduced the volatility of output?

Although investment in inventories is the smallest expenditure component of GDP, it often has a noticeable impact on aggregate GDP growth, because it can be volatile. Chart 2 shows the contribution to four-quarter GDP growth from investment in inventories, compared with the contribution from all other elements of demand ('final demand'). The inventories contribution has varied significantly: between -2.6 and +2.1 percentage points since 1955.

Chart 2
Final demand and stockbuilding



Another feature of Chart 2 is the apparent tendency for the contribution from stockbuilding to be sharply negative during downturns in final demand. That is apparent in the downturns of 1975, 1980 and 1991 in Chart 2. It would suggest that stockbuilding has exacerbated the volatility of output growth, relative to final demand. To check that more precisely, Table A shows the standard deviation of growth rates of whole-economy final demand and output. For both quarterly and four-quarter growth rates, output has been more volatile than final demand. The only difference between output growth and final demand growth is the contribution from stockbuilding. So that would suggest that movements in inventories have increased the volatility of output. This is true for the manufacturing

and distribution sectors, and for periods of above and below average growth.

Table A
Volatility of growth rates

Standard deviations (percentage points)

	Output (GDP)	Final demand (GDP excluding stockbuilding)
Quarterly	0.98	0.92
Annual	2.12	1.77

Sample: 1960–2005.

Motives for holding stocks

The fact that investment in inventories has added to the volatility of output seems puzzling. But it is more explicable once one considers all of the motives firms might have for holding stocks. The three main motives, as set out by Blinder and Maccini (1991), are considered below. Firms may place weight on all three motives.

- Firms can hold stocks of inputs to ensure that they have adequate materials for their production needs. That offers protection against disruption to supplies, or price volatility, and also against any shortages that might arise from a need to increase production sharply.
- Firms can hold stocks of finished goods to avoid having to change production levels. For this to be the motive, the firm must find changing production rates expensive. That might be true if, for example, it is necessary to pay overtime in order to raise production levels.
- Firms can have a target stock level. They hold stocks of finished goods to ensure that they always have adequate supplies to meet demand. They react strongly if actual stocks move too far below or above their target level. If stock levels fall too low, firms face the risk of not being able to meet their customers' demands and possibly losing that custom altogether. But if stock levels rise too high, then firms' stock holding costs will become excessive.

If the predominant motive is to avoid changing production levels, then we would expect stockbuilding to reduce the volatility of output relative to the volatility of final demand. Whereas if firms have a target stock level, they might be willing to see sharp changes in output rates to ensure their stock levels do not depart too far

from their desired levels. For aggregate behaviour all three motives could be important, in which case actual stockbuilding might represent some compromise between reducing the volatility of output and of stock levels.

The weight given to each motive will depend upon the cost of changing output versus the cost of allowing stock levels to deviate too far from desired levels. There are several factors that will affect the flexibility of output: does the firm use skilled staff that are difficult to recruit and train?; is there a high overtime premium?; is production capital intensive and does that place an upper bound on output? But there are also various factors that will affect how costly it is for stock levels to diverge from desired levels: how variable does demand tend to be (as that determines the risk in allowing stock levels to fall)?; how costly are the materials to store?; how likely is it that the customer will go elsewhere if their demand cannot be met instantly?

Another key factor that will affect the dynamics of stock adjustment is the degree to which any change in demand is expected to persist. If demand picks up and is expected to stay strong, a company is more likely to raise output. They will judge that the adjustment cost of changing production cannot be avoided, and that it is worth paying that adjustment cost to ensure demand can be met. But if the rise in demand is only expected to be temporary, the stronger demand is more likely to be met out of stocks. The desired stock level is also likely to be affected by a company's financial position, just like any other form of investment. Other things being equal, higher interest rates should put downwards pressure on desired stock levels, because some firms may judge that at the higher rate of interest they would be better off investing their capital in financial assets rather than in inventories. And if the general corporate financial position were to worsen, say due to a fall in profits or a credit crunch, that would also push down on the desired stock level. Both of these factors might help to explain why stockbuilding has tended to follow protracted upturns and downturns in final demand, rather than moving in the opposite direction.

