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Business Cycles, Inventory Behavior, and the Role of Monetary Policy

Lecture by

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It is a pleasure to help celebrate the founding of this great academic institution in 1913, a year that also saw the creation of the Federal Reserve System.

The founding of these two institutions, a university and a central bank, was inspired by a common desire to encourage the rule of reason over chaos. Both our institutions share in a search of rational inquiry into the workings of our society. The history of intellectual interactions between the Federal Reserve and such academic institutions as DePaul University in Chicago has been long-standing and of great benefit to a free and vital society. Let us hope that the first seventy–five years are merely a beginning.

The Federal Reserve System was created following historical episodes of economic bubbles and panics, representing cycles of unchecked speculative euphoria and pessimism. It was believed that a reserve–based central bank would be able to regulate the supply of money and credit and, thereby, damp potentially explosive movements in financial and real product markets.

Seventy-five years later, the recent stock market crash and the Federal Reserve's role in calming financial markets remind us how pertinent that goal is, even now.

In this talk, I would like to dwell on the nature of imperfections that seem to require stabilizing interventions, namely the cyclicality of most economic phenomena. In particular, I will focus on something quite

pedestrian: the **behavior of inventories**, because they appear to hold the key for much that has mystified us about economic cycles.

A preoccupation with cycles in nature is as old as human thought. Long ago, Eastern philosophers developed a sophisticated theory of the cosmos based on an inherent and immutable cyclicality of all reality, including human life. Such thinking resulted partially from their reflection on the order in the universe and their observations of recurrent processes as found, for example, in the seasons and in the cycle of life and death itself.

For these thinkers and their successors, the belief in the unchanging and perpetual nature of cycles did not imply passive submission. Intrinsic in their philosophy was also the idea that we can and should make choices for the betterment of the world. The Judeo-Christian tradition is similarly rooted in the belief that human intervention can contribute to the well-being of mankind. Your great university is an example of the Church's deep and historic commitment to improving the lot of man through intelligent and compassionate involvement.

The idea that society can take steps to improve welfare is morally attractive. It may therefore be heretical—at least, in a can-do society, such as ours—to suggest, or better, to ask, if there are not circumstances when interference may have unintended harmful consequences. But this is the question I want to pose, and I would like to explore it in the context of business cycles and monetary policy.

From the beginning of economics as a discipline, the profession has been preoccupied with the existence of business cycles, first as a phenomenon to be explained, and, later, as an unwanted disruption to the normal course of events. Joseph Stalin considered the very suggestion of business cycles a threat to the inevitability of socialism. So it was that the Russian economist, Nikolai Dimitrievich Kondratiev, learned the hard way that some things, like totalitarian vanity, are as inexorable as

the very business cycle he himself had proposed in 1922. Kondratiev had found evidence that capitalist economies experienced very long cycles, or "long waves", which he identified. Unfortunately, given the complementary implications of such a theory for the future of socialism, he was arrested in 1930 to testify at a political trial, and although he himself was never tried in court, he remained in prison where he died on an unknown date.

In the nineteen thirties, with the advent of Keynesian economics, the smoothing of economic cycles became one of the principal functions of government. But in recent years, stabilization as a feasible, or even desirable, goal has come under attack by schools of thought within economics. First, monetarists objected on grounds that policy intervention may be inadvertently destabilizing because of long and variable response lags. Later, proponents of a refurbished theory of classical economics, called **rational expectations**, argued that no historical representation of the economy, such as the typical large-scale empirical models found at universities or at the Federal Reserve, could be used to predict the consequences of policy changes because they did not contain adequate characterizations of the public's **rational anticipations** of economic events, including policy. Further, if models did specify people's expectations properly, then one would find stabilization policies to be discounted in advance and, thus, ineffective or irrelevant.

