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## On the Classification of Economic Fluctuations

**ABSTRACT:** Attempts to classify economic fluctuations have historically focused mainly on the identification of turning points, that is, so-called peaks and troughs. In this paper we report on an experimental use of multivariate discriminant analysis to determine a four-phase classification of the business cycle, using quarterly and monthly U.S. economic data for 1947-1973. Specifically, we attempted to discriminate between phases of (1) recession, (2) recovery, (3) demand-pull, and (4) stagflation. Using these techniques, we were able to identify two complete four-phase cycles in the postwar period: 1949 through 1953 and 1960 through 1969. ¶ As a further test, extrapolations were made to periods occurring before February 1947 and after September 1973. Using annual data for the period 1926-1951, a "backcasting" to the prewar U.S. economy suggests that the major difference between prewar and postwar business cycles is the omission of the stagflation phase in the former. Quarterly and monthly data were used to analyze the cyclical phasing for the period October 1973 through September 1974; this extrapolation strongly suggests that a recession in the U.S.

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economy started during this period. ¶ To improve the usefulness and the timeliness of the analysis, a set of readily available monthly time series were also selected and tested against the four-phase scheme. Using these variables, we can with a short lag classify the current state of the economy with a reasonable degree of accuracy.

## [I] INTRODUCTION

The classification of economic fluctuations has long been a subject of interest to economists. A very considerable literature exists, dating well back into the nineteenth century, concerning the various kinds and types of business cycle phenomena. (A good concise bibliography of the more important historical references can be found in Burns [1968]. A very extensive bibliography can be found in Hansen [1964, pp. 699–710]). That literature, moreover, is associated with some of the most widely known names in all of economics—Mitchell, Burns, Kitchin, Juglar, Kondratief, Kuznets, Schumpeter, Hansen, Haberler. Some of these names, in fact, have been linked generally with certain specific types of cyclical phenomena: Kitchin with the short or inventory cycle; Juglar with the "regular" (i.e., approximately seven-year) trade cycle; Kondratief, Kuznets, and Schumpeter with long cycles (of twenty or forty years or more).

In most previous efforts to establish business cycle taxonomies, the emphasis has been to a considerable extent on defining turning points, that is, so-called peaks and troughs of the basic (Juglar) trade cycle and the shorter inventory (Kitchin) cycle. As one might expect, popular concern or discussion has focused on the problems created by the so-called recession or depression periods between peak and trough, the "infamous" shaded areas in National Bureau time series charts, as well as in the plotting of economic time series commonly done by others, both in the private and public sectors in the United States.

Historical discussion of cyclical phenomena has been extensively concerned with the manner in which an accumulation of individual choices made by private decision-makers in a decentralized market economy can give rise to surges or contractions in total economic activity. Historically, the key words have apparently been "cumulative" and "private." Public policy, if it entered at all into early discussions of the trade cycle, tended to be concentrated on *monetary* considerations. Of course, monetary policy has not always been primarily public in character. Indeed, only in the twentieth century did most market economy or Western societies evolve the political accommodations necessary to divide responsibility for mone-

tary policy between the private and public sectors. In a sense, the advent of the "Keynesian policy revolution" completed this change in emphasis by emphasizing the role of fiscal policy, which by definition is public in character.

Thus, a new actor, the public sector, now plays a prominent role in influencing patterns of economic fluctuations. Some, in fact, would insist that the public sector is today the dominant force in shaping cyclical activity.<sup>1</sup> Some observers have even gone so far as to say that the political cycle is the only important business cycle still extant in the West. The suggestion is increasingly made that the public sector may use its powers to manipulate the economy to achieve political rather than purely economic goals—and often in contradiction of the underlying economic realities and priorities.

However that may be, the Keynesian revolution and its accompaniment of an activist role for public policy in economic affairs have led to a good deal of dissatisfaction with traditional ways of viewing and classifying cyclical phenomena. Two important changes in the empirical facts of cyclical behavior would seem to be related to these dissatisfactions, and both of these changes can be deemed accompaniments or even consequences of the revolution in public policy. The first is the seeming emergence of a systematic bias in public policy toward achieving lower unemployment at the expense of somewhat greater and more persistent price inflation; that is, economic policy in Western democracies seems to have been increasingly dominated during the postwar period by a willingness to sacrifice more in the way of price stability to achieve lower unemployment. The second new systematic empirical regularity to emerge in the "Keynesian policy era" is that declines in absolute measures of output have become increasingly rare in the market economies of Europe, Japan, and to a lesser degree, North America. It seems fair to say that by the usual semantics no actual depression has occurred in these economies since the end of World War II.

These empirical changes have not gone unnoticed, of course, in the literature on business cycle chronology. Perhaps the most formal recognition of this awareness is the emergence of so-called growth cycles in which a declining *rate* of growth rather than an *absolute* decline [Fabricant 1972], defines a recession. Similarly, too, in recognition of the systematic bias toward price inflation, an increasing emphasis is to be found in the taxonomic exercises on real rather than monetary measures. Still another recognition of these same facts has been the increasing emphasis on the GNP gap (the differences between potential and actual gross national product) as an important measure for setting government budgets and stabilization policies. Likewise, we are becoming more sophisticated about our definitions and analyses of unemployment, recognizing that national

unemployment, an aggregate measure, may convey only a small portion of the total information needed for policy purposes. Increasingly, we desire detail on the cyclical, frictional, and structural components of unemployment, preferably classified by demographic and area characteristics as well.<sup>2</sup>

Of course, national income models, as these emerged from the conjuncture of Keynes's theory and the development of the essential national income accounting by Kuznets, Jaszi, and others, have also had a profound impact on how we study cyclical phenomena. We have seen a shift from more exploratory and taxonomic investigations to the testing of explicit hypotheses suggested by economic theory. Large-scale econometric models of international economies, as in the LINK exercise, represent the fullest and most recent expressions of this line of development. Without wishing to resurrect the debates of twenty-five years ago among Burns, Mitchell, Vining, Koopmans, and others, we can still point out that these two channels of development—one emphasizing the development of behavioral hypotheses from empirical observations and the other, rigorous testing of suggested hypotheses—tend to be both complementary and necessary.<sup>3</sup>

Purely taxonomic exercises, though, perhaps need special justification, and the best proof of their usefulness would be if they provide insights for either scientific or policy purposes that would not otherwise be available. For example, taxonomy might identify time periods during which the coefficients of a system of regression equations would differ, thus improving the structural fidelity of econometric models. Alternatively, taxonomy might provide more prompt identification of a pathological state in the economy, thereby shortening the response time required for corrective policies (which may or may not be deemed "a good thing" depending on a person's sanguinity about the efficacy of economic policy decisions). A full and well-designed econometric model, of course, should be able to identify the current and expected future state of the economy at least as well as it can identify the current state of the business cycle. But just because of the structural complexity of a good econometric model, the data requirements may exceed what is available with the shortest time lag. Taxonomy, in short, would be most valuable if it could be done promptly and with modest data inputs, as we attempt in some experiments reported in section V.

### **[III] ALTERNATIVE BUSINESS CYCLE TAXONOMIES**

As an approach to the classification of cyclical phenomena, both the shift in the emphasis to real values and the development of the growth cycle

concept must be deemed significant adaptations and in all probability improvements in the state of the art. Their utility, moreover, is likely to be enhanced with the passage of time. Nevertheless, they may not have met all the problems posed by the new departures in economic policy and cyclical behavior.

For example, modern discussions of the business cycle, perhaps best illustrated in forecasting exercises, increasingly stress the role of government in conditioning the course of events. Forecasts today tend to be *conditioned* on certain fiscal or monetary policy assumptions. Concomitantly, we hear less about the automatic character of the cycle; that is, how the cycle emerges from the interaction or feedbacks between private decisions and their consequences. Private decisions are still involved, but the stress is on the ability, perhaps even responsibility, of government to offset or neutralize the more adverse effects that might emerge from these private decisions. Rightly or wrongly, the modern view tends to be that public policy should not allow private decisions to cumulate into cyclical adversity. As a result, the cycle is less likely today to run its full course. At least as judged by nearly three decades of experience since the end of World War II, governments are reluctant to permit recessions, let alone retrogression into depression. We may hope, as a corollary, that a full financial panic should also not be needed today to cure the excesses of inflation and speculation—though some may remain less hopeful about this latter point than in our ability to prevent full-scale depressions.

In keeping with the new emphasis on the public policy role in achieving stabilization and growth objectives, one possible objective of taxonomy might be (and, indeed, increasingly is by implication if not by formal definition) identifying or diagnosing the current state of the economy rather than simply asserting when a recession has occurred. Indeed, the identification of cyclical turning points *ex post* (as contrasted with *ex ante*) never was that overwhelmingly important from a policy standpoint. Rather, it was a device for facilitating scientific and historical study of economic fluctuations, e.g., better identification of the underlying causal relationships or improvement of the structural specification of an econometric model. The public, however, always has been and remains understandably interested in the identification of turning points. Perhaps more pertinently, those charged with making policy decisions are interested not only in identifying turning points somewhat before the fact, but also in making more elaborate diagnoses of the state of the economy as soon as possible. In short, if policy is uppermost in mind, then the temptation is to identify the "pathological condition" or state of the economy at different points in time as promptly as possible. Promptness or currency in identifying the cyclical condition almost surely explains much of the public interest in National Bureau research on business cycle "indicators." It seems highly probable, moreover, that policymakers will want to know more than if the

economy is simply in a state of expansion or contraction, especially if contractions are relatively rare.