Evidence on the importance of different motives

The standard deviations reported in Table A suggest a tendency for inventory investment to increase the volatility of output. That would seem to imply that firms are reluctant to let their stock levels deviate too far from

desired levels. Firms' desired stock levels will reflect the level of their expected demand: they will effectively have a target for the ratio of stocks to expected demand. But that target will change over time, for example in response to changes in the cost of investing in stocks and trends in production technologies. Chart 3 shows the actual ratio of whole-economy stocks to final demand, compared with a fitted trend. Chart 4 shows the gap between the two. If the fitted trend picks up movements in the target stock/demand ratio, then deviations from that trend would show undesired changes in stock levels.

Chart 3
The ratio of stocks to final demand

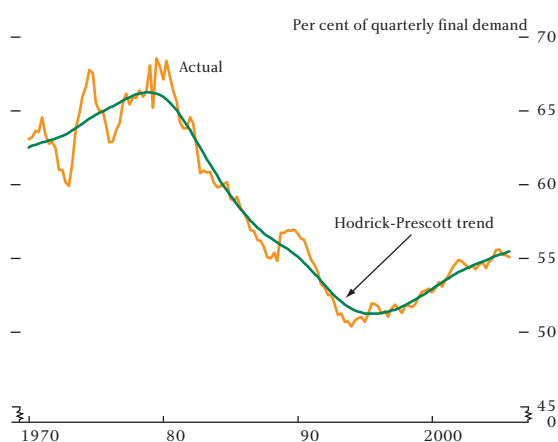


Chart 4
Final demand and deviations of the stock/demand ratio from trend

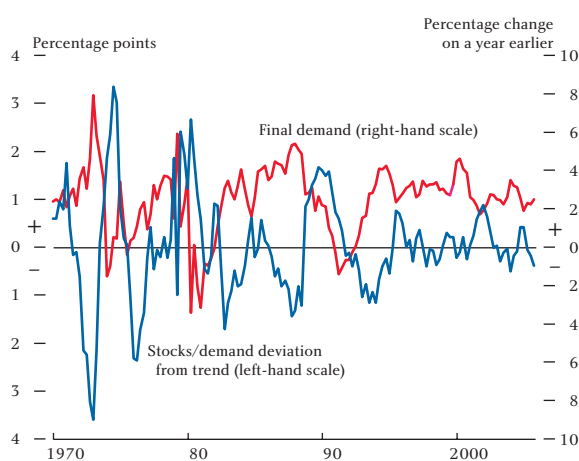


Chart 4 also compares the deviations of stocks from this estimated target with final demand growth. Deviations of stocks have tended to be countercyclical. The correlation coefficient between the two series in Chart 4 is -0.5. So when demand growth has been above average, stocks have tended to fall relative to target. Similarly, when demand has been weak, stocks have

tended to rise above target levels. That evidence suggests that investment in inventories reflects a balance between stabilising output growth, and maintaining a desired level of stocks. Stockbuilding has not been sufficiently countercyclical to reduce the volatility of production relative to final demand. But neither has it been sufficiently procyclical to stabilise the ratio of stocks to demand.

As a further illustration of that point, we can calculate how volatile GDP growth might have been if stock levels had always been kept at their target level (as proxied by the fitted trend in Chart 4). Table B compares the standard deviation of annual and quarterly GDP growth from such an experiment with the actual standard deviations of output and final demand. It shows that if companies had put 100% weight on achieving a target ratio of stocks to demand, then the volatility of GDP growth (especially at the quarterly frequency) might have been considerably higher than the actual outcome. Again that demonstrates that some companies put significant weight on reducing the volatility of their output when choosing how much to invest in inventories.

Table B
Volatility of growth rates

Standard deviations (percentage points)

	Counterfactual (stocks always held at desired levels)	Output (GDP)	Final demand (GDP excluding stockbuilding)
Quarterly	1.69	0.98	0.92
Annual	2.24	2.12	1.77

Sample: 1960–2005.

Tsoukalas (2005) reports an attempt to estimate the different weights that firms place on the costs of volatile stock levels and of volatile production. That involves constructing a detailed model of inventory investment for the manufacturing sector and estimating adjustment costs explicitly. Inventory accumulation of inputs and of outputs are modelled separately, which is shown to improve the ability of the model to fit the data. The results suggest that manufacturing firms face significant costs of adjusting production levels. But it is also costly for inventory levels to deviate far from desired levels. As a result the inventory decision reflects a compromise between reducing the volatility of output and avoiding large deviations of the stock level from target. That result is consistent with the standard deviations reported in Table B. Similar research has been carried out for the United States (for example Humphreys,

Maccini and Schuh (2001)) and reaches broadly the same conclusions.

