

Inventories in the Australian business cycle

Introduction

This Economics Research Note examines inventories in the business cycle for Australia covering the period since the mid 1980s. The Australian Bureau of Statistics (ABS) defines inventories as all materials etc., work in progress and finished goods owned by a business, whether held at locations of the business or elsewhere. These items are usually held by businesses in anticipation of a product's sale. Inventory investment is counted as an additional contribution to gross domestic product (GDP).

This Note finds evidence of an inventory cycle at both the aggregate economy level and also for the manufacturing industry. Fluctuations in inventories have played a significant role in amplifying and exacerbating the business cycle and continue to significantly detract from GDP growth during periods of economic downturn.

Rationale for holding inventories

Why do businesses hold and accumulate inventories when there are costs associated with doing so – such as depreciation and storage costs? Inventories are held by businesses for a number of reasons:

- In anticipation of future demand by customers when additional demand cannot be immediately met by increased production.
- As a means of reducing the impact of demand uncertainty.
- The reduced cost of having to order goods less frequently.
- As a tool to smooth production – rather than constantly change the level of production, inventories can be used to deal with fluctuating demand.
- As an unavoidable consequence of production and supply variance.

Businesses may also have a desired inventory to total sales ratio which fluctuates with the business cycle. For example, in the situation of high demand may mean that a business would prefer a higher inventory to sales ratio to meet ongoing high demand.

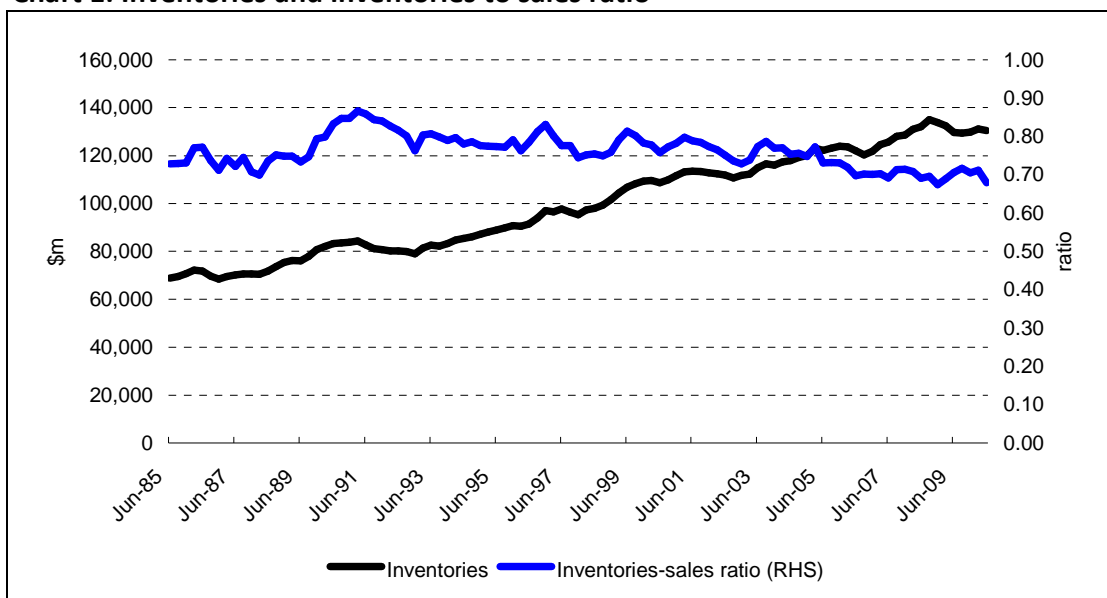
The aggregate inventory cycle

The inventory cycle relates to, and occurs because of, the distinction between planned and unplanned inventory accumulation. When sales are unexpectedly low, unplanned inventories

accumulate. In comparison, some businesses may plan for, and implement, an inventory replenishment program whereby inventory investment is high in order to restore a desired inventory to sales ratio. In this case businesses are purposely adding to their inventories.

Chart 1 shows the levels of inventories for Australia and the ratio of inventories to sales. While the level of inventories has risen steadily since the mid 1980s, the growth of sales has been even stronger so that the inventories to sales ratio for the economy has declined to approximately 0.68 in 2010, suggesting that on average businesses hold approximately 8 months worth of their annual sales as inventories.