Of course, the possibility also exists that cycle taxonomy, like so many classifications of social phenomena, may not be quite that distinct or clear-cut (that is, "either-or"). It is at least possible that the economy may simply glide from one stage of the cycle to another rather than make abrupt transitions. Or, given the increasing complexity of economic systems, "pure states" of the cyclical condition may be increasingly rare. Accordingly, in the diagnosis of the cyclical state at any particular time, the actuality may involve a wide mix of different forces, influences, or conditions.

Nevertheless, conceptual clarity, if nothing else, suggests that we try to define certain circumstances as relatively "pure" representations of different stages of the business cycle. A "four-stage taxonomy" would seem, in fact, to be identifiable (or at least implicit) in nearly all current forecasting and popular discussions of the cycle. These four cyclical states might be defined to a first approximation as follows:

1. *Recession*. Considered initially (for the United States economy at least) to be more or less consonant with current National Bureau definitions; that is, a period of some duration in which total aggregate activity actually declines somewhat from previous peak levels and is reasonably widely diffused throughout the economy (in other words, the negative influences are felt in most sectors of economic activity).

2. *Recovery*. Defined as the early expansion out of a recession and a state of economic affairs in which virtually everything is "going well"—unemployment is declining, prices are relatively stable, productivity is rising, and total output is expanding.

3. *Demand-pull inflation*. Equated with the classic inflationary situation in which "too much money chases too few goods"; that is, the forces of recovery are allowed somehow to achieve too much force or pull with production forced up to capacity constraints, prices rising, rates of productivity improvement declining, etc.

4. *Stagflation*. Defined as a situation of stagnation (slow or no growth in the major measures of economic performance) at a relatively high level of activity mixed with price inflation; that is, a situation in which the strains of demand-pull perhaps recede and total monetary expansion diminishes but prices and wages nevertheless continue to increase, perhaps because of catch-up effects due to sectoral imbalances created during the preceding demand-pull inflation or because productivity ceases to improve rapidly.

In this proposed cyclical phasing, only the stagflation stage is likely to elicit much debate or argument. Even there, the issue is not so much

whether some separately definable stage sometimes does exist after the demand-pull and before the recession, but rather how to describe it, and particularly how to label its causes. Thus, in many discussions it might be termed a cost-push inflation. Others, though, would insist that such a cost-push is simply a winding down of classical inflation. This in turn leads to a policy debate about whether stagflation or cost-push is an entirely different breed of economic condition requiring new and different policies, such as wage and price controls. Following National Bureau tradition, no position will be adopted on these policy issues here. Rather, the focus will be on determining whether real empirical delineations corresponding to this four-stage scheme can be identified in the economy. The obvious time period in which to test for such phenomena would be post-World War II, that is, the period roughly corresponding to the new cyclical circumstances and the availability of good quarterly and monthly data on aggregate economic performance.

### [III] METHODS AND VARIABLES

From an empirical standpoint, taxonomy can be posed as a reasonably straightforward problem in multivariate discriminant analysis. The basic objective of discriminant analysis is to classify an observation (for which the defining characteristic is not available or observable) into one of several groups on the basis of available data or variables other than the defining characteristic. Strictly speaking, the estimation of the classificatory discriminant function should be based on prior sample observations for which the correct classification has been established, that is, for which we know the basic defining characteristics. Clearly, useful independent variables for performing a classification under these circumstances would be those for which the average values in the different identifiable groups are substantially different. Conversely, if the values or average for a variable were essentially the same in all groups, that variable would be of little use for classification.

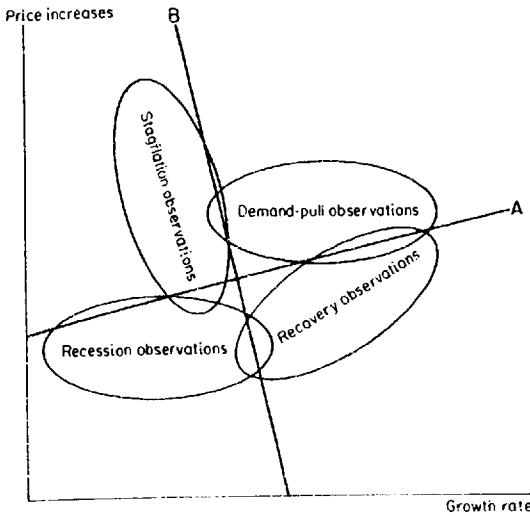
More formally, let us assert that we can identify  $k$  groups in our population. (In our cyclical analysis these  $k$  groups would be the different cyclical phases or stages.) We can also observe values for  $m$  independent variables for all of our units of observation belonging to these different  $k$  groups. (For our cyclical problem these  $m$  variables would typically be different time series values, such as prices or productivity, associated with general economic performance, and the unit of observation would be a month or a quarter.) For a sample with known group identities, multivariate discriminant analysis may be interpreted as maximizing the between-group distance of the  $k$  group means of the set of  $m$  variables ( $x_1, x_2, x_3, \dots, x_m$ )

while minimizing the within-group variance. That is, we desire to partition the  $m$ -dimensional space into  $k$  disjoint subsets  $E_1, E_2, \dots, E_k$ , such that if an "individual" is characterized by a vector  $x = (x_1, x_2, \dots, x_m)$  and  $x$  belongs to the subset  $E_r$ , then that individual is classified into the  $r$ th population. Again, rigorously, the correct population or group identity to which an individual belongs should be known for the sample used to establish the discriminant functions. Once estimated, the discriminant functions can then be used to classify new individuals whose population or group identity is unknown but for whom observation values are available on the  $m$  independent variables.

Graphically we might portray the situation as shown in Figure 1. In this graph four hypothetical distributions corresponding to recession, recovery, stagflation, and demand-pull are shown with different central tendencies or mean values for price increase and growth rate characteristics. As drawn, stagflation is a situation characterized by price increases but low growth; recession, a period in which both growth and price increases are low; demand-pull, a situation in which both are high; and recovery, a period that combines low price increases with high growth rates. (Again, it should be stressed that at this point the example is strictly hypothetical and illustrative!) An obvious next step in any classification exercise would be to draw lines on the graph so as to divide the space into four regions closely corresponding to the underlying groups. Lines A and B in the graph illustrate that step. Thus, if we obtained results like those shown in the graph for our sample observations, about which we know the defining characteristics, we would then have a basis for classifying new observations for which the defining characteristic was not evident. Specifically, if a new observation had values that fell in the northeast quadrant as formed by the lines A and B, we would classify it as demand-pull. An observation in the southwest quadrant would be characterized as recession; one in the northwest, as stagflation; and one in the southeast, as recovery. That is, any new observation for which the defining characteristic was not known could be simply classified into its most likely group according to the quadrant or region into which it fell, these quadrants or regions being determined by the original analysis. In essence discriminant analysis is nothing more than a formal application of these basic notions.

From a strictly formal standpoint, unfortunately, we really do not know precisely to which of our four stages or classifications (populations) different historical observations of monthly or quarterly data actually belong. In lieu of this precise knowledge of the group identities, we initially chose a specific phase identity for each monthly observation, using available information and common sense. We then adjusted the boundary points in an ad hoc or experimental manner in an attempt to use the available sample information to set these boundary identities on a more open-ended empirical basis.

**FIGURE 1 Hypothetical Distribution of Observations**



Specifically, we started with existing National Bureau definitions for recessions. These block out (define) five segments in the postwar period: December 1948 to October 1949, August 1953 to August 1954, August 1957 to April 1958, June 1960 to February 1961, and December 1969 to November 1970. For the other stages, a bit of common sense reinforced by some knowledge of recent business cycle history can carry the analysis a considerable distance. For example, the onset of demand-pull inflation is commonly associated both with the third quarter of 1950 because of the Korean War and with mid-1965 because of the Vietnam buildup that escalated sharply starting in July of that year. Similarly, the years just after the end of World War II, particularly from mid-1946 until mid-1948, are associated with decontrol of the wartime economy and substantial demand-pull inflation. With somewhat less certainty, the second half of 1955 and all of 1956 might be termed a period of demand-pull inflation merging into stagflation late in 1956 or early in 1957. It is more difficult to specify any period between the trough of 1958 and peak of mid-1960 as demand-pull, but if it happened it was probably in 1959. By a process of elimination, recoveries have to be periods that occur before these demand-pull periods but after the preceding recessions; and stagflations must occur, if at all, after demand-pulls but before the next recession. The a priori classification of periods evolved through such considerations is shown in Table 1.