These criticisms make important points, and they have changed how we look at business cycles and at policy. Scepticism regarding active stabilization policy is re-evaluated from time to time as new methods of analysis emerge in economics. One sophisticated approach under development is the ominously titled field of **chaotic theory**. Oxymoronically, chaotic theory is used to organize thinking about episodically unstable processes in the economy that are not accessible to

analysis by traditional methods. The concept of an underlying order in the splash of a raindrop—or the collapse of an auction price bubble—is remarkable. This field is too new and exploratory to yield useful behavioral or policy inferences. However, we know that, in some instances, a threat of disaster may induce a stabilizing discipline on actions: if we are unable to make truly optimal decisions, we may be forced to adopt approximate rules of thumb as behavioral guidelines. A familiar example is traffic on an icy road: automobiles are not built for surfaces without friction; hence, slow and cautious maneuvers are called for, and (almost) everybody slows down! It may be that in many economic markets, the potential for chaos brings about analogous stable aggregate movements. The development of these new methods of analysis are encouraging, for they offer the promise of bringing us closer to an understanding of the fundamental causes of business fluctuations.

My own concerns have long been two-fold. One is the conjecture that some cyclicality may be intrinsic to economic behavior, and that some types of interference may be unnecessary, or cause dead weight losses to society, unless the mechanisms are well understood.

Since I am going to focus on inventories a little later, let me use a paradigm from inventory theory. Let us suppose that an entrepreneur is in the business of selling fertilizer. For various well-known reasons, it is necessary to maintain a stock from which to make sales. But exactly how much? If the stock is too large, the business is probably losing opportunities to earn more by investing excess funds in alternative activities. If the stock is too small, the business is risking a situation where it may have no inventories to sell. This would mean a loss of sales and, possibly, clientele. Assume that ordering costs are such that it is economical to replenish the stock only with relatively large orders. Then it is easy to see—and mathematicians have figured out precise formulae—that for this firm **there will be a cycle of stock depletions**

and re-orders, even if sales themselves are not cyclical. Given that this is an economically optimal cycle, what is the presumption that government intervention would necessarily improve performance? After all, inventories that are held at any given time are held in anticipation of future uncertain sales, in speculation against future prospects of sales. This allows more efficient planning than would be the case in the absence of inventories.

My other concern is the diametrical opposite of the preceding point, but one that leads to the same question. It arises from the possibility that some well-intentioned policies, rather than alleviating cycles, may actually cause them, by **imposing synchronicity on aggregate behavior** that might otherwise have been absent.

Synchronicity is a word I use to describe uniform behavior in the aggregate by many, perhaps otherwise independent, agents. What if monetary policy has the effect of imposing synchronicity on the market where there was none before, where natural forces would otherwise have led to **asynchronous** behavior? We might then observe cyclicality in aggregate behavior that was actually an unintended artifact of active stabilization policies.

How could such inadvertent consequences arise? In central banking, monetary decisions evolve as responses to observations of variables considered to be indicators of aggregate economic performance. Policy makers look at monetary growth, interest rates, inflation, and unemployment, among other things. By reacting to such observations, policy makers also alter the terms on which firms and households base their own decisions. For firms holding inventories, these include reorder and storage costs, and the expectations of future sales, interest rates, and relative prices. In the case of monetary policy, the Federal Reserve can influence these expectations by its **Open Market Operations,** in which it trades government securities for bank reserves (thereby affecting

interest rates and the supply of money), or by any of the other policy tools at its disposal.

Policy can influence inventory decisions of each firm, and, by implication, those of all other firms. By the nature of its aggregate impacts, monetary policy can induce synchronicity in the responses of economic agents. This synchronicity is a two-edged sword with one sharp and one dull edge: if well-timed, policy can trim undesirable or destabilizing excesses in markets; if ill-timed, policy may induce inappropriate aggregated responses that did not exist prior to the policy action.

For good or ill, the economic environment is changed when policy is altered, and many market participants may find themselves moving in lock–step.

A related concern, also affecting the interactions of policy with the business cycle, involves conflicting, or **dissonant** price expectations among agents and institutions in the economy. Let me again refer to the example of inventory management.

