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FORECASTING THE DEPRESSION: HARVARD VERSUS YALE

Ray C. Fair

Matthew D. Shapiro

Kathryn M. Dominguez

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ABSTRACT

Was the Depression forecastable? After the Crash, how long did it take contemporary economic forecasters to realize how severe the downturn was going to be? How long should it have taken them to come to this realization? These questions are addressed by studying the predictions of the Harvard Economic Service and Yale's Irving Fisher during 1929 and the early 1930's. The data assembled by the Harvard and Yale forecasters are subjected to modern statistical analysis to learn whether their verbal pronouncements were consistent with the data. We find that both the Harvard and Yale forecasters were systematically too optimistic, yet nothing in the data suggests that the optimism was unwarranted.

Ray C. Fair
Cowles Foundation for
Research in Economics
Yale University
Box 2125 Yale Station
New Haven, CT 06520

Matthew D. Shapiro
Cowles Foundation for
Research in Economics
Yale University
Box 2125 Yale Station
New Haven, CT 06520

Kathryn M. Dominquez
Cowles Foundation for
Research in Economics
Yale University
Box 2125 Yale Station
New Haven, CT 06520

I. Introduction

James Tobin relates the following story, which was told to him and other members of the Harvard graduate economics club by Professor W.L. Crum. In the 1920's the Harvard Economic Service (HES) issued monthly reports on the current and their expected future state of the economy. HES used three indices, representing speculation, business, and money, to help predict the future. Crum said that in the summer of 1929 the statistical assistant at HES became alarmed when she noticed that the charts indicated that a sharp downturn in economic activity was imminent. Crum did not see in the current business situation any cause for this adverse forecast. Moreover, he feared that a pessimistic forecast by the influential service could itself have an adverse effect on financial markets and economic activity. Therefore, he suppressed the pessimistic findings of the assistant,[1] and the published report did not speak of a potential downturn.

The data, in fact, provide only mild support for this account. The account does, however, raise an interesting and general set of questions. Was there anything in the data prior to the October 1929 stock market crash that indicated the economy was about to enter a protracted slowdown? How should the news of the crash have revised forecasts of economic growth? To address these questions, we study two sets of data assembled by contemporary business-conditions forecasters. The first consists of the three HES indices. The second consists of commodity and stock price indices compiled and analyzed by Irving Fisher. Fisher, who was at Yale from 1891 until his

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[1] And consequently lost the opportunity to gain a reputation for Delphic wisdom.

death in 1947, was a competitor of HES. He also released periodic reports on the state of the economy. Moreover, he was a critic of the HES indices.

In the next section, we discuss the data and procedures of the Harvard Economic Service and Irving Fisher. We discuss how the data were prepared and analyzed. We also compare the verbal forecasts about economic performance in 1929 and in the early 1930's. In the following section, we analyze the two data sets using modern statistical techniques. This allows us to address the questions concerning the forecastability of the depression and the effect of the crash on the statistical forecasts. We can then ask whether the verbal pronouncements made by the contemporary forecasters match the pattern we find in the data.

II. Description of the Economic Forecasting Services

The Harvard forecasting service was from the beginning marketed as a business tool for executives for short- and long-range planning. By contrast, the Fisher service was designed originally to serve as an educational tool for the public betterment. Fisher described his service's goal as "to accustom the public to the thought that the dollar is not a constant but a variable" [Fisher (1934, p.385)]. By contrast, the Harvard brochure introduces its product with the following advertisement:

> As you go about your various tasks today, shaping your plans for the coming year's business - plans which will determine largely the profits of your concern during the coming months - ask yourself this: Wouldn't it be really worth while if you and other members of your organization had a tried and dependent means of judging future conditions, thus eliminating largely the chances you must otherwise take? [Harvard University Committee on Economic Research (1923a, p.3)]

Later, perhaps realizing the potential profits to be had, Fisher was to market his own service fully as aggressively as did Harvard. His prose

became ultimately at least as purple as that of his Harvard peers, as in this passage from 1929:

> 'Dead reckoning' won't do -- even the man of millions needs the guidance of precedent. The Fisher Digest stands between the average investor and the loss that may follow the ill-timed or ill-advised investment[2] -- it is the weather-vane, the trustworthy barometer of commerce.