Using these preliminary classifications, we analyzed time series data on the performance of the U.S. economy starting with February 1947 characterized as a demand-pull month. Boundary months between different cyclical phases as tentatively identified in Table 1 were left to be classified ex post by the analysis, that is, in an empirical fashion. In essence, this

**TABLE 1 Preliminary (A Priori) Classification of U.S. Business Cycles into a Four-Stage Scheme, February 1947–September 1973**

Recession	Starting Dates for		
	Recovery	Demand-Pull	Stagflation
?	?	?	May 1948
December 1948	November 1949	June 1950	March 1951
August 1953	September 1954	February 1956	October 1956
August 1957	May 1958	January 1959(?)	January 1960(?)
June 1960	March 1961	September 1965	January 1969
December 1969	December 1970	March 1973	?

meant assigning no prior identity to boundary months whereas all other months, being established periods, were given an exact identity. Formally, since we used a Bayesian discriminant analysis, this meant assigning diffuse or null prior probabilities<sup>4</sup> to the boundary months. Adjustments in the stage definitions were then made to minimize misclassifications at boundaries. As the analysis proceeded, comparisons were made with original NBER definitions of recession and nonrecession periods in the light of the behavior of various time series. Ad hoc adjustments in the boundaries were undertaken in a few instances where there were differences between the established NBER definitions of recession periods and those yielded by the discriminant functions. In short, the new phase definitions, as described in the next section, were established by an interplay of common sense, the usual National Bureau considerations in dating cycles, and the more mechanistic procedures of the discriminant analysis.

Selection of the variables used in the initial discriminant analyses was done through a general survey of the literature. In general, the choice of variables was suggested by the policy and historical considerations already discussed. More narrowly, variables that had figured prominently in the development of formal econometric models of the U.S. economy or had been singled out as particularly sensitive cyclical indicators (in previous NBER studies or elsewhere) were given special attention. Those variables not available for the entire time period of the analysis, 1947 through 1973, were eliminated. The variables actually used for the classification exercises can be found in Table 3, along with their average values for the phases finally established.

#### **[IV] A FOUR-PHASE DISCRIMINANT ANALYSIS OF THE POST-WORLD WAR II U.S. CYCLICAL EXPERIENCE**

After some experimentation and modification (as described in the preceding section) discriminant analysis applied to U.S. data for the years

1947–1973 seemed able to identify or differentiate between two essentially complete four-stage cycles in the postwar period: 1949 through 1953 and 1960 through 1969. Moreover, the months before the recession of 1949 seemed marked by stagflation and demand-pull, as the conceptual scheme would suggest. The years after 1969 also seemed to repeat the basic cyclical structure: 1970 was a year of recession, 1971 and 1972 were years of recovery, 1973 was a year of demand-pull. In addition, the period from 1953 to 1958 could be defined as either a four-stage cycle, in which the fourth stage, stagflation or cost-push, was extremely abbreviated, or as a three-stage cycle, in which the stagflation phase was totally eliminated. We finally adopted a three- rather than a four-stage characterization for those mid-1950 years. One truncated or two-stage cycle occurred between 1958 and 1960. Classification of the phases by months from mid-1948 through September 1973 (the last date for which we had adequate data when we did our original classification analyses) can be found in Table 2. The posterior classifications of each month from February 1947 through September 1973 along with the probabilities characterizing each of the four phases of the business cycle can be found in Appendix A.

On the whole, the impressionistic or prior classifications outlined in the previous section and shown in Table 1 respond remarkably well to discriminant tests or classifications. As noted, the only major instance in which the four-way prior specification seemed to fail totally was in the years 1958 through 1960. In that period the economy appears to have moved from recession to recovery to recession without passing through either a demand-pull or cost-push stage or any other type of major inflationary experience—and even this was not totally unexpected. The 1958–1959 recovery has often been described as aborted or short-lived in the literature and in journalistic accounts. Moreover, there is no reason why all four stages must occur. The economic re-entry problem (from too fast to sustainable growth) might be characterized as finding a way to make

**TABLE 2** Final Classification of U.S. Business Cycles into a Four-Stage Scheme, February 1947–September 1973

Recession	Starting Dates for			Stagflation
	Recovery	Demand-Pull		
?	?	?		May 1948
December 1948	November 1949	July 1950		January 1951
November 1953	August 1954	March 1955		–
September 1957	May 1958	–		–
June 1960	February 1961	May 1965		December 1967
January 1970	December 1970	January 1973		?

the transition from demand-pull back to recovery without experiencing recession (a feat, incidentally, not achieved in the United States during the period analyzed, that is, since 1947). Similarly, there is nothing necessarily inevitable about so much fiscal or monetary stimulus being applied that all recoveries must end in demand-pull inflations. In keeping with the modern emphasis on the responsibility of public policy for the course of the cycle, it might be anticipated that truly wise (or lucky!) policy decisions could avert this outcome.

The average values for the variables used in carrying out the classification scheme for the different cyclical stages as defined in Table 2 are shown in Table 3. These averages more or less conform with prior expectations about the differences in the different cyclical stages. Prices and labor costs rise much less rapidly on average in recession and recovery than in either of the inflationary periods. Recovery in particular is a period when productivity surges; as a result, the gap between unit labor cost and price increases is largest in that stage and therefore almost certainly most favorable to business profitability. On the other hand, recovery and demand-pull are the periods in which the economy expands in real terms. Recession is characterized by actual decline in real gross national product (GNP), while in stagflation the economy experiences only modest growth. Stagflation or cost-push also seems to be a period in which leading indications of incipient recession appear: rates of increase in New York Stock Exchange prices begin to decline even as output continues to grow, and rates of increase in wholesale prices turn sharply downward even though consumer prices continue upward at a vigorous rate. Government fiscal policy also seems to follow conventional prescriptions: though gross government expenditures expand sharply with inflation, the net fiscal position is one of deficits in recession and recovery, of surplus in demand-pull, and slight surplus in stagflation. Monetary policy also seems to move parallel to real GNP growth, as might be expected, though it might be deemed by some to be too permissive in times of inflation and somewhat too constraining during recession. Gestation lags, of course, could alter and certainly would complicate these judgments.

A discriminant function, as noted, is created by attaching different weights to different variables so as to maximize the differences in the group weighted mean differences (i.e., in the group mean discriminant scores, with the groups here being the recession, recovery, demand-pull, or stagflation months). On a conventional  $F$  test, these mean discriminant scores are significantly different for the different groups. As might be expected the two inflation periods are the least differentiated, but even their  $F$  test is at a level three times the  $F$  value associated with 1 per cent significance for such a sample. Stagflation and recovery, by contrast, are the most sharply delineated periods in a statistical sense. The  $F$  statistics are presented in Table 4.

**TABLE 3 Average Value of Variables for Four Cyclical Stages<sup>a</sup> Since World War II**

Variables	Recession	Recovery	Demand-Pull	Stagflation	Average, All Periods	Availability <sup>b</sup>
Money GNP <sup>c</sup>	-0.79	8.43	8.48	6.46	6.66	Q, AH
Real GNP (1958 dollars) <sup>c</sup>	-2.69	6.56	4.07	3.29	3.79	Q, AH
Govt. surplus (+) or deficit (-) as per cent of GNP	-1.14	-0.64	1.47	0.17	0.05	Q, AH
Gross govt. expenditures <sup>c</sup>	6.35	5.32	10.22	14.40	8.74	Q, AH
GNP price deflator <sup>c</sup>	1.82	1.89	4.41	3.20	2.87	Q, AH
Consumer price index <sup>c</sup>	1.37	1.47	4.49	3.71	2.78	M, AH
Food only <sup>c</sup>	0.99	0.98	6.30	3.12	2.93	M
All commodities other than food <sup>c</sup>	-0.34	1.03	3.64	2.80	1.93	M
Wholesale price index <sup>c</sup>	-0.93	1.43	6.08	1.39	2.39	M, AH
Industrial commodities only <sup>c</sup>	-0.82	1.44	5.44	1.89	2.33	M
N.Y. Stock Exchange composite price index <sup>d</sup>	0.20	1.15	0.19	0.07	0.51	M, AH
Compensation per man-hour <sup>c</sup>	2.38	5.12	6.25	7.47	5.51	Q, AH
Output per man-hour <sup>c</sup>	1.57	4.68	2.41	2.36	3.09	Q
Unit labor cost <sup>c</sup>	0.78	0.44	3.84	5.12	2.42	Q
Prime rate <sup>e</sup>	-0.142	0.028	0.096	0.065	0.029	M, AH
Corporate bond rate <sup>e</sup>	-0.010	-0.005	0.042	0.037	0.016	M, AH
Money supply <sup>e</sup>						
M1	1.74	3.99	2.96	3.85	3.33	M, AH
M2	4.79	7.02	5.33	3.83	5.55	M, AH

**TABLE 3 (concluded)**

Variables	Recession	Recovery	Demand-Pull	Stagflation	Average, All Periods	Availability <sup>b</sup>
Unemployment rate <sup>c</sup>	5.46	5.76	4.08	3.29	4.73	M, AH
Net exports as per cent of GNP	0.36	0.20	0.45	0.22	0.30	Q

SOURCE: See Appendix B.

<sup>a</sup>The dates of the cyclical stages are shown in Table 2.

<sup>b</sup>Q = data available on a quarterly basis; M = data available on a monthly basis; AH = data available, at least to a good approximation, annually back to 1920. Data available from source only on a quarterly basis (Q) were interpolated by a smoothing procedure so that they could be used on a monthly basis for discriminant analysis.