The decision to hold inventories is, in an essential way, a speculative matter because the firm must formulate anticipations of several things: future sales, future buying and selling prices of the goods it plans to hold, and of the general price level. (The future general price level is important, because it determines the value of the dollar in the future.) The firm must also anticipate interest rates over the length of time for which funds must be committed when holding inventories. Monetary policy influences these nominal interest rates and price expectations, and thereby affects the real opportunity cost of inventory holding.

Are the expectations of our firm the same as those assumed by the policy authority when it sets a course of monetary growth? More broadly, are expectations of our firm consistent with expectations

formed by other businesses and households? Unfortunately, because of the potential for differences in price expectations among firms making inventory decisions, households making consumption decisions, and the monetary authority making policy decisions, the perceived real opportunity cost of a given level of nominal interest rates is likely to depend on one's vantage point.

To illustrate, suppose that at the beginning of an expansion, policy makers have more optimistic (lower) inflation expectations than inventory managers. Policy may then be somewhat more expansionary than would be the case otherwise, thereby inducing nominal interest rates to fall. Firms that had previously computed real opportunity costs for holding inventories, now find these costs to be unexpectedly lower, giving them incentives to further build up inventories. Since, as noted earlier, this "overshooting" effect tends to be synchronized, there is a possibility of an artificially induced inventory cycle, especially if the differences in expectations are themselves cyclical.

To begin to answer questions such as those raised above, more needs to be known about the nature and causes of business cycles. Few phenomena that accompany the cyclic fortunes of capitalist economies have been pondered as much as the behavior of inventories during business fluctuations. The current body of empirical evidence has been documented through the efforts of researchers like Arthur Burns and Wesley Mitchell, Moses Abramovitz, Michael Lovell, and, more recently, Alan Blinder. Yet, after decades of examination and theorizing, inventory cycles still remain largely unpredictable.

Even a casual look at historical charts reveals that business cycles **are** inventory cycles. But how do they arise, and what connects them to the rest of the economy, to the cycles in output, unemployment, and inflation?

In light of what I just said about the importance of inventory cycles, it may be startling to learn that total business inventory **investment**—(and we are really only concerned with changes in inventories)—is a tiny **.7 percent of GNP**. The pie chart in Chart 1 of the the handout shows the average shares of the major components of GNP over the last forty years.

The real story of the connection between inventories and the business cycle is told by the cyclic **changes** in inventory investment.

But first, let us get an overall view of things. Look at Chart 2. It shows the average percentage share of GNP components in total GNP volatility over the last thirty-nine years. By "volatility" I mean simply the variance, which is a conventional measure of average variability. The relative volatilities of **levels** of GNP components are **lightly** shaded and those of **changes** are **darkly** shaded. As you can see, for all items other than consumption, such as capital investment, government purchases, and inventory investment, the average volatility of the levels is practically invisible. Not so for changes! The **relative volatility of inventory investment changes** shown by the tallest darkly shaded block is close to 40 percent and very clearly dominates that of any other single item, including consumption, and shows how much cyclical energy is hidden in that average .7 percent share contribution to GNP.

A more disaggregated view is provided in Chart 3. This chart is similar to Chart 2, except that volatilities have been computed in relation to total business inventory investment. The light shading once more refers to levels, that is, to **levels** of inventory investment, while the dark shading refers to **changes** in inventory investment. Again, observe the difference between the volatilities of investment levels and those of the corresponding changes. Notice also the unexpected shift in importance away from manufacturing inventories toward wholesale and, especially,

towards retail inventories, which are more directly responsive to events in final sales.

It is natural to inquire if inventory behavior has different features during different phases of the business cycle. A good way to do this is to compare **peak-to-trough** and **trough-to-peak** changes in inventory investment. These, too, are changes, but instead of looking at a measure of quarterly changes, we will look at changes during entire phases of the business cycle to see if recessions are, in some sense, inherently different from expansions and not just mirror images of each other. This sounds like an obvious point to make, but a look at the next two charts will probably surprise some of you, anyway.