Harvard Economic Service

HES offered businessmen a comprehensive forecasting service beginning in 1919. A subscription to the service cost $100 per year ($623 in 1986 dollars) and consisted of the Weekly Letter, which contained the Index of General Business Conditions and an accompanying analysis and forecast, the Quarterly Review of Economic Statistics, and special statistical supplements. The Index of General Business Conditions was created by HES's first editor, Warren Persons. Its three curves were meant to represent "speculation" (the A-curve), "business" (the B-curve), and "money" (the C-curve). The Harvard forecasts were then based on the relations determined to exist among the three curves during any given phase of the business cycle and on the magnitude of the movement from crest to trough of each curve.

The Harvard analysts believed that the A-curve was a leading indicator of the B-curve. They specified a specific lag structure. Declines in the A-curve (speculation) were interpreted as forecasting that the B-curve (business) would begin to decline in six to twelve months [Harvard University Committee on Economic Research (1923b, p.9)]. Although HES is clear about A leading B, its description of the dynamics of the C-curve (money) is ambiguous. It notes that troughs in C follow troughs in B. That

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[2]This advertisement was printed in the Herald Tribune on February 25, 1929.

is, interest rates, which make up C, are low coming out of recessions. At points, HES describes this as causal relationship [Harvard University Committee on Economic Research (1923b, p.11)]. At other points in the discussion of the indices, HES notes that troughs in C precede peaks in activity [Harvard University Committee on Economic Research (1923b, p.9)]. The problem, which HES never directly addresses, is that a leading indicator also appears to be a lagging indicator of the previous cycle. This ambiguity is present in all atheoretical analyses of business cycles. When we analyze the HES series statistically, either we will assume that interest rates lead activity, which is consistent with a wide range of theories of the business cycle, or we will make no assumption concerning the ordering of the lags.

Although the specific series that made up the three curves changed over the thirteen years that HES published the indices, the basic index methodology remained the same. Curve A, representing speculation, included a series of New York bank clearings and industrial stock prices; curve B, representing business, included outside bank debits and commodity prices;[3] curve C, representing money, was based upon commercial paper rates.

To construct each of the three indicators, the Harvard methodology was

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[3]Curve B, as first constructed by Warren Persons in 1919, was a composite of economic series that reflected business conditions, including both production of materials and goods (most notably pig iron production) and transactions in commodities and services. The curve was revised in 1923 to include only bank debits and a ten-commodity price index. The position of the baseline (Bradstreet's index) used in constructing curve B "was determined by shifting the curve upward so that the crossing points with the ten-commodity index would correspond to the dates of crossing given for pig iron production, the index of trade, and outside debits" [Persons (1923, p.187)]. Therefore, although a measure of industrial production was not directly included in the revised B-curve, pig iron production entered into its construction.

as follows. First, the underlying component(s) in the index were adjusted for seasonality. Then, for each underlying component, a "similar" series not in the index was isolated, which was thought to represent a secular trend relative to the cyclical component in question. (For example, for the "money" series, the baseline was the average yield of ten prime railroad bonds of distant maturities.) Percentage deviations between each component of the index and the "baseline" series were taken and then normalized by the appropriate standard deviation. The resulting groups of adjusted components were then averaged to form the relevant index curve.

The resulting indices are illustrated in Figures 1 and 2 for, respectively, the years 1904-1913 and 1919-1931. As can be seen, there appears to be strong predictive power in the earlier period. A close inspection of HES's brochure suggests, however, that the remarkable fit was in fact achieved by an "exhaustive study of business statistics, for the primary purpose of developing a reliable index of general business conditions" [Harvard University Committee on Economic Research (1923b, p.8)] and that this exhaustive study was performed using data from the years 1904-1913.

At first glance, the data in Figure 2 do not appear to correspond closely to Crum's account, namely that the Harvard indices in the summer of 1929 foretold the coming business collapse. All three indices appear to lag the crash, rather than anticipate it. The brochure states that "the index (C) also forecasts speculation" and that "a persistent rise in interest rates was the forerunner of a decline in security prices; after such a decline in security prices, a decline in business of several months duration..." [Harvard University Committee on Economic Research (1923b,

p.11)]. In the period 1927-1929 curve C had reflected exactly such a persistent rise in interest rates, and while it is not clear from the service's description exactly when such a rise should ultimately be expected to imply a stock market downturn, it is entirely possible that by the summer of 1929 the staff saw a market decline as imminent. More importantly, the speculation index (A) shows a major decline during the second quarter of 1929. It peaked in March and by June had declined by over ten percent. This major but transitory decline is almost lost in a graph of curve A including the crash, but it would have looked substantial to the Harvard analysts during the second quarter.[4]