Chart 1: Inventories and inventories to sales ratio^(a)



(a) Source: ABS. Non-farm, chain volume measures, seasonally adjusted.

Inventory levels tend to fluctuate much due to the fact that some inventories accumulation is unplanned by businesses (the so called inventory cycle) and this in turn can contribute to, and explain, the business cycle (the volatility of GDP around a long-term trend). That is, when demand falls in a contractionary period, businesses may have unplanned inventory accumulation. The response may be to address this unwanted accumulation by cutting production and inventories in the face of reduced or flat sales. In doing so this may amplify the degree of contraction in the economy than would be the case if inventories had not been accumulated in an unplanned way.

Chart 2 shows the periods where there has been an economic downturn in Australia (approximated by periods of one or more quarters of negative GDP(P) growth) together with inventories, sales and the ratio of inventories to sales.

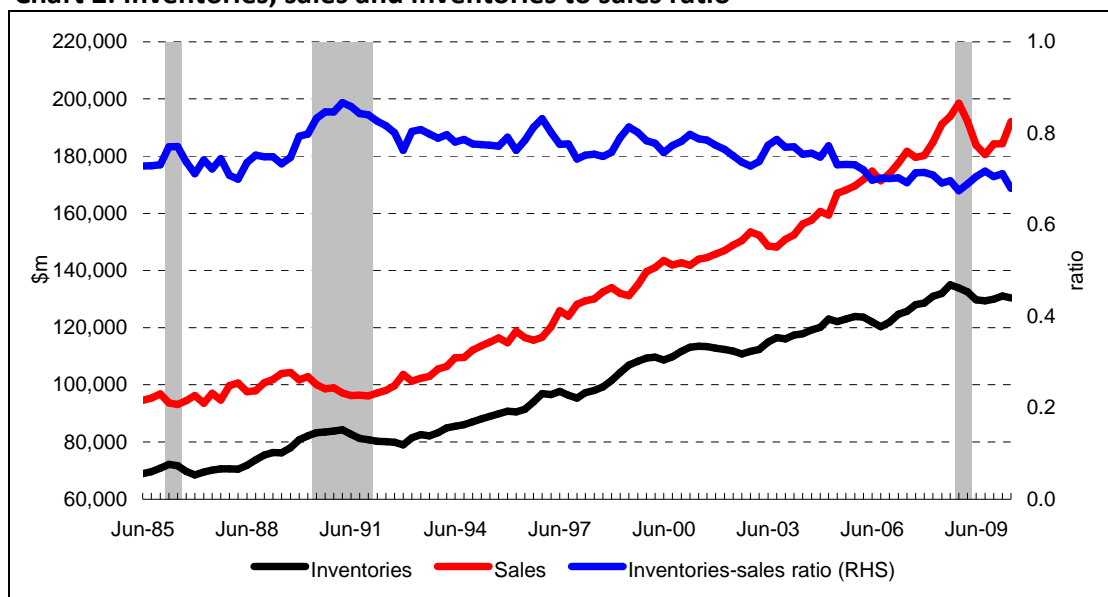
In the period around March 1986 when there was a negative GDP growth episode, we can see from Chart 2 that sales began declining ahead of the economic downturn, resulting in significant unplanned inventory accumulation in the first quarter of 1986 and hence a rising inventories to sales

ratio. As a consequence, businesses reacted by reducing production and inventories from the second quarter of 1986 at a time when sales were still falling, hence amplifying the downturn. Inventories continued to decline beyond the period of negative GDP growth even after sales began to grow and hence the inventories to sales ratio declined below the ratio level prior to the economic downturn.

When we examine the recessionary period of the early 1990s, Chart 2 shows that again, the inventory cycle contributed to an exacerbated economic downturn. We see the unwanted build up of inventories in the lead up to the recession at a time when sales had begun to decline. Sales continued to decline into the recessionary period and the level of inventories decline commenced approximately half way during the recessionary period. The inventories to sales ratio climbed in the first half of the recessionary period and then declined.