Chart 4 shows the changes of several inventory categories as a percent of GNP changes during the last eight peak-to-trough contractions from 1948 to 1982. These relative changes are analogous to those shown in the dark blocks for inventories in Chart 2. The difference in magnitudes alone is stunning. Whereas the average contribution of inventory investment to a change in GNP volatility during the entire postwar period is approximately 40 percent, during the 1960 recession, which by most measures was mild, the contribution of inventory investment to the **change** in GNP rose to 220 percent! While that is an unusually high number, it is not too far from typical. **In half the recessions of the postwar period since 1948, the relative change in inventory investment was over a hundred percent of the change in real GNP.**

The next observation concerns the distribution of inventory components. Notice how, during contractions, relative wholesale and retail inventory investment changes truly dominate the scene. This predominance of trade inventory volatility among types of inventories is apparent throughout the postwar period. The only exception occurs during the very short 1980 recession, which was associated with credit

controls imposed at that time, and which was relatively severe in terms of GNP growth but mild in terms of unemployment increases. During that recession, both wholesale and retail inventory atypically moved opposite to the decrease in GNP. You may verify this by looking at the upper panel of Chart 6, which shows average annualized percent changes in inventory **stocks** during peak-to-trough intervals. Also, in the lower panel of Chart 6, which shows inventory stock changes in expansions—or trough-to-peak intervals, there is a clue to the anomalous behavior of inventories in 1980. Observe that during the preceding expansion (from 1975 to 1980), trade inventory accumulation was relatively mild, indicating that inventory managers had less stock than usual to sell off at the onset of the 1980 recession.

The lower panel in Chart 4 shows concurrent changes in unemployment and average annual growth rates of real GNP. The general impression one gets from a comparison of the panels in Chart 4 is that larger unemployment changes appear to be accompanied by smaller changes in inventory investment, and vice versa, though this is not invariably the case, suggesting that each recession had its own idiosyncracies.

To illustrate, the 1960 contraction, which ranks among the mildest of postwar recessions, was marked by huge inventory decumulations that passed the 200 percent mark in relation to the GNP decline, and much of this was due to the manufacturing and retail sectors. Conversely, in the 1981–1982 contraction, which counts among the most severe of post-war recessions, the drop in inventory accumulation—**it was not a decumulation**—was less than 90 percent of the GNP decline, and its components are miniscule when compared with those in other severe recessions. Thus, 1960 would appear to be more of an inventory recession, and 1981–82 was predominantly an unemployment recession.

Chart 5 is like Chart 4, but applies to cyclical expansions, or, trough-to-peak events. Whereas expansions tend to last longer, the absolute values of **unemployment increases in recessions** and **unemployment decreases in expansions** are similar. This cannot be said of inventory behavior. The average increase of inventory investment during all business expansions was barely 10 percent of the GNP gain (note that the vertical scales of Charts 4 and 5 are identical); again, there is an inverse relationship between the strength of recovery and the size of movements in inventory investment, except that during upturns, this relationship seems to be more predictable. Strong and protracted expansions like 1950–1953 and 1975–1979 were marked by very small proportionate increases in inventory investment, while mild and short upturns, like the one in 1980–1981, show relatively larger gains in inventory investment relative to GNP.

What about the near future? In the last quarter of 1987, we observed rapid build-ups of inventories, leading some to worry about what this may portend. For example, are businesses setting themselves up for a fall if these stocks are to be sold in periods of declining sales and orders? Or do these stocks represent a justified anticipation of further growth in sales? Some evidence for the latter, appearing in early measurements for 1988, suggest that the rate of inventory accumulation has slowed, in part due to stronger sales.

My own forecast may be just as unreliable as yours, for, contrary to popular perceptions, policy makers do not always possess a special advantage in making predictions. Therefore, what these most recent inventory fluctuations may imply for future events, no one knows, but I assure you, everyone at the Fed, from the members of the Board to the staff, works in constant vigilance toward a common goal of price level stability that is consistent with healthy economic growth.