If the Harvard staff did believe that the data foretold business doom, this was not apparent in their public pronouncements through the period of collapse. The service painted a considerably gloomier picture earlier in 1929, only to moderate its view as the stock market continued to boom. In April 1929, HES issued the following warning about the overheated economic environment:

> Recent developments - notably the weakness of certain commodity prices, as well as the money tension - suggest some recession from the present level of business.... A renewed unsettlement of stock prices, perhaps a protracted liquidation, might well result under present conditions of money tension.... Business is not in the strained condition which has led to real depression in the past; and, while interest rates are now higher than at any other time since 1921, the present large resources of the reserve system give assurance that no shortage of credit for industrial purposes will develop. [HES (4/20/1929)][5]

This view persisted through the summer of 1929. In May, the service

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[4]This decline is not present in either Fisher's stock price index or the Cowles (1939) stock price index. Hence, it may have been spurious.

[5]Here and henceforth quotes from the Harvard Economic Service (HES) are referenced by the date of the Weekly Letter in which they appeared.

noted that "The signs pointing to recession continue to pile up" [HES (5/18/1929)].

By mid-September, when the speculation index was rising, the tone moderated considerably:

> Recent developments (reduced volume of construction projects, below average crop prospects, unfavorable international trade balances) have tended to emphasize the unfavorable elements in the business (as distinguished from the financial) situation.... But no sharp decline has appeared in general business, and activity remains high. [HES (9/21/1929)]

The week prior to Black Friday, the assessment was that

> If recession should threaten serious consequences for business (as is not indicated at present) there is little doubt that the reserve system would take steps to ease the money market and so check the movement. [HES (10/19/1929)]

This tone persisted as calamities mounted over the coming year.

Immediately following the crash, in early November, the appraisal was that

> Doubtless the losses entailed by the decline in stocks will increase the extent of the present business recession. On the other hand, money rates have declined promptly and considerably ... this is in itself evidence of the soundness of the present business situation. Under such conditions, we believe that the present recession, both for stocks and business, is not the precursor of business depression, but will prove intermediate in character. [HES (11/2/1929)]

By late December 1929, the Harvard staff was even forecasting recovery.

> Today a depression seems improbable, and continuance of business recession is all that is in prospect. This justifies a forecast of recovery of business next spring, with further improvement in the fall, so that 1930, as a whole, should prove at least a fairly good year. [HES (12/21/1929)]

Confidence then continued as the downturn worsened.

> Since our monetary and credit structure is not only sound but unusually strong, commercial credits are liquid, and production for some months has probably been less than current demands, there is every prospect that the recovery which we have been expecting will not be long delayed, and that the only change that need be made in our forecast is that this fall business will not acquire as much impetus as we have been expecting. [HES (8/20/1930)]

> Except in construction activity, the current depression seems to be following much the same course as that of 1920-21, as respects the length and severity of decline and the inception of recovery; and we conclude that improvement in business volumes, the first step in business recovery, is already under way. [HES (6/30/1931)]

A dawning awareness that this economic downturn was not similar in nature to those preceding it is found in the final months of 1931. In August, the Service noted that "If financial unsettlement continues in Europe, real business recovery here may be prevented..." [HES (8/22/1931)]. And by December of that year, the assessment had finally become quite bleak:

> But though the threatening elements in the situation are fewer, adequate grounds for forecasting business revival have not yet appeared. [HES (12/19/1931)]

The Fisher Index

Beginning in January 1923 the Fisher Index was published weekly in the author's syndicated column, The Fisher Business Page, which was widely carried by leading newspapers. Only in early 1930 did Fisher begin to market a separate and more detailed financial service. Initially, The Business Page included the Fisher Commodity Price Index and the Purchasing Power of the Dollar Index, along with weekly discussions of relevant economic issues of the time. In 1925, a stock market value index was added. The later Financial Analysis Service, published by the Index Number Institute (a company founded by Fisher), also included explicit analyses and economic forecasts based upon the Fisher indices.[6]

Of the two indices published in Fisher's weekly column, the Commodity

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[6]The Financial Analysis Service was succeeded by a similar service named Trade and Money Index in late 1931. This service was in turn succeeded by Market Indicators, which ceased publication in 1934.