In relation to the recent negative GDP growth period associated with the global financial crisis (GFC), there was a clear build up in inventories in the lead up, with businesses only beginning to shed inventories just preceding this period. However, the decline in inventories was marginally earlier and less pronounced than the decline in sales that resulted from the collapse of demand during the GFC. Hence the inventory to sales ratio increased over this period. Since early 2009 the level of inventories has stabilised and with a strong resumption in sales, the resulting inventory to sales ratio has declined again.

Chart 2: Inventories, sales and inventories to sales ratio^(a)



(a) Source: ABS. Non-farm, chain volume measures, seasonally adjusted.

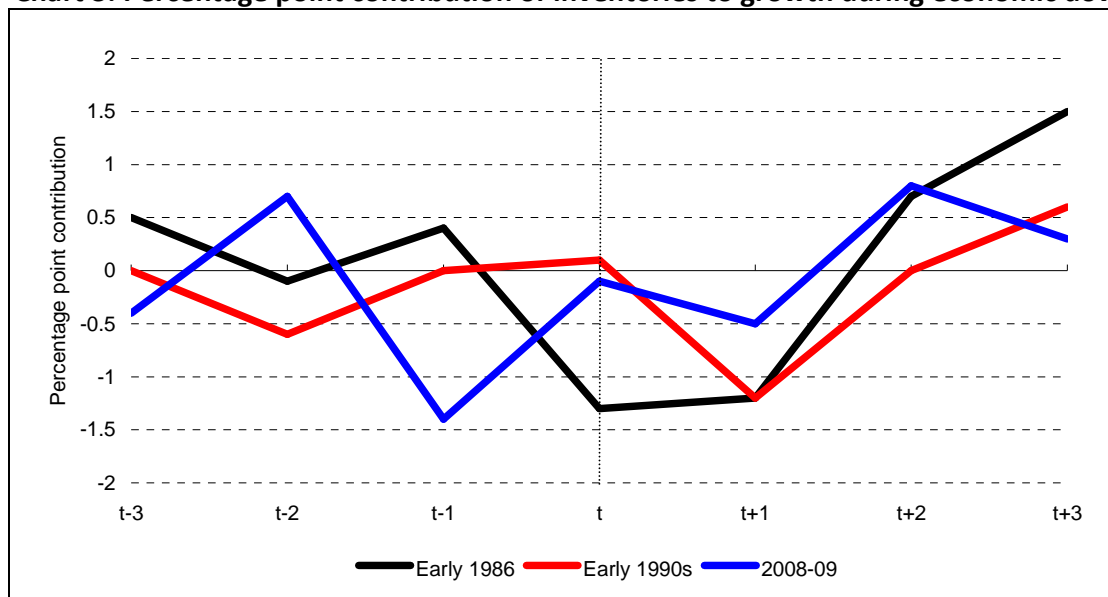
Chart 3 compares the percentage point contribution of the change in inventories to GDP growth over the three economic downturn episodes outlined in Chart 2. Period t represents the quarter in which there was a trough in the quarterly GDP growth rate and the other periods represent the 3 quarters before and after this point.

In the period around March 1986, we can see from Chart 3 that inventories were making a positive contribution up until the quarter representing the trough in GDP growth and in this quarter inventories reduced the quarterly GDP growth rate by a significant 1.3 percentage points. This significant negative contribution to GDP growth continued beyond the period representing the trough in growth (hence exacerbating the economic downturn), with inventories taking a further 1.2 percentage points off GDP growth in the following quarter, before making a positive contribution in the second quarter after the trough.

During the economic downturn period in the early 1990s, Chart 3 shows that the change in inventories had a benign impact on the GDP growth rate in the period preceding and during the trough in GDP growth, with the negative contribution to GDP growth from inventory declines occurring in the quarter after the trough in GDP growth.

During the recent negative GDP growth period during 2008-09, in contrast to the previous economic downturn episodes, the negative contribution of a change in inventories to GDP growth occurred mainly preceding the trough in GDP growth. Chart 3 shows that in the quarter preceding the trough, the change in inventories reduced GDP growth by 1.4 percentage points, which is the most significant one-quarter negative impact in any of the three episodes examined. A quarter after the trough in GDP growth, the decline in inventories was still taking away 0.5 percentage points from GDP growth.