As I mentioned earlier, potential lags in perceptions and responses make it difficult for policy to be always completely satisfactory. We must act when necessary, but guard against unwanted synchronizing and overshooting effects, which can occur when policy steps are taken prematurely or too late.

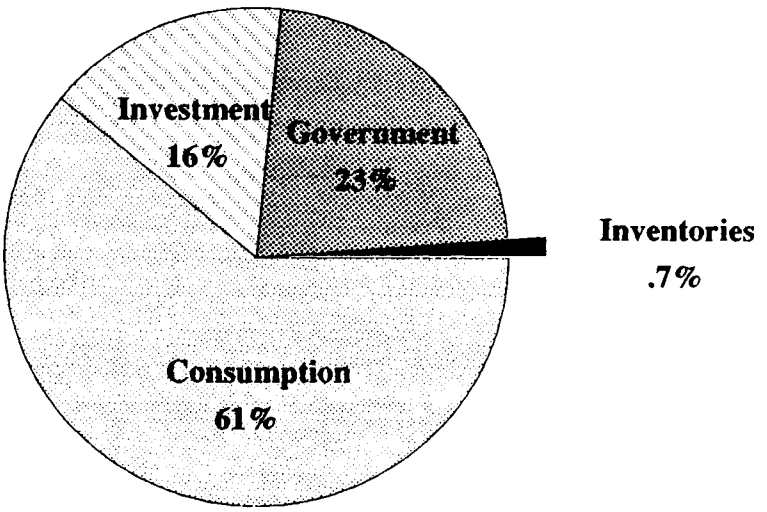
In trying to learn more about how current events may be linked to future events, such as inflation, staff members at the Federal Reserve are studying the usefulness of commodity prices as predictors of future inflation pressures. Commodity markets are monitors of the initial building blocks of the economy, in the sense that many of the goods traded in these markets, like oil and raw materials, are the inputs to intermediate and finished goods. Prices in these markets may, therefore, presage future prices in consumer markets. It is my hope that by monitoring commodity auction markets, monetary policy can become better informed and more effective.

There is much that needs to be done to bring us closer to an understanding of business cycles, and in this talk I have merely raised some questions, particularly as they relate to the making of monetary policy. The inventory examples that I used here are germane, because inventory behavior appears to be at the heart of the business cycle. By considering some of the mechanisms that affect inventory accumulation, we have, I hope, illuminated the synchronizing effects of policy. Of course, the stylized facts in the charts do not, by themselves, provide answers to the questions I have raised. Only further research, such as is now going on at the Federal Reserve and elsewhere, can bring us closer to a deeper understanding of the fundamentals of cyclical behavior.

You at this university, and we in your government share a common goal in seeking to understand the complexity of modern society. I am therefore very happy to have had this opportunity to join with you in a

celebration of seventy-five years of coexistence and collaboration with each other. Thank you.