Price index is substantially Fisher's "Ideal" index,[7] which "is an aggregative formula representing the fluctuations in value of a fixed budget or an imaginary cargo consisting of specified quantities of 200 goods. The index number for any date is simply the ratio of the value of the cargo, at said date, to its base value, multiplied by the base number."[8] The Purchasing Power of the Dollar index is simply the inverse of the Commodity Price index -- and thus a duplicative measure. The duplication is, however, central to Fisher's missionary ideas for his service. He aimed to educate the public and thereby eliminate money illusion. His stated view of the Purchasing Power index is that:

> The purchasing power of the dollar is shown separately from the commodity price level, although one is the reciprocal of the other, to emphasize the importance of the purchasing power of the dollar. As the price level goes up, a dollar will buy less; as the price level declines, the dollar will buy more. [Fisher (5/14/1924)][9]

The stock price index that was later added to the service consisted of a weighted value index for the market, with stocks picked based on a standard of "popularity." The index was computed based on averaging the value of the

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[7] Fisher's book The Making of Index Numbers is a "complete survey of all possible index formulae as any hitherto attempted." It concludes that the "'ideal' is the best form of index number for general purposes." In this book Fisher analyses a number of indices published at the time. In a footnote, Fisher comments on the Harvard index methodology: "One of the most interesting kinds of index number is Prof. Person's new index number for use as a barometer of trade. In this case the selection of the 10 commodities included is based, not on any of the usual criteria, but on their previous behavior in relation to the business cycle" [Fisher (1927, p.336)].

[8] The formula is $\sqrt{[(\Sigma p_1 q_0/\Sigma p_0 q_0)(\Sigma p_1 q_1/\Sigma p_0 q_1)]}$, that is, a geometric average of base and current period weighted indices [Fisher (1923, p.835)].

[9] Statements made be Fisher are referenced by the date in which they appeared in Fisher's syndicated Business Page. Copies of all Fisher's columns are contained in the Fisher collection housed in Yale's Manuscript and Archive Library.

previous week's fifty best-selling stocks, based on total market value of share turnover. The index was linked across weeks by calculating a composite average based on the subsample of stocks that appeared in both weeks' indices.[10]

Unlike HES's, Fisher's forecasts were simple and straightforward applications of the classical paradigm, allowing for some rigidities slowing adjustment. Thus, for example, a falling dollar and rising commodity prices "shows that the volume of money and credit available is increasing faster than its utilization in the production and exchange of goods and services. When more money and credit are applied to the same (or smaller) volume of goods and services, it results in increased competition by the funds for the available goods and services."[11] Rising commodity prices would thus engender a forecast of declines in real interest rates, a rising industrial production rate, and increasing inventories due to increases in the value of goods.

The Fisher Service is closer to a modern economic analysis and forecasting tool. It simply provided businessmen, policy-makers and the public with an analysis of current macroeconomic data from the perspective of then-current macroeconomic and financial theory. Fisher's service thus stands in contrast to the chartist exertions produced by members of the Harvard Economic Service.

Although Fisher's economic analysis are on firmer theoretical grounds than Harvard's, his predictions in the period before and after the crash,

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[10] See Fisher (1927) for a description of the index methodology.

[11] See Newdick (1929, p.2). A brief exposition of Fisher's forecasting methodology, "How to Use Fisher Indexes" by Newdick, was part of the Financial Analysis Service subscription package.

were no closer to the mark than those of his Harvard brethren. Indeed, his analyses during 1930 and 1931 were, consistently, even more optimistic than Harvard's.

In September 1929, Fisher was bullish about future prospects, seeing none of the potential warning signs that the Harvard service had noted through the summer of that year.[12]

> We have witnessed probably the greatest expansion in history, within any similar period of time, of the real income of a people.... The alarm over the supposed inflation of security values seems unjustified by the recent record of dividend yields, increases which doubtless will be followed by much larger increases. [Fisher (9/2/1929)]

The day before Black Friday, Fisher continued bullish in the face of the (relatively) small perturbations that had rocked the market in recent weeks and stirred concern on Wall Street.

> The (stock-market) break certainly exhibited signs of a market rendered topheavy by the activities of shoals of speculators, acting unintelligently, who at last became frightened and dumped millions of shares in a way temporarily to swamp the Exchanges.... The only event which can bring about a serious decline in stock value is a severe business slump, which does not seem likely from present indications. [Fisher (10/28/1929)]

Immediately after the crash, the outlook remained optimistic.