<sup>c</sup>Per cent change; seasonally adjusted at an annual rate.

<sup>d</sup>Change per month.

<sup>e</sup>Seasonally adjusted at an annual rate.

**TABLE 4** Significance of Mean Discriminant Score Differences

[F matrix—degrees of freedom for each F statistic: F(20, 297)]			
	Recession	Recovery	Demand-Pull
Recovery	12.573		
Demand-pull	24.169	28.577	
Stagflation	38.359	48.277	10.920

Two canonical functions seem to be quite sufficient to perform the basic discrimination (as shown by the eigenvalues and cumulative proportions of "explained" dispersion at the bottom of Table 5). Moreover, the functions can be interpreted in a reasonably straightforward way by looking at the weights or coefficients shown in the second and third columns of the table. The first function apparently differentiates by unemployment, interest rate changes, productivity, and price behavior; it thus separates recession and recovery from the two inflationary periods. Specifically, high unemployment rates, good productivity gains, negative changes in corporate bond rates, and small to negative price changes will yield a high negative score on this index; opposite conditions will register positively. The second canonical function apparently adds only a little to the differentiation, mainly in terms of interest rate behavior. This apparently helps somewhat in separating the "real growth" stages, recovery and demand-pull, from the no-growth or monetary-only growth periods, recession and stagflation. The foregoing behavior is shown graphically by the plot of the canonical variates in Figure 2. The first canonical is plotted against the horizontal axis and the second against the vertical axis. Thus, against the vertical axis, the minus-growth period of recession is entirely in the upper half while stagflation tends in that direction. For the first canonical plotted on the horizontal axis, the relatively price-stable periods of recession and recovery are on the right-hand or positive side of the diagram, whereas the two inflationary periods are on the left, with the stagflation period being further separated from the demand-pull by recording substantially more negative scores on average on the first canonical variable.<sup>5</sup>

An interesting test of the basic discriminant concept (as of almost any statistical time series analysis) is to extrapolate the analyses to periods beyond the historical data for which the original functional parameters were estimated. In the present case, the obvious test periods would be those occurring before 1947 and after September 1973, that is, before and after the period used for the basic analysis. For these extrapolations, diffuse or null prior probabilities<sup>6</sup> would appear appropriate.

Attempting to backcast to the period prior to 1947 one immediately encounters the difficulty that good quarterly data are simply not available. However, fourteen of the quarterly or monthly variables used in the basic classification analysis are available (at least to a fair approximation) on at

**TABLE 5 Summary Tables with Canonical Discriminant Analysis Results**

Variable Entered	F Value to Enter	Coefficients for First and Second Canonical Variables	
		First	Second
Unemployment rate <sup>a</sup>	307.31	1.757	-0.164
Real GNP (1958 dollars) <sup>b</sup>	50.46	-0.236	-0.309
Unit labor cost <sup>b</sup>	19.49	0.033	-0.446
Govt. surplus as per cent of GNP	15.87	0.239	-0.125
GNP deflator <sup>b</sup>	8.54	-0.113	0.133
Prime rate <sup>c</sup>	7.30	0.160	0.041
Gross govt. expenditures <sup>b</sup>	5.65	-0.017	0.006
Money supply <sup>b</sup>			
M2	5.32	0.048	-0.059
M1	5.72	-0.010	0.037
Net exports as per cent of GNP	3.76	-0.710	0.395
Wholesale price index, industrial commodities only <sup>b</sup>	4.28	-0.030	0.049
Compensation per man-hour <sup>b</sup>	3.44	-0.184	0.318
Corporate bond rate <sup>c</sup>	3.27	-0.072	3.287
Consumer price index <sup>b</sup>	2.58	0.024	0.098
Food only <sup>b</sup>	2.35	-0.042	0.006
Output per man-hour <sup>b</sup>	1.83	0.148	-0.266
N.Y. Stock Exchange price index <sup>d</sup>	1.40	-0.045	-0.041
Consumer price index, all commodities except food <sup>b</sup>	1.69	-0.058	-0.049
Money: GNP <sup>b</sup>	0.58	0.160	0.041
Wholesale price index <sup>b</sup>	0.41	0.011	0.009

	Canonical Variables			
	First	Second	Third	Fourth
Associated eigenvalues	4.2201	0.8428	0.4340	0.0001
Cumulative proportion of total dispersion explained	0.7677	0.9211	1.0000	1.0000

SOURCE: See Appendix B.

<sup>a</sup>Seasonally adjusted at an annual rate.

<sup>b</sup>Per cent change; seasonally adjusted at an annual rate.

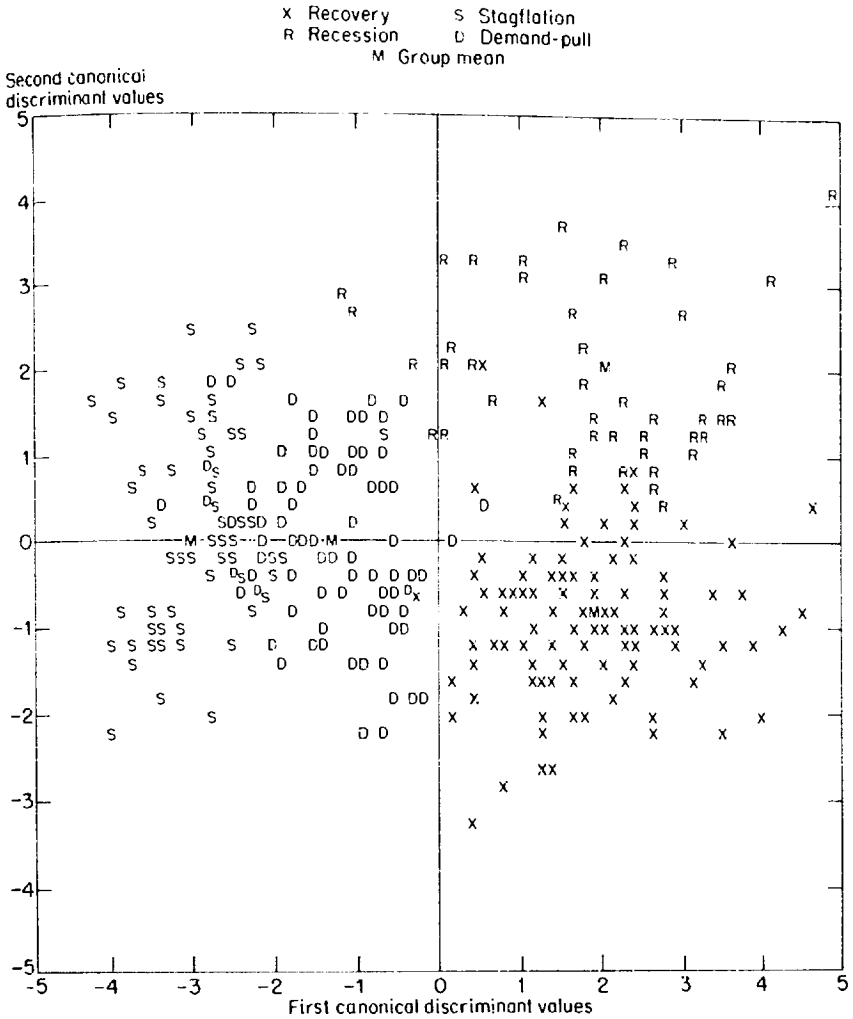
<sup>c</sup>Change per month.

<sup>d</sup>Per cent change.

least an annual basis back to 1920. These fourteen variables are designated by an AH entry in the far right or availability column of Table 3.

To backcast, the discriminant functions were redefined using monthly observations for those fourteen series only for February 1947 through September 1973. From the newly constructed fourteen-variable discriminant functions, posterior probabilities of recession, recovery, demand-pull,

**FIGURE 2 Plots of First and Second Canonical Discriminant Values**



and stagflation can be estimated for each of the years 1920 through 1951, using annual data only. The classifications and probabilities derived from this extrapolation exercise are shown in Table 6.