Chart 1: Share of GNP Components
1948 Q2 to 1987 Q4

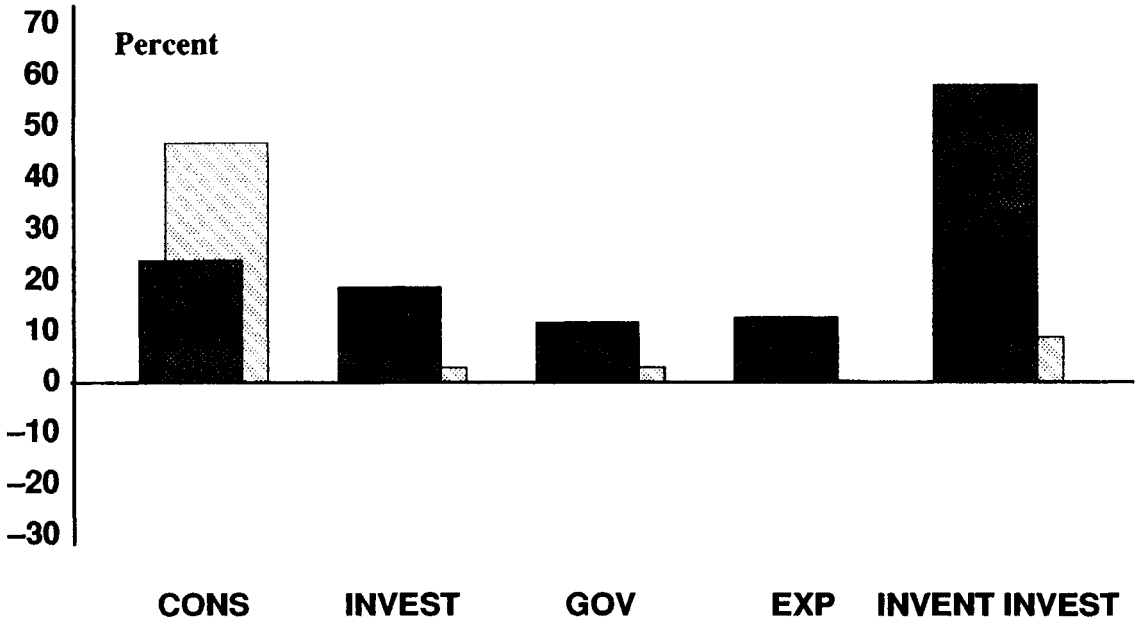


***AVERAGE SHARE OF GNP COMPONENTS IN GNP**

(Average net exports have been negative over the measured period)

Chart 2: Average Share of GNP Components in Total GNP Volatility*

1948 Q1 – 1987 Q4



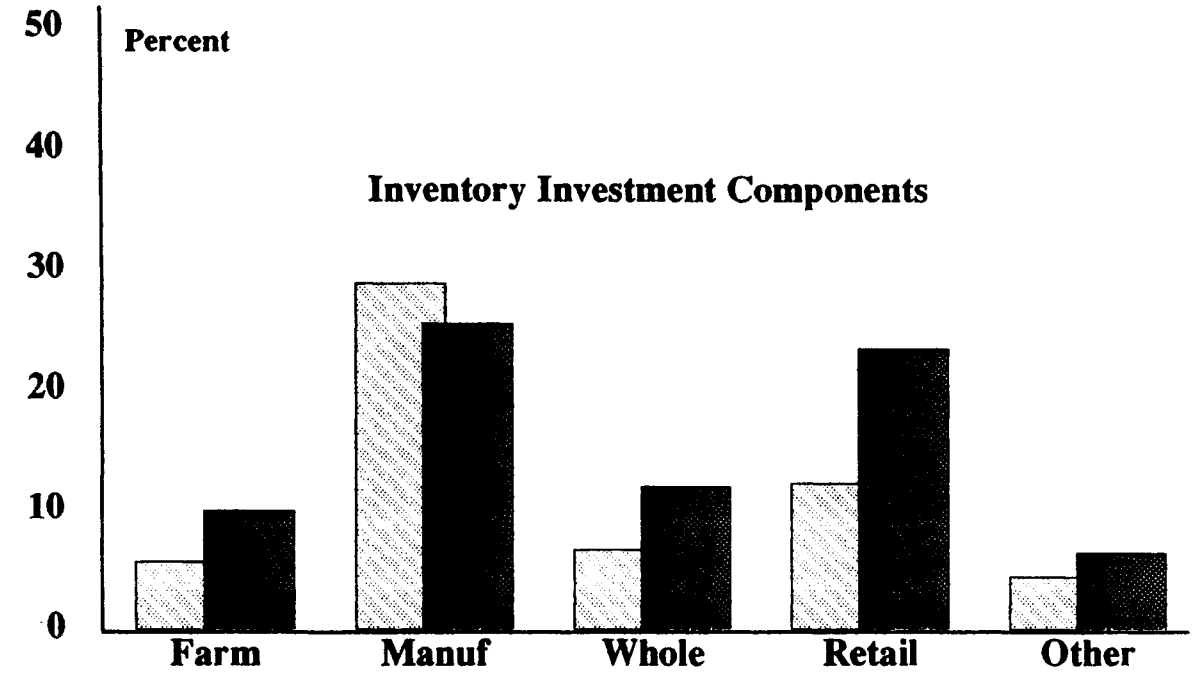
Levels of GNP Components and Inventory Investment