> The price of industrial stocks at less than 11 times their earnings seems too low a ratio, in view of the expectation of a faster rate of earnings in future and of the diminished risks of modern investment methods.... The market has, therefore, good reason for recovering on a new plateau. [Fisher (11/4/1929)]

As the recession deepened, Fisher's optimism bordered on advocacy, inveighing against dire interpretations of the direction of current indicators.

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[12] Fisher's optimism, however, is consistent with his data. In contrast to the Harvard speculation index (A) which shows a ten percent decline from March to June 1929, the Fisher stock price index shows no decline. Similarly, the Cowles (1939) stock price index, which has been widely used in recent studies, has some fluctuations but is essentially flat over the interval.

> It should be noted that while the stock exchange endured the severest panic in history, this did not suffice to shake the price level of stocks off a warrantable high new plateau, which had been built up since 1922.... The function of the stock market is to reflect the discounted value of future increased business, as clearly foreshadowed in the increasing rate at which earnings are plowed-back into industry. [Fisher (12/30/1929)]

> While prediction is always hazardous in economic statistics, and I wish to avoid making any definite prediction, it would not be surprising if by next month the worst of the recession will have been felt and improvement looked for. [Fisher (1/20/1930)]

In the early summer of 1930, Fisher remained unwilling to read calamity into the current economic situation. Comparisons with the 1920-21 recession predominated in his analysis -- as they did in Harvard's -- but Fisher's brand of optimism remained both stronger and more colorful.

> It seems manifest that thus far the difference between the present comparatively mild business recession and the severe depression of 1920-21 is like that between a thunder-shower and a tornado. [Fisher (5/19/1930)]

By winter of that year, Fisher finally acknowledged the seriousness of the economic situation; yet like members of the Harvard group, he continued to see the potential for an imminent upturn and expressed his hopes with mounting drama.

> Doubtless, to many, this will be the winter of our discontent, and to all of us it is as gloomy as the darkness that precedes dawn.... One would expect the bottom to be reached in the stock market prior to the upturn in commodity prices. Since the middle of November this seems to have been the case. [Fisher (12/1/1930)]

> In attempting to review and estimate the business situation, it is sometimes necessary, during a business depression such as this, to find hopeful signs in negative figures. Such a peculiar state of affairs holds true just now. [Fisher (2/2/1931)]

> The industrial giant has become conscious again. He is beginning to move around slowly in an effort to regain his feet, as the cobwebs from a knockout blow gradually clear from his brain. [Fisher (2/23/1931)]

By the end of 1931, when the Harvard team had begun to admit to the reality contained in the steady flow of bleak economic data, Fisher maintained his

optimism.

> Business showed further gain last week, and if improvement continues at the present rate, September should mark the low of the depression. Particular attention is called to the fact that commodity prices for both raw materials and agricultural products were strong. No single factor would be as helpful to business as a cessation in the commodity price decline that has been continued for the past two years. [Fisher (10/17/1931)]

III. Statistical Analysis

The above excerpts from the Harvard and Yale services make it clear that the services neither explicitly predicted a downturn in their written analyses nor, following the crash, predicted correctly its dire implications for future macroeconomic activity. Harvard's C-curve might have warranted a pessimistic forecast before the crash, but this evidence is not very strong. The question considered in this section is whether the use of modern statistical procedures reveals any evidence in the data of a forthcoming depression. The data examined are Harvard's A, B, and C indices and Fisher's commodity price and stock price indices.[13]

In the first statistical exercise, we attempt to formalize the timing relationships among the A, B, and C indices posed by HES. The B series is a contemporaneous measure of business activity. In this first exercise, we take the B series as the object to be forecast. The B series did turn down sharply at the time of the crash. According to HES, the B series was lead 6

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[13] One way to analyze the question of whether the depression was forecastable would be to construct a structural econometric model based on the data prior to the depression and then see if the model predicts the depression based on predictions of the future exogenous variable values that seems likely to have existed at the time. Our aim in this paper is much more modest. We simply want to examine the monthly Harvard and Fisher data for signs of an impending slowdown. Hence, we estimate reduced forms that would be consistent with a wide range of models.

to 12 months by the A series, which was largely determined by movements in stock prices. The conventional valuation model for asset prices also suggests that the stock market should be a leading indicator of activity. Asset prices should react instantaneously to events that take time to affect real activity. As discussed earlier, the Harvard analysts are less clear about the relation of the B and C series. At points they suggest that C should lag B, but elsewhere they suggest that it, like A, should be a leading indictor.[14] Of course, absent a theory, the question of whether a series leads or lags in the cycle is wholely arbitrary. In the following analysis, we treat both A and C as leading indicators of B.