Chart 3: Percentage point contribution of inventories to growth during economic downturns



Volatility over the business cycle

Having examined inventories, sales and the ratio of inventories to sales over the past 25 years, it is worth considering whether the volatility of inventories over the business cycle has changed. To do

this, inventories and GDP are ‘decomposed’ so that the cyclical component of each is identified.¹ Chart 4 presents these estimated cyclical components of GDP and inventories.

Chart 4: Cyclical components of GDP and inventories

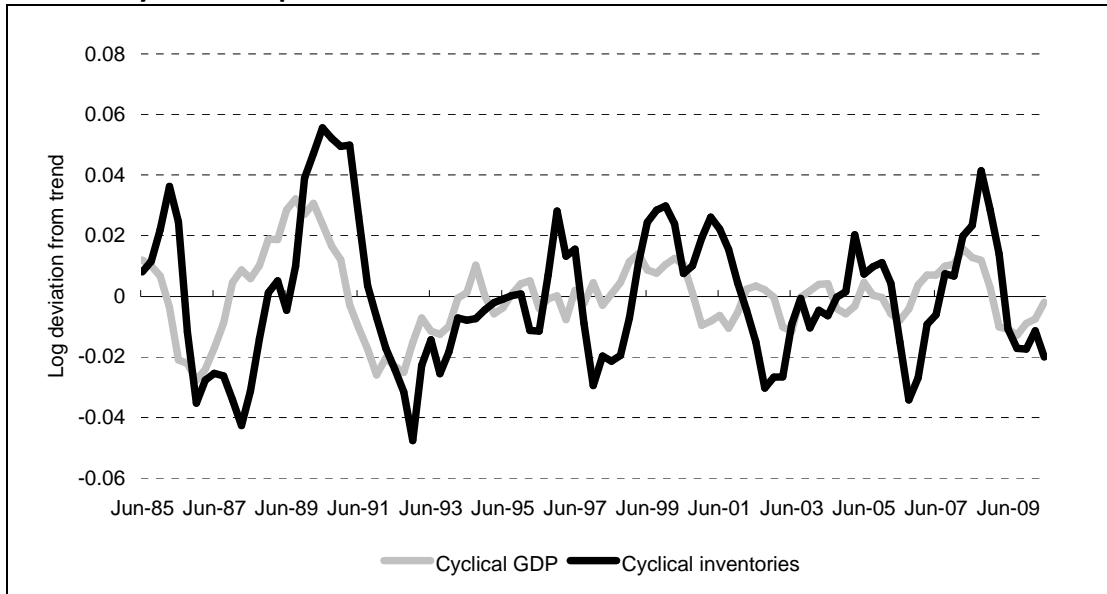


Chart 4 shows that inventories are procyclical (a statistically significant correlation coefficient of 0.43 with respect to the cyclical component of GDP). The cyclical component of inventories has been more volatile than the cyclical component of GDP (respective standard deviations of 0.02 and 0.01). Moreover, while the volatility of both the cyclical components of GDP and inventories have declined overtime, the decline in the volatility of inventories has been less pronounced, suggesting that while there may be offsetting components of GDP that have led to a moderation in GDP volatility, the inventory cycle continues to play a role in contributing to (smaller) fluctuations in GDP.

The inventory cycle for the manufacturing industry

The manufacturing industry is a significant holder and accumulator of inventories in the Australian economy, holding an average of 40 per cent of total non-farm inventories in Australia since the mid 1980s. Therefore it is expected that the inventory cycle at the industry level may play a role in the growth performance of the manufacturing industry itself and the economy as a whole.