Quarterly Changes (annualized)

*Notation: CON=Consumption, INVEST=investment, GOV=government purchases, EXP=net exports, INVENT INVEST=inventory investment. Ratios of variances of GNP components are given as percent of GNP variance. Because of negative correlations, the variance contributions do not sum to 100. For levels, the covariances are negative. For changes, the covariances are positive.

Chart 3: Average Share in Business Inventory Investment Volatility*

1948 Q1 – 1987 Q4



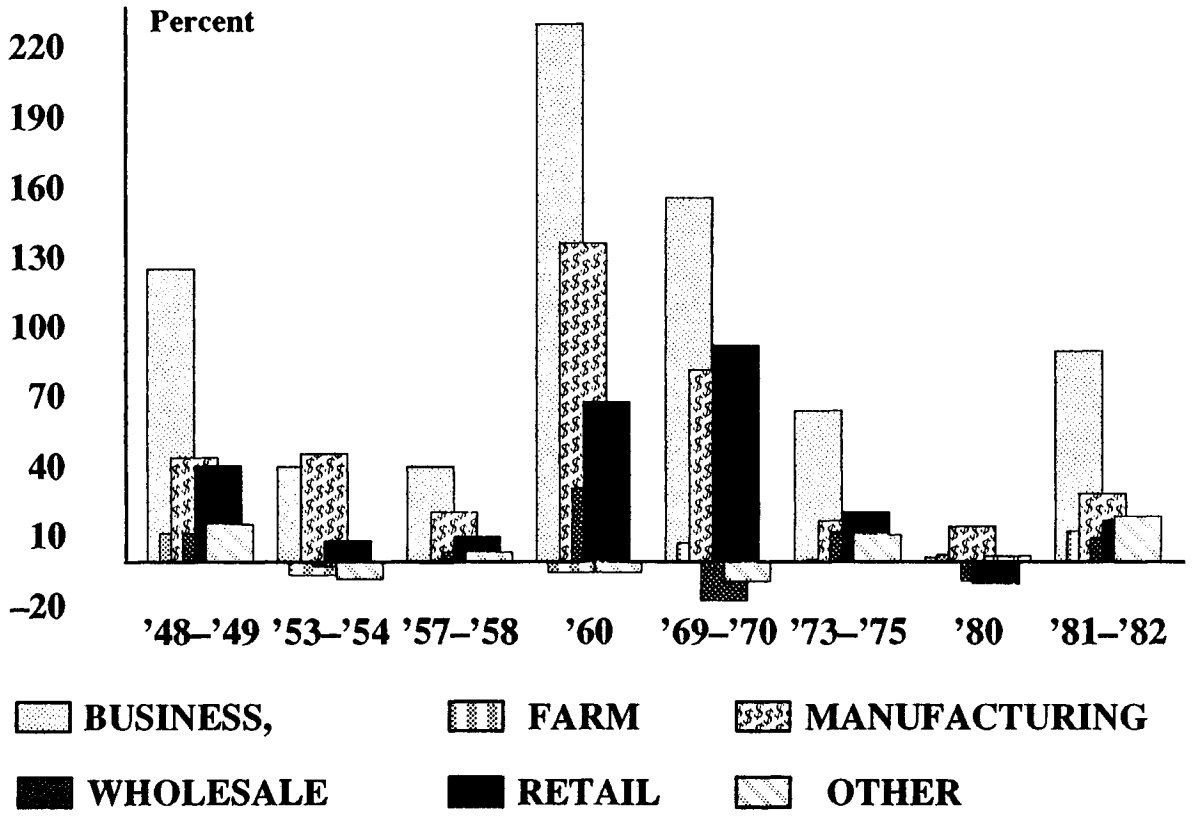
Levels of inventory investment

Quarterly Changes (annualized)

*Ratios of variances of sector inventory investment as percent of variance of total business inventory investment. Because of covariances among the items, the percent variances alone do not sum to 100.