Has stock management behaviour changed over time?

The UK economy appears to have become more stable over the past decade or so (see for example Benati (2004)). As an example, the standard deviation of four-quarter GDP growth rates between 1993 and 2005 was two thirds lower than between 1960 and 1992 (Table C). Is there any evidence that changes in stock management have contributed to that greater stability?

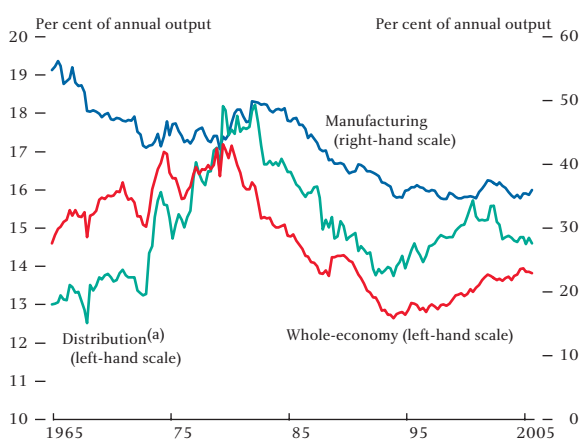
Table C
Volatility of growth rates

Standard deviations (percentage points)

	Output (GDP)	Final demand (GDP excluding stockbuilding)
Quarterly		
1960–92	1.15	1.06
1993–2005	0.30	0.34
Change	-0.84	-0.72
Annual		
1960–92	2.44	2.03
1993–2005	0.81	0.72
Change	-1.62	-1.32

Sample: 1960–2005.

Chart 5
Stock levels relative to output



(a) Volume of distribution stocks divided by volume measure of household spending on goods.

The ratio of whole-economy stocks to GDP declined through the 1980s (Chart 5). Recognising the cost of holding stocks, management practices seized on so called 'lean production techniques' that attempted to reduce stock levels. That was achieved by increasing the frequency of deliveries into and out of the company, by reorganising production to minimise the need for stocks using so-called 'just-in-time' inventory operations, and by making greater use of information and

communication technology to manage stocks (see for example McConnell, Mosser and Perez-Quiros (1999)). The drive to economise on stock holdings may have reflected the increase in real interest rates that companies faced from the early 1980s. Since the early 1990s the aggregate stock/output ratio has picked up a little, but remains below the levels in much of the 1970s.

The decline in the ratio of whole-economy stocks to GDP in part reflected the restructuring of the UK economy away from manufacturing. That reduced aggregate inventory levels relative to GDP because manufacturing firms tend to hold more stocks, relative to their output, than other types of firms. But even within manufacturing there was a sharp reduction in the stock to output ratio (Chart 5). The distribution sector also economised on stocks through that period, although the ratio of stocks to sales has picked up modestly since the mid-1990s.

In theory, it is not clear whether the trend to economise on stocks would increase or reduce output volatility. The lower the desired stock to output ratio is, the less stockbuilding has to increase when demand rises in order to maintain the ratio of stocks to demand. So that might suggest that lower stock levels reduce the volatility of output. But that logic only applies if the fall in the ratio of stocks to demand reflected an improvement in stock management techniques. If the desired stock to sales ratio falls because of a higher cost of investing in or holding stocks, then that would

suggest that companies were willing to accept greater volatility of output for the sake of economising on their stock holdings. Clearly, if that has been the case we would not expect to see lower output volatility.

Table C shows the volatility of final demand and of output, over the period 1960–92 and 1993–2005. For both quarterly and annual growth rates, output volatility has declined more than final demand volatility. That indicates that stockbuilding has played a role in reducing the volatility of output growth since the early 1990s, suggesting that firms have improved their inventories management. However as is also clear from Table C, stockbuilding has only played a small part in the decline in overall volatility. Much of the reduction in output volatility reflects the decline in the volatility of final demand.

Conclusions

One reason for firms to hold inventories is to allow them to meet fluctuations in demand without adjusting production rates. But firms are also unwilling to see stock levels move too far from their desired levels. As a result, in aggregate at least, inventory adjustments have not acted to reduce output volatility. Since the early 1980s, there has been a marked reduction in stockholdings relative to output levels. That largely reflected an improvement in stock management techniques and appears to have been responsible for a small part of the reduction in GDP volatility evident since the early 1990s.

References

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