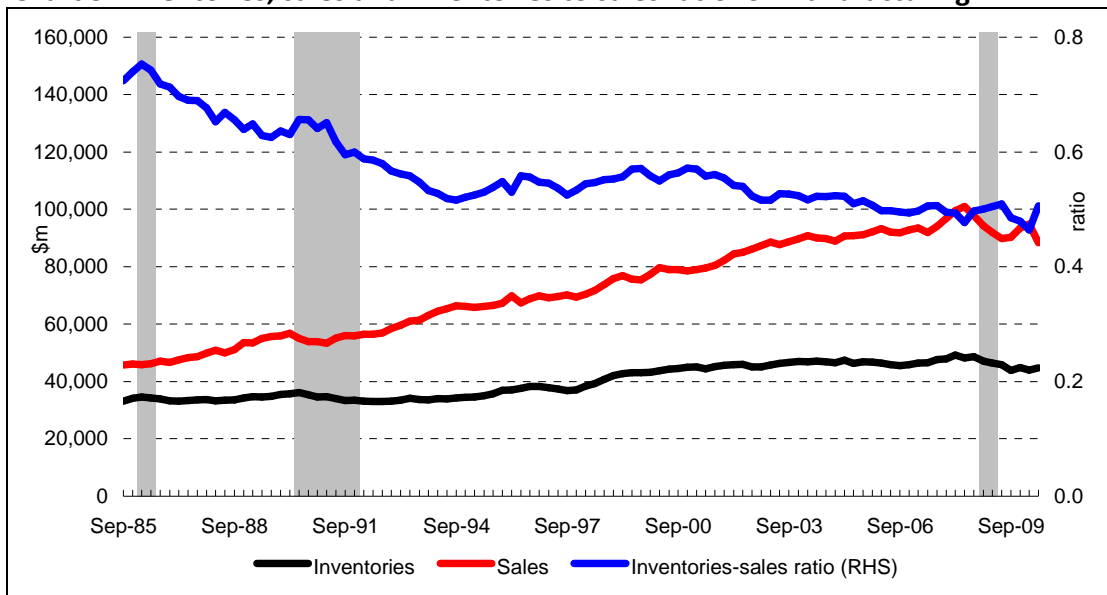
Chart 5 presents the periods where there has been an economic downturn in Australia together with inventories, sales and the ratio of inventories to sales for the manufacturing industry. The inventory to sales ratio for the manufacturing industry has declined over this entire period more rapidly than for the economy as a whole and is approximately 0.50 in 2010, suggesting manufacturing businesses

¹ In technical terms, a Hodrick-Prescott filter is applied to identify the cyclical component of each variable. The cyclical components are represented as natural log deviations from trend to enable comparison.

hold approximately 6 months worth of their annual sales as inventories. Examining the three periods of economic downturn identified:

- The inventory cycle is clear for the period of early 1986. The level of inventories in late 1985 was rising fast in the manufacturing industry. The level peaked in the quarter preceding the trough in GDP growth and then proceeded to decline at the same rate in the 3 quarters after the trough (essentially an inverted V shaped response). Sales essentially continued to grow through this period so the inventories to sales ratio peaked during the same quarter as the trough in GDP growth and then declined linearly after that point (and continued to decline in the 3 years that followed).
- The economic downturn of the early 1990s involved a similar inventory cycle experience for the manufacturing industry. There was an increase in inventory levels (reversing the trend in the three preceding years) in early 1990 around the same time that sales dipped considerably. This resulted in unwanted inventory accumulation and a rapidly declining inventory to sales ratio from the midpoint of the recessionary period (as sales began picking up).
- The recent economic downturn period was associated with a preceding fall in demand for manufactured goods as sales declined from June 2008 and continued to fall. Since inventories were falling over the same time but at a slower pace, the inventories to sales ratio rose over this period with a subsequent downward adjustment in the ratio after the identified economic downturn period.

Chart 5: Inventories, sales and inventories to sales ratio for manufacturing^(a)



(a) Source: ABS. Chain volume measures, seasonally adjusted.

Conclusion

The inventory cycle occurs because of planned and unplanned inventory accumulation. In comparing the behaviour of inventories, sales and the inventories to sales ratio since 1985 and specifically over three identified episodes of economic downturn, there is evidence of an inventory cycle at the aggregate level and for the manufacturing industry. Even though businesses have increasingly implemented just-in-time production processes so as to minimise the need to hold unwanted inventories, fluctuations in inventories continue to exacerbate the business cycle and significantly detract from GDP growth during periods of economic downturn. Changes in inventories exacerbated the downward movement in GDP during the early period of 1986, in the recessionary period of the early 1990s and most recently in 2008-09. The cyclical component of inventories is much more volatile than the cyclical component of GDP and while this volatility has generally declined for both GDP and inventories, the volatility of inventories remains much more pronounced, suggesting that the inventory cycle continues to play a role in the business cycle.

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