The historical record with which these historical backcasts would seem best compared is that of the NBER business cycle chronology. Actually, the National Bureau has defined recession periods for the U.S. economy going back before 1900; those for the years after 1920 are shown in Table 7. Obviously, many recessions have lasted more than a year. Since we do not have a full set of monthly or quarterly data for the interwar period, detailed turning points cannot be specified in the historical extrapolation. In spite of

**TABLE 6** Posterior Probabilities of the Four Business Cycle Phases for 1920–1951 Based on Extrapolations of Postwar (1947–1973) Discriminant Analyses

Year	Recession	Recovery	Demand-Pull	Stagflation
1920	0.000	0.988*	0.002	0.000
1921	1.000*	0.000	0.000	0.000
1922	0.061	0.939*	0.000	0.000
1923	0.000	0.025	0.895*	0.081
1924	0.999*	0.001	0.000	0.000
1925	0.000	0.988*	0.007	0.005
1926	0.000	0.000	0.308	0.692*
1927	0.001	0.003	0.957*	0.039
1928	0.000	0.005	0.992*	0.003
1929	0.000	0.000	0.996*	0.004
1930	1.000*	0.000	0.000	0.000
1931	0.999*	0.001	0.000	0.000
1932	1.000*	0.000	0.000	0.000
1933	0.032	0.968*	0.000	0.000
1934	0.032	0.968*	0.000	0.000
1935	0.000	1.000*	0.000	0.000
1936	0.000	1.000*	0.000	0.000
1937	0.001	0.999*	0.000	0.000
1938	0.995*	0.005	0.000	0.000
1939	0.013	0.987*	0.000	0.000
1940	0.020	0.980*	0.000	0.000
1941	0.050	0.950*	0.000	0.000
1942	0.000	0.000	0.000	1.000*
1943	0.000	0.000	0.000	1.000*
1944	0.000	0.000	0.000	1.000*
1945	0.000	0.000	0.000	1.000*
1946	0.000	0.000	0.001	0.999*
1947	0.001	0.009	0.895*	0.095
1948	0.000	0.000	0.988*	0.012
1949	0.940*	0.058	0.002	0.000
1950	0.001	0.119	0.845*	0.036
1951	0.000	0.000	0.895*	0.105

\*Most probable group.

this data handicap, the extrapolations reported in Table 6 agree remarkably well with the formal NBER chronology and also with common sense. The only NBER-designated recessions not observable in the historical extrapolations—and this may simply reflect the lack of monthly data—are the relatively mild 1926–1927 and 1945 episodes: the 1927 recession lasted barely a year and the minirecession of 1945 had a duration of less

**TABLE 7 Peaks and Troughs in NBER Business Cycle Chronology<sup>a</sup> Since 1920**

Peak		Trough	
January	1920	July	1921
May	1923	July	1924
October	1926	November	1927
August	1929	March	1933
May	1937	June	1938
February	1945	October	1945
November	1948	October	1949
July	1953	August	1954
July	1957	April	1958
May	1960	February	1961
November	1969	November	1970

<sup>a</sup>The period between the peak and the trough can be considered a recession.

than one year. The Great Depression of the early 1930s is unmistakable, with three years of recession being recorded in 1930, 1931, and 1932. Similarly, the sharp downturn of 1938 is clearly noted.

The four-phase cycle is not, however, evident in the interwar experience. Stagflation is a quite rare event in the interwar years, appearing only in 1926 and then with a relatively weak posterior probability. The only other years of stagflation in the backcast occur during World War II, apparently reflecting the price and wage controls of that period. Since stagflation or cost-push inflation is deemed to be a relatively recent or post-World War II phenomenon this may not be considered too surprising. If the 1926 and wartime stagflations are ignored, then it can be argued that the three decades from 1920 through 1950 are characterized by three classic three-phase business cycles plus one aborted cycle of that kind, with the three phases proceeding in the expected order of recession to recovery to demand-pull and then back to recession. The three full cycles are those of 1921 through 1924, 1924 through 1932, and 1938 through 1949 (with the war years looked upon as an interruption or aberration in the sequence). The incomplete two-stage cycle is that of 1932 through 1938 in which there are no signs of demand-pull or other inflationary effects, just as in 1958–1959. Again, the 1937 recovery, like that of 1959, has often been described in the literature and commentary as aborted.

An interesting question posed by this historical analysis is why the postwar experience extrapolates so well to the interwar experience if indeed a profound change occurred in the character of the business cycle with the advent of new policy initiatives in the postwar period. The only major difference, as already noted, is the apparent lack of much true stagflation during the interwar years. But, rhetorically speaking, is a fourth

phase of the business cycle, stagflation, a major contribution of postwar policy? The answer to that question almost certainly must remain an open issue.

The other extrapolative test that can be made, of course, is to project the discriminant analyses forward to the periods after those in which the basic analysis was performed, that is, to months after September 1973. For those months exactly the same data series are available as were used in the basic or original analysis. The results from such a forward extrapolation (again using no a priori specification of the character of these months, that is, giving them a so-called diffuse prior probability) is shown in Table 8.

For the projections into late 1973 and early 1974, our tentative reading of the available evidence is that just as in the interwar years, stagflation was skipped, with the economy slipping almost directly from demand-pull into recession sometime late in 1973 or early 1974. Specifically, the discriminant analysis suggests that October through December 1973 as well as the first two months of 1974 should be classified as recession months. However, March, April, June, and July 1974 seem more accurately classified as demand-pull. Starting in August 1974, though, the classification returns unmistakably to recession.

Explanations for these convolutions in the classifications during early 1974 are not difficult to identify. The classification of the last three months

**TABLE 8** Extrapolation of Discriminant Classifications to 1973 and 1974

Year	Month	Posterior Probabilities			
		Recession	Recovery	Demand-Pull	Stagflation
1973	October	0.423*	0.099	0.395	0.083
	November	0.607*	0.005	0.373	0.015
	December	0.441	0.001	0.558*	0.000
1974	January	0.843*	0.000	0.157	0.000
	February	0.997*	0.000	0.003	0.000
	March	0.000	0.000	0.997*	0.003
	April	0.000	0.000	1.000*	0.000
	May	0.000	0.000	1.000*	0.000
	June	0.014	0.003	0.983*	0.000
	July	0.001	0.000	0.998*	0.000
	August	0.674*	0.002	0.324	0.000
	September	1.000*	0.000	0.000	0.000

\*Most probable group.

in 1973 and the first two months of 1974 as recession reflects the dampening effects on the economy of the Arab oil embargo. The re-emergence of inflation as dominant in March, April, and May of 1974 corresponds to the special circumstances surrounding the formal removal of price controls in April and the prior anticipation of that event, both in the private and public sectors and perhaps particularly the emergence of the so-called special industry settlements arrived at just prior to decontrol.

Current discussion has used the term stagflation to describe the period from late 1973 through mid-1974. Stagflation is typically characterized (see Table 3) by small yet still positive growth in GNP coupled with significant price inflation. The period from November 1973 through July 1974 is different from other periods classified as stagflation. It is a period of negative GNP growth coupled with substantial price inflation, more a mixture of demand-pull and recession than a "classical" stagflation as we have defined the term (i.e., consistent with pre-1973 cycles).

While there cannot be much doubt as of this date (January 1975) that the U.S. economy is certainly in a state of recession, establishing a formal date for its onset is severely complicated by the distortions created by the oil embargo and decontrol. Two good alternatives for dating the initiation of the recession exist: November 1973 or August 1974. In a strict sense, the usual diffusion criterion for the existence of a formal "National Bureau recession" was not met until late in 1974 (cf. G. Moore's article in this issue). Similarly, total employment and total industrial production did not weaken as in a recession until late in 1974, although real GNP fell sharply early in the year (again, cf. Moore's article). One moral almost surely to be drawn from these complications is that history rarely repeats itself in any neat and orderly fashion.

#### **[V] CONCURRENT FOUR-PHASE CYCLICAL ANALYSIS**

Apart from the obvious oversimplifications embedded in any discrete cycle taxonomy, another self-evident deficiency, at least for policy purposes, in the classification scheme just presented is the use of quarterly variables that will be available only after a time lag. Policymaking is at least thought to be facilitated if the state of the economy can be evaluated on the basis of variables that are available with only a short time lag after the actual fact.

To remedy this shortcoming, the basic four-phase scheme just defined and outlined can be implemented using only readily available monthly variables, i.e., those that are available no later than a month and a half after the end of the particular month under study. On this basis, eleven of

the original twenty variables can be retained (specifically, all the variables marked with an *M* in the last or availability column of Table 3). To these can be added other monthly variables "promptly" available and which might be expected to act as proxy variables for the quarterly variables, mainly dealing with the national income accounts, that were used in the basic classification exercises outlined above. Specifically, from the list of eighteen monthly variables used by Ilse Mintz [1972] in her study of U.S. growth cycles we took eight to develop a group of nineteen readily available variables we call our policy analysis set. To this set exactly the same discriminant analysis techniques were applied as before, using the group or phase definitions established by the basic analysis, that is, as defined in Table 2.

A listing of these nineteen policy analysis variables, along with their average values for the different phases—recession, recovery, demand-pull, and stagflation—are shown in Table 9. Eleven of the variables of course behave exactly as before, that is, as reported in Table 3, since they are the monthly variables of the basic analysis. Six of the eight new variables (the new ones are listed at the top of Table 9) are mainly measures of output or proxies for the quarterly GNP figures that figured prominently in the original analysis. These monthly output measures seem to differentiate about as strongly between the two growth periods, recovery and demand-pull, and the stagnant periods, recession and stagflation, as the original GNP figures. The other two new variables, the change per month in the Treasury bill and bond rates, seem to behave much like the prime rate used in both analyses.

Assuming that the periodicity as defined in Table 2 is correct, a key question when using only the monthly variables is how much, if any, accuracy is sacrificed by not waiting for the quarterly variables. The loss in accuracy would not seem to be too great, as shown by the data in Table 10. The major loss is for recession periods, but perhaps not of a magnitude to create substantial problems or difficulties.