Chart 4: Inventory Investment Changes as Percent of GNP Changes

Eight Post–War Contractions



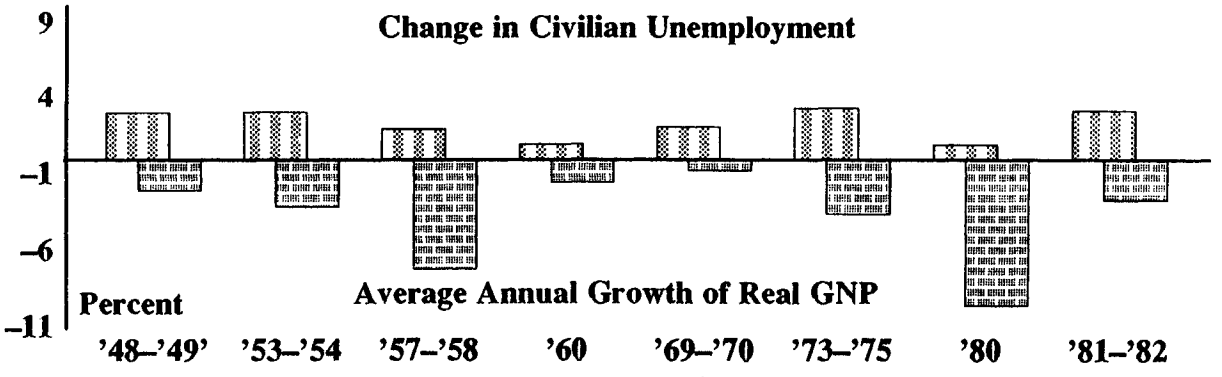


Chart 5: Inventory Investment Changes as Percent of GNP Changes

Eight Post–War Expansions

BUSINESS FARM MANUFACTURING

WHOLESALE RETAIL OTHER

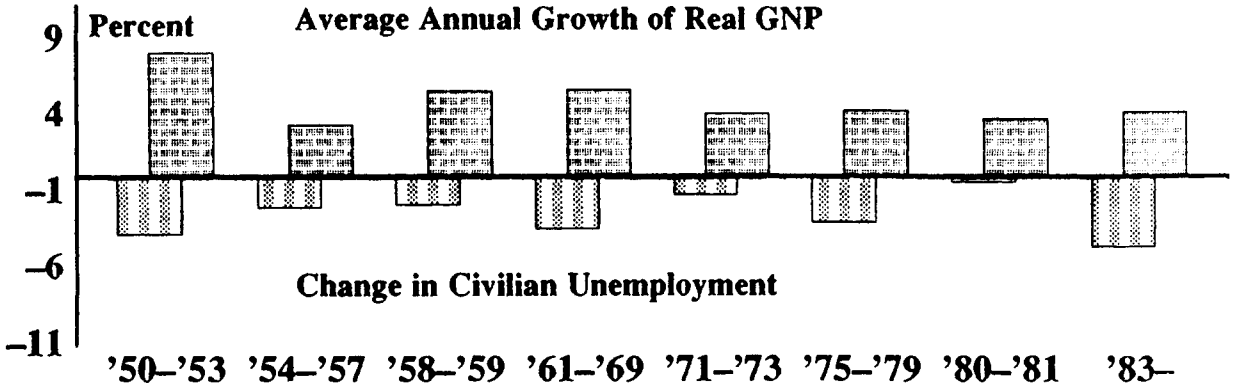


Chart 6: Average Change in Inventory Stock

(Shading Key same as in Charts 4 and 5)