To capture the timing relationships posited by the Harvard analysts, we estimate the following regressions. The analysts sometimes suggested that the A series (speculation) was forecastable by other series, which is, of course, inconsistent with the martingale model for asset prices. We estimate a univariate, second-order autoregression for A.[15] In the equation for series B, we include lags 6 through 12 of both series A and C to capture the timing relationships discussed above. We also include the first two lags of B itself. Without them, errors remain strongly serially correlated. Because of the ambiguities in the analysts' discussion of series C, we treat series C symmetrically with series A, that is, as a univariate, second-order autoregression.

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[14] See Harvard University Committee on Economic Research (1923b, p.9-11).

[15] If series A were point-in-time data just for stock prices, we would expect a random walk model to be the best approximation. The data, however, are averaged and include information on bank clearings, and so we include the extra lag. If required returns are predictably time-varying, perhaps C should forecast A. This possibility is allowed in subsequent specifications.

These and all the subsequent equations include constant terms and are estimated using the data as published, which are corrected for trend and seasonal factors.[16] All data used in this paper are presented in the Appendix. The equations are estimated by ordinary least squares.

To evaluate whether the A, B, and C series were useful in forecasting the depression, we estimate the system just described and then compute dynamic forecasts based on the estimates. Estimation is carried out through the month prior to the beginning of the forecast period. The first month of the estimation period is January 1920. The forecasts are computed over a 24 month horizon. The first forecast period considered begins in July 1929, and so the first estimation period ends in June 1929. The three estimated equations for this first estimation period are (standard errors are in parentheses):

(1) $A = \underset{(.0447)}{.0380} + \underset{(.094)}{1.099} \cdot A_{-1} - \underset{(.097)}{.088} \cdot A_{-2}$, DW = 2.02, R^2 = .978, SE = .407

(2) $C = \underset{(.0121)}{.0058} + \underset{(.075)}{1.595} \cdot C_{-1} - \underset{(.076)}{.614} \cdot C_{-2}$, DW = 2.04, R^2 = .984, SE = .126

(3) $B = \underset{(.0383)}{.0393} + \underset{(.101)}{.800} \cdot B_{-1} + \underset{(.103)}{.043} \cdot B_{-2} + \underset{(.070)}{.047} \cdot A_{-6} - \underset{(.096)}{.081} \cdot A_{-7} + \underset{(.096)}{.158} \cdot A_{-8}$

$- \underset{(.099)}{.018} \cdot A_{-9} - \underset{(.097)}{.015} \cdot A_{-10} + \underset{(.135)}{.127} \cdot A_{-11} - \underset{(.103)}{.190} \cdot A_{12} + \underset{(.221)}{.268} \cdot C_{-6}$

$- \underset{(.383)}{.308} \cdot C_{-7} - \underset{(.400)}{.443} \cdot C_{-8} + \underset{(.400)}{.204} \cdot C_{-9} + \underset{(.409)}{.206} \cdot C_{-10} + \underset{(.401)}{.189} \cdot C_{-11}$

$- \underset{(.220)}{.198} \cdot C_{-12}$, DW = 2.07, R^2 = .929, SE = .256

Sample period: January 1920 - June 1929.

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[16] We expect that the Harvard Economic Service's detrending procedure induces spurious cyclicality in the published series. See Nelson and Kang (1981) and Mankiw and Shapiro (1985). Because we are trying to mimic the contemporary procedures, we do not wish to attempt to correct for any spurious cycles.

Equation (1) reveals that A is nearly a random walk. C in equation (2) is a second order autoregressive process with approximately a unit root. In equation (3) none of the A and C variables is individually significant, although the hypotheses that the coefficients of the A series are jointly zero and those of the C series are jointly zero are both rejected with more than 95 percent confidence.[17]

Table 1 presents the actual and predicted values of the B series. Column 1 contains the actual values, and column 2 contains the predicted values from equations (1) - (3) above. The forecast in column 2 contains no evidence confirming the statistical assistant's fear that a collapse in business activity was imminent in the summer of 1929. If anything, the A,B,C series indicated a strong economy over the next six months. Although there is a slight downturn forecast at the beginning of 1930, the predicted fall is very mild. Hence, this forecast implies that Crum appears to have been correct in his view that the data did not bear out the alarm raised by the assistant.