It is interesting to compare extrapolations of the policy analysis to late 1973 and early 1974 with those of the basic analysis as shown in Table 8. The policy analysis extrapolations are presented in Table 11. Those for 1974 seem to be even more ambiguous than the original or basic analysis extrapolations. Specifically, less evidence exists of incipient recession late in 1973 and early 1974 using the policy analysis rather than the basic set. This is almost certainly due to the sharp downturn in real GNP recorded in the first quarter of 1974 which was incorporated into the basic analysis but not reflected in the monthly output or production variables. Which of these two sets of variables—the quarterly GNP figures or the monthly figures—should be construed to be the better representation of reality is, of course, debatable. For example, some observers have contended that the sharp

**TABLE 9 Average Value of Variables for the Four Cyclical Stages, Using Readily Available Monthly Time Series**

Variable	Recession	Recovery	Demand-Pull	Stagflation	Average, All Periods
Industrial production (N) <sup>a</sup>	-10.29	9.83	5.67	3.60	4.34
Personal income (N) <sup>a</sup>	0.08	7.19	8.40	7.35	6.50
Retail sales (N) <sup>a</sup>	-0.94	7.83	7.03	3.69	5.43
Man-hours in nonagricultural establishments (N) <sup>a</sup>	-5.27	3.58	2.81	2.26	1.76
Employees on nonagricultural payrolls (N) <sup>a</sup>	-3.87	3.22	3.34	2.69	2.08
Mining, manufacturing, construction: wages and salaries (N) <sup>a</sup>	-8.78	8.49	9.23	8.22	6.05
Treasury bill rate (N) <sup>b</sup>	-0.134	0.036	0.080	0.048	0.025
Treasury bond rate (N) <sup>b</sup>	-0.041	0.010	0.035	0.027	0.013
Prime rate <sup>b</sup>	-0.142	0.028	0.096	0.065	0.029
Corporate bond rate <sup>b</sup>	-0.010	-0.005	0.042	0.037	0.016
Consumer price index <sup>a</sup>	1.37	1.47	4.49	3.71	2.78
Food only <sup>a</sup>	0.99	0.98	6.30	3.12	2.93
All commodities exc. food <sup>a</sup>	-0.34	1.03	3.64	2.80	1.93
Wholesale price index <sup>a</sup>	-0.93	1.43	6.08	1.39	2.39
Industrial commodities only <sup>a</sup>	-0.82	1.44	5.44	1.89	2.33
N.Y. Stock Exchange composite price index <sup>c</sup>	0.20	1.15	0.19	0.07	0.51
Money supply <sup>a</sup>					
M1	1.74	3.99	2.96	3.85	3.33
M2	4.79	7.02	5.33	3.83	5.55
Unemployment rate <sup>d</sup>	5.46	5.76	4.08	3.29	4.73

SOURCE: See Appendix B.

N = new variables not employed in previous analysis.

<sup>a</sup>Per cent change; seasonally adjusted at an annual rate.

<sup>b</sup>Change per month.

<sup>c</sup>Per cent change.

<sup>d</sup>Seasonally adjusted at an annual rate.

**TABLE 10** Number of Cases Classified into Groups,  
February 1947–September 1973

Original (Basic) Phase	Discriminant Analysis Classification			
	Recession	Recovery	Demand-Pull	Stagflation
Original Analysis Using Quarterly and Monthly Data				
Recession	42	2	3	1
Recovery	6	108	1	0
Demand-pull	0	1	79	11
Stagflation	0	0	5	61
Policy Analysis Using Monthly Data Only				
Recession	38	5	3	2
Recovery	10	103	2	0
Demand-pull	1	0	72	18
Stagflation	0	0	12	54

downturn in real GNP in the first quarter of 1974 was at least partially a statistical artifact created by deficiencies in the inventory valuation adjustment and other similar problems inherent in adjusting for price changes in periods of substantial inflation. Furthermore, GNP (as contrasted with gross domestic product, GDP) was affected by nationalization of overseas prop-

**TABLE 11** Extrapolation of Discriminant Classification to  
1973 and 1974 Using Policy Analysis Data Set

Year	Month	Posterior Probabilities			
		Recession	Recovery	Demand-Pull	Stagflation
1973	October	0.667*	0.129	0.158	0.046
	November	0.104	0.257	0.612*	0.027
	December	0.117	0.015	0.840*	0.027
1974	January	0.016	0.007	0.977*	0.000
	February	0.647*	0.027	0.326	0.000
	March	0.000	0.001	0.999*	0.000
	April	0.000	0.000	1.000*	0.000
	May	0.000	0.001	0.999*	0.000
	June	0.011	0.011	0.977*	0.001
	July	0.000	0.001	0.998*	0.000
	August	0.048	0.035	0.918*	0.000
	September	0.995*	0.005	0.000	0.000
	October	1.000*	0.000	0.000	0.000
	November	0.889*	0.111	0.000	0.000

\*Most probable group.

erties of U.S. companies, particularly oil holdings, during this period. The logic, though, of the present classification scheme, as well as traditional National Bureau methods, would suggest that the quarterly GNP figures be given substantial weight in determining the existence or nonexistence of a recession. Thus, the balance of evidence favors the basic set results; i.e., with the quarterly GNP figures included. The emergence of unequivocal evidence of a recession phase by the end of 1974 lends further credibility to this conclusion in the sense that the basic set more clearly signaled that stage and at an earlier date than the policy set.

## [VI] SUMMARY AND CONCLUDING OBSERVATIONS

The empirical results presented in this paper seem to support the following conclusions:

1. A four-phase cycle—recession, recovery, demand-pull, and stagflation—corresponding to the current conventional wisdom about the character of the present-day business cycle can be identified in time series data chronicling postwar business activity in the United States.
2. The appearance of all four of these stages in all postwar business cycles is not, though, a definite certainty. In particular, the stagflation phase seems ephemeral, not appearing in the business cycles of the mid- and late 1950s or in the most current cyclical experience.
3. Omission of a stagflation phase seems even more a characteristic of cyclical experiences during the interwar years, that is, between 1920 and 1940. Indeed, the major difference between the prewar and postwar cycles seems to be the almost total absence of any stagflation experiences in the former.
4. With the exception of the omission of the stagflation phase, however, the prewar cyclical experience would not seem to be markedly different in its basic characteristics from that of the postwar period. Specifically, discriminant functions developed using monthly and quarterly data for the postwar period extrapolate with remarkable consistency and logic to the prewar experience even though this must be done with relatively crude annual data.
5. The discriminant analysis definitely tends to confirm the conclusion reached by National Bureau researchers using less formal and more historical techniques that a new business cycle recession almost surely started sometime late in 1973 or during 1974. The formalized or highly structured discriminant analysis suggests that recession started either in November 1973, which has now been adopted as the starting date of a recession by the National Bureau, or in August 1974.

Obviously, these analyses and the conclusions just summarized hardly point to an unequivocally simple definition of the constituents of a business cycle experience and, most particularly, the recession phase of the cycle. The truth seems to be that business cycle experiences rarely repeat themselves in any neat, symmetrical, standard fashion. Indeed, it would appear that simple classification of cyclical experiences into recession or nonrecession categories is not always very illuminating or useful. Indeed, Wesley C. Mitchell emphasized this long ago (1927). When he identified each cycle in terms of nine stages, he divided each of two main phases, expansion and contraction, into four subphases. He studied the changes between successive stages and analyzed the differences among the phases, and always emphasized that business cycles vary widely in character.

Given the complexity of modern economies and the multiplicity of potential policy responses, far more complex and detailed analyses must be made. In short, it is not enough simply to assert that the economy is in recession or not in recession, or even to go somewhat further, as we have done with the more complex classification schemes tested in this paper, and assert that the economy is in a state of recession or recovery or demand-pull or stagflation. Rather, one must go behind these classifications into an examination of the basic data to develop a more comprehensive, detailed, and sensitive analysis of the true cyclical state for meaningful policy analyses. Our further research thus will be aimed primarily at determining the usefulness of our simple classification for improving historical and macroeconomic analyses.

**APPENDIX A Posterior Probability Classifications of the Four Business Cycle Stages, 1947-1973**

Year	Month	Posterior Probabilities			
		Recession	Recovery	Demand-Pull	Stagflation
1947	February	0.000	0.000	0.999*	0.000
	March	0.000	0.001	0.993*	0.006
	April	0.000	0.001	0.997*	0.002
	May	0.006	0.001	0.992*	0.001
	June	0.000	0.000	0.995*	0.005
	July	0.000	0.000	0.994*	0.006
	August	0.000	0.000	0.999*	0.001
	September	0.000	0.000	0.978*	0.022
	October	0.000	0.000	1.000*	0.000
	November	0.000	0.000	0.997*	0.003
	December	0.000	0.000	0.973*	0.027
	1948	January	0.000	0.000	0.956*
February		0.000	0.002	0.992*	0.006
March		0.001	0.002	0.995*	0.002
April		0.002	0.001	0.987*	0.010
May		0.000	0.000	0.758*	0.242
June		0.000	0.000	0.510*	0.490
July		0.000	0.000	0.031	0.969*
August		0.000	0.000	0.300	0.700*
September		0.000	0.000	0.051	0.949*
October		0.000	0.000	0.168	0.831*
November		0.036	0.011	0.916*	0.037
December		0.700*	0.010	0.290	0.001
1949	January	0.999*	0.001	0.000	0.000
	February	1.000*	0.000	0.000	0.000
	March	0.997*	0.003	0.000	0.000
	April	0.962*	0.038	0.000	0.000
	May	0.907*	0.093	0.000	0.000
	June	0.865*	0.134	0.000	0.000
	July	0.817*	0.183	0.000	0.000
	August	0.896*	0.104	0.000	0.000
	September	0.991*	0.009	0.000	0.000
	October	0.996*	0.004	0.000	0.000
	November	0.288	0.712*	0.000	0.000
	December	0.001	0.999*	0.000	0.000
1950	January	0.000	0.991*	0.007	0.001
	February	0.000	0.999*	0.001	0.000
	March	0.001	0.999*	0.000	0.000
	April	0.002	0.998*	0.000	0.000
	May	0.002	0.996*	0.002	0.000
	June	0.000	0.962*	0.038	0.000

APPENDIX A (continued)

Year	Month	Posterior Probabilities			
		Recession	Recovery	Demand-Pull	Stagflation
1951	July	0.000	0.072	0.928*	0.000
	August	0.000	0.013	0.985*	0.002
	September	0.000	0.009	0.990*	0.000
	October	0.000	0.005	0.993*	0.002
	November	0.000	0.002	0.990*	0.007
	December	0.000	0.000	0.987*	0.013
	January	0.000	0.000	0.435	0.565*
	February	0.000	0.000	0.609	0.991*
	March	0.000	0.000	0.018	0.982*
	April	0.000	0.000	0.012	0.988*
	May	0.000	0.000	0.004	0.996*
	June	0.000	0.000	0.115	0.885*
1952	July	0.000	0.000	0.098	0.902*
	August	0.000	0.000	0.019	0.981*
	September	0.000	0.000	0.036	0.964*
	October	0.000	0.000	0.062	0.938*
	November	0.000	0.000	0.083	0.917*
	December	0.000	0.000	0.033	0.967*
	January	0.000	0.000	0.063	0.937*
	February	0.000	0.000	0.114	0.886*
	March	0.000	0.000	0.005	0.995*
	April	0.000	0.000	0.001	0.999*
	May	0.000	0.000	0.005	0.995*
	June	0.000	0.000	0.008	0.992*
July	0.000	0.000	0.012	0.988*	
August	0.000	0.000	0.100	0.900*	
September	0.000	0.000	0.011	0.989*	
October	0.000	0.000	0.001	0.999*	
November	0.000	0.000	0.002	0.998*	
December	0.000	0.000	0.005	0.995*	
1953	January	0.000	0.000	0.049	0.951*
	February	0.000	0.000	0.017	0.983*
	March	0.000	0.000	0.009	0.991*
	April	0.000	0.000	0.007	0.993*
	May	0.000	0.000	0.021	0.979*
	June	0.000	0.000	0.014	0.986*
	July	0.000	0.000	0.019	0.981*
	August	0.000	0.000	0.010	0.990*
	September	0.001	0.000	0.046	0.953*
	October	0.001	0.000	0.028	0.971*
	November	0.207	0.001	0.307	0.485*
	December	0.960*	0.001	0.039	0.001

APPENDIX A (continued)

Year	Month	Posterior Probabilities			
		Recession	Recovery	Demand-Pull	Stagflation
1954	January	0.998*	0.001	0.001	0.000
	February	0.993*	0.007	0.000	0.000
	March	0.961*	0.039	0.000	0.000
	April	0.927*	0.072	0.002	0.000
	May	0.549*	0.451	0.000	0.000
	June	0.718*	0.281	0.001	0.000
	July	0.685*	0.314	0.000	0.000
	August	0.259	0.741*	0.000	0.000
	September	0.063	0.937*	0.000	0.000
	October	0.008	0.982*	0.009	0.000
	November	0.005	0.982*	0.013	0.000
	December	0.004	0.936*	0.059	0.000
1955	January	0.021	0.949*	0.030	0.000
	February	0.021	0.513*	0.465	0.002
	March	0.008	0.243	0.709*	0.040
	April	0.004	0.115	0.797*	0.084
	May	0.002	0.210	0.455*	0.333
	June	0.002	0.160	0.794*	0.043
	July	0.000	0.042	0.911*	0.046
	August	0.001	0.016	0.978*	0.005
	September	0.000	0.003	0.956*	0.041
	October	0.002	0.077	0.827*	0.094
	November	0.001	0.020	0.747*	0.231
	December	0.000	0.002	0.749*	0.249
1956	January	0.047	0.008	0.587*	0.358
	February	0.000	0.001	0.184	0.815*
	March	0.000	0.001	0.618*	0.381
	April	0.000	0.000	0.856*	0.144
	May	0.003	0.003	0.852*	0.142
	June	0.092	0.015	0.824*	0.069
	July	0.261	0.020	0.683*	0.035
	August	0.016	0.002	0.979*	0.003
	September	0.000	0.001	0.835*	0.164
	October	0.000	0.001	0.137	0.862*
	November	0.000	0.004	0.933*	0.063
	December	0.000	0.004	0.851*	0.146
1957	January	0.009	0.001	0.987*	0.003
	February	0.001	0.000	0.882*	0.116
	March	0.004	0.002	0.578*	0.416
	April	0.003	0.001	0.506*	0.490
	May	0.009	0.006	0.921*	0.065
	June	0.010	0.018	0.944*	0.027

**APPENDIX A (continued)**

Year	Month	Posterior Probabilities			
		Recession	Recovery	Demand-Pull	Stagflation
1958	July	0.006	0.009	0.980*	0.005
	August	0.011	0.006	0.975*	0.008
	September	0.729*	0.022	0.243	0.007
	October	0.994*	0.001	0.005	0.000
	November	0.999*	0.001	0.000	0.000
	December	1.000*	0.000	0.000	0.000
	January	1.000*	0.000	0.000	0.000
	February	1.000*	0.000	0.000	0.000
	March	0.999*	0.001	0.000	0.000
	April	0.983*	0.017	0.000	0.000
	May	0.551*	0.449	0.000	0.000
	June	0.031	0.969*	0.000	0.000
1959	July	0.001	0.999*	0.000	0.000
	August	0.000	1.000*	0.000	0.000
	September	0.000	0.999*	0.000	0.000
	October	0.002	0.998*	0.000	0.000
	November	0.019	0.980*	0.001	0.000
	December	0.100	0.899*	0.001	0.000
	January	0.094	0.905*	0.000	0.000
	February	0.015	0.984*	0.001	0.000
	March	0.000	0.999*	0.001	0.000
	April	0.000	0.989*	0.011	0.000
	May	0.004	0.943*	0.052	0.001
	June	0.396	0.461*	0.131	0.011
1960	July	0.963*	0.022	0.014	0.002
	August	0.946*	0.051	0.003	0.000
	September	0.164	0.832*	0.004	0.000
	October	0.010	0.990*	0.000	0.000
	November	0.014	0.985*	0.000	0.000
	December	0.001	0.952*	0.045	0.002
	January	0.002	0.889*	0.106	0.002
	February	0.052	0.875*	0.055	0.018
	March	0.730*	0.270	0.000	0.000
	April	0.207	0.781*	0.011	0.000
	May	0.732*	0.263	0.006	0.000
	June	0.889*	0.111	0.001	0.000
July	0.845*	0.154	0.000	0.000	
August	0.479	0.521*	0.000	0.000	
September	0.909*	0.090	0.000	0.000	
October	0.984*	0.016	0.000	0.000	
November	0.944*	0.056	0.000	0.000	
December	0.949*	0.051	0.000	0.000	

## APPENDIX A (continued)

Year	Month	Posterior Probabilities			
		Recession	Recovery	Demand-Pull	Stagflation
1961	January	0.948*	0.052	0.000	0.000
	February	0.278	0.722*	0.000	0.000
	March	0.046	0.954*	0.000	0.000
	April	0.056	0.944*	0.000	0.000
	May	0.030	0.970*	0.000	0.000
	June	0.009	0.991*	0.000	0.000
	July	0.018	0.982*	0.000	0.000
	August	0.011	0.989*	0.000	0.000
	September	0.005	0.995*	0.000	0.000
	October	0.015	0.985*	0.000	0.000
	November	0.009	0.990*	0.001	0.000
	December	0.028	0.968*	0.004	0.000
1962	January	0.019	0.977*	0.004	0.000
	February	0.002	0.983*	0.016	0.000
	March	0.001	0.997*	0.002	0.000
	April	0.003	0.994*	0.003	0.000
	May	0.071	0.927*	0.002	0.000
	June	0.396	0.603*	0.001	0.000
	July	0.503*	0.467	0.030	0.000
	August	0.410	0.588*	0.002	0.000
	September	0.238	0.758*	0.004	0.000
	October	0.592*	0.406	0.002	0.000
	November	0.091	0.907*	0.003	0.000
	December	0.057	0.935*	0.008	0.000
1963	January	0.053	0.923*	0.024	0.000
	February	0.023	0.976*	0.001	0.000
	March	0.047	0.952*	0.001	0.000
	April	0.046	0.952*	0.001	0.000
	May	0.053	0.947*	0.000	0.000
	June	0.005	0.993*	0.002	0.000
	July	0.005	0.990*	0.005	0.000
	August	0.002	0.984*	0.014	0.000
	September	0.014	0.983*	0.002	0.000
	October	0.041	0.952*	0.007	0.000
	November	0.018	0.979*	0.003	0.000
	December	0.064	0.829*	0.108	0.000
1964	January	0.051	0.922*	0.027	0.000
	February	0.021	0.893*	0.086	0.000
	March	0.025	0.957*	0.018	0.000
	April	0.042	0.888*	0.070	0.000
	May	0.021	0.924*	0.055	0.001
	June	0.012	0.927*	0.060	0.001

APPENDIX A (continued)

Year	Month	Posterior Probabilities			
		Recession	Recovery	Demand-Pull	Stagflation
1965	July	0.008	0.257	0.689*	0.046
	August	0.027	0.857*	0.114	0.002
	September	0.022	0.882*	0.093	0.003
	October	0.050	0.600*	0.348	0.002
	November	0.031	0.623*	0.341	0.004
	December	0.021	0.683*	0.296	0.000
	January	0.034	0.876*	0.091	0.000
	February	0.009	0.965*	0.025	0.000
	March	0.006	0.508*	0.484	0.002
	April	0.004	0.843*	0.151	0.003
	May	0.001	0.158	0.822*	0.020
	June	0.009	0.170	0.803*	0.018
1966	July	0.006	0.043	0.911*	0.040
	August	0.001	0.042	0.940*	0.017
	September	0.000	0.191	0.659*	0.149
	October	0.000	0.035	0.858*	0.106
	November	0.000	0.006	0.875*	0.119
	December	0.000	0.003	0.392	0.605*
	January	0.000	0.002	0.828*	0.170
	February	0.000	0.000	0.220	0.780*
	March	0.000	0.000	0.663*	0.337
	April	0.000	0.001	0.624*	0.374
	May	0.000	0.001	0.946*	0.052
	June	0.000	0.000	0.626*	0.374
1967	July	0.000	0.000	0.913*	0.087
	August	0.000	0.000	0.722*	0.277
	September	0.000	0.001	0.261	0.738*
	October	0.000	0.000	0.059	0.941*
	November	0.000	0.000	0.049	0.951*
	December	0.002	0.001	0.617*	0.379
	January	0.011	0.002	0.970*	0.017
	February	0.016	0.009	0.415	0.560*
	March	0.006	0.001	0.473	0.520*
	April	0.003	0.002	0.624*	0.371
	May	0.001	0.001	0.370	0.627*
	June	0.000	0.000	0.826*	0.174
July	0.000	0.000	0.279	0.721*	
August	0.000	0.000	0.615*	0.385	
September	0.000	0.001	0.560*	0.438	
October	0.001	0.001	0.722*	0.276	
November	0.000	0.000	0.782*	0.218	
December	0.000	0.000	0.331	0.669*	

APPENDIX A (continued)

Year	Month	Posterior Probabilities			
		Recession	Recovery	Demand-Pull	Stagflation
1968	January	0.000	0.000	0.052	0.948*
	February	0.000	0.001	0.182	0.818*
	March	0.000	0.000	0.056	0.944*
	April	0.000	0.000	0.029	0.971*
	May	0.000	0.000	0.006	0.994*
	June	0.000	0.000	0.017	0.983*
	July	0.000	0.000	0.082	0.917*
	August	0.000	0.000	0.148	0.852*
	September	0.000	0.000	0.107	0.893*
	October	0.000	0.000	0.246	0.754*
	November	0.000	0.000	0.121	0.879*
	December	0.000	0.000	0.807*	0.193
1969	January	0.000	0.000	0.167	0.832*
	February	0.000	0.000	0.038	0.962*
	March	0.000	0.000	0.038	0.962*
	April	0.000	0.000	0.023	0.977*
	May	0.000	0.000	0.013	0.987*
	June	0.000	0.000	0.139	0.861*
	July	0.000	0.000	0.016	0.984*
	August	0.000	0.000	0.024	0.976*
	September	0.000	0.000	0.087	0.913*
	October	0.000	0.000	0.090	0.910*
	November	0.000	0.000	0.064	0.936*
	December	0.000	0.000	0.877*	0.122
1970	January	0.356	0.001	0.384*	0.258
	February	0.675*	0.015	0.270	0.040
	March	0.969*	0.021	0.007	0.003
	April	0.333	0.102	0.550*	0.016
	May	0.204	0.042	0.743*	0.010
	June	0.824*	0.050	0.125	0.000
	July	0.291	0.577*	0.132	0.000
	August	0.686*	0.304	0.010	0.000
	September	0.877*	0.122	0.001	0.000
	October	0.999*	0.001	0.000	0.000
	November	0.998*	0.002	0.000	0.000
	December	0.013	0.987*	0.000	0.000
1971	January	0.008	0.992*	0.000	0.000
	February	0.016	0.984*	0.000	0.000
	March	0.165	0.830*	0.005	0.000
	April	0.023	0.929*	0.048	0.000
	May	0.058	0.937*	0.006	0.000
	June	0.053	0.934*	0.013	0.000

APPENDIX A (concluded)

Year	Month	Posterior Probabilities			
		Recession	Recovery	Demand-Puil	Stagflation
1972	July	0.303	0.683*	0.014	0.000
	August	0.328	0.671*	0.002	0.000
	September	0.004	0.996*	0.000	0.000
	October	0.021	0.979*	0.000	0.000
	November	0.014	0.986*	0.000	0.000
	December	0.034	0.952*	0.014	0.000
	January	0.212	0.787*	0.002	0.000
	February	0.110	0.883*	0.007	0.000
	March	0.000	0.998*	0.001	0.000
	April	0.000	0.998*	0.002	0.000
	May	0.009	0.991*	0.000	0.000
	June	0.004	0.995*	0.001	0.000
1973	July	0.015	0.985*	0.000	0.000
	August	0.027	0.971*	0.003	0.000
	September	0.002	0.995*	0.003	0.000
	October	0.003	0.988*	0.009	0.000
	November	0.001	0.862*	0.129	0.008
	December	0.000	0.962*	0.029	0.009
	January	0.000	0.087	0.904*	0.009
	February	0.000	0.052	0.948*	0.000
	March	0.000	0.006	0.994*	0.000
	April	0.008	0.065	0.927*	0.000
	May	0.182	0.440*	0.377	0.002
	June	0.004	0.134	0.846*	0.016
July	0.000	0.004	0.994*	0.001	
August	0.000	0.000	0.999*	0.001	
September	0.001	0.043	0.953*	0.003	

\*Most probable group.

## APPENDIX B Data Sources

Series Name	Source
Unemployment rate	<i>Business Conditions Digest</i> (BCD)
Man-hours in nonagricultural establishments	BCD
Number of employees on nonagricultural payrolls	BCD
Wages and salaries in mining, manufacturing, and construction	BCD
Gross national product, current dollars	BCD
Gross national product, 1958 dollars	BCD
Index of industrial production	BCD
Personal income	BCD
Retail sales, current dollars	BCD
Output per man-hour, private economy	BCD
Compensation per man-hour, private economy	Bureau of Labor Statistics (BLS)
Index of unit labor cost, private economy	BCD
Money supply (M1, M2)	BCD
Net exports as per cent of GNP	BCD
Gross government receipts and expenditures	<i>Survey of Current Business</i> (SCB)
Implicit price deflator	BCD
Consumer price index (CPI)	BCD
Consumer price index, food	<i>Economic Indicators</i> (EI)
Consumer price index, all commodities less food	EI
Wholesale price index (WPI)	BCD
Wholesale price index, industrial commodities	BCD
Prime rate, 90-day paper	Federal Reserve Board <i>Bulletin</i>
Average yields on corporate bonds	Moody's
Treasury bill rate	BCD
Treasury bond yields	BCD
New York Stock Exchange (NYSE) composite stock price index	SCB Weekly Statistics

## NOTES

1. The existence of this bias was perhaps first noted and commented upon systematically by Smithies [1972]. The durability of this issue is perhaps best attested by an elegant theoretical analysis of some possible sources of the bias as developed by William Nordhaus in a paper presented at the meeting of the Econometrics Society in Toronto, Canada, December 1972.
2. Some empirical support for this observation might, in fact, be derived from the work of Haitovsky, Treyz, and Su [1974].
3. Indeed, such an emphasis is implicit, if not explicit, in much earlier Bureau work on business cycle phenomena: Burns and Mitchell's multiple- (e.g., nine-) stage partition of the basic cycle and their emphasis on the differences that exist between early and late stages of expansion and contraction; Ruth Mack's subcycles; and the use of diffusion indexes.
4. That is, ex ante, exactly the same probability (0.25) is assigned to the likelihood that each group (recession, recovery, demand-pull, stagflation) is the true or correct classification.
5. The covariance matrix is used to define new variables, called canonical variables, that are linear combinations of the old variables, such that each additional canonical variable explains a decreasing amount of the variance. In this situation, only three canonical variables were necessary to explain the total variance (see Table 5). For further information, see Anderson [1958].
6. See note 4, above.

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