Seven more forecasts are presented in Table 1. Starting dates for these forecasts are October, November, and December 1929; January, May, and September 1930; and January 1931. For each of these forecasts the above three equations were reestimated through the month prior to the beginning month of the forecast. The beginning month for all estimation periods was January 1920.

The forecast in column 3, which is the forecast immediately before the crash, shows very robust economic activity. This forecast is driven by the huge increase in the value of stock prices, which continued through early

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[17]The F(7,61) statistics are 2.34 and 2.20 for the respective tests.

autumn. The first forecast that reflects the news of the decline of the stock market (column 4) does not have the very favorable outlook of the previous forecast. Yet, it shows a continued strong medium run outlook with only a small downturn in the first half-year. The next forecast (column 5) is, however, much more pessimistic because the decline in stock prices is fully reflected in the lagged values in the equation for A. Subsequent forecasts show temporary downturns over the forecast horizons, but fail to capture the continuing decline in activity into 1931. The pessimistic forecast in the last column reflects the continuing decline in the B series throughout 1931. In summary, our analysis of the HES data using the lag structure suggested by the Harvard analysts does not show that the depression was forecastable. It also indicates that the slow adjustment of the forecasts to the bad news of the crash was consistent with the data.

For the rest of the statistical work we use an alternative measure of economic activity from the B series. The series we consider is the Federal Reserve Board's monthly, seasonally adjusted industrial production index, denoted IP.[18] This index is available beginning in 1919. The industrial production index, of course, was never in the information set of the contemporary forecasters. Yet, it is one of the best indicators of economic activity available to modern researchers. Insofar as the contemporary forecasters were interested in predicting the level of activity, it is of interest to see how well they could predict the IP series.

For a basis of comparison, we first estimate second order

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[18]The index of industrial production is a modern time series constructed by the Federal Reserve Board on the same basis as postwar data. It, as far as we know, does not suffer from the problems raised by Romer (1986).

autoregressive equations for IP and use these equations to forecast. The equations are specified in log form. The estimation periods are the same as those used above except that the beginning month for all periods was March 1919 rather than January 1920. The estimated equation for the period through June 1929 is:

$$(4)\quad \log IP = \underset{(.0322)}{.0374} + \underset{(.081)}{1.399}\cdot \log IP_{-1} - \underset{(.082)}{.413}\cdot \log IP_{-2} \ ,$$

$$DW = 1.97,\ R^2 = .980,\ SE = .0253 \ .$$

Sample period: March 1919 - June 1929.

The coefficients on the two lags of IP sum almost exactly to one. Hence, shocks to IP are estimated to be permanent, yet will lead to some short run fluctuations.

The actual values of IP are presented in column 1 of Table 2, and the predicted values from equation (4) are presented in column 2. (The results in Table 2 are reported in terms of the level of IP even though the estimated equations are in terms of logs.) The sum of the coefficient estimates of the two lagged values in equation (4) is close to one. Therefore, the shocks to IP are essentially permanent; the forecast in column 2 exhibits little short-run dynamics. This is also true of the other forecasts in Table 2. All the sums of the two coefficient estimates in the reestimated equations are close to one. The predicted levels in columns 3 through 9 thus follow the decline in the initial conditions as the depression unfolds, but they do not anticipate the continuing negative growth.[19]

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[19] In analyzing these forecasts (as well as the ones to come), it is worthwhile to keep in mind the period over which the underlying equations are estimated. Except for a sharp downturn in 1920 and 1921, the sample

The next exercise is to see how accurately the Harvard indices predict IP. We already have forecasting equations for A, B, and C, namely equations (1) - (3), and so we merely need to add an equation relating IP to these indices. It seems consistent with the thinking of the Harvard analysts to include the values of the B variable in the IP equation but not the values of the A and C variables. As noted above, the B variable is meant to be the measure of current economic activity, whereas the A and C variables are leading indicators. The IP equation that we estimate includes B, B lagged once, and the first two lags of IP. We included the two lags of IP to eliminate serial correlation of the error term and to nest the previous experiment in this one. We used the same estimation periods as we used for the first experiment, where the beginning month is January 1920. The equation estimated through June 1929 is:

$$\underset{(5)}{\log IP} = \underset{(.0548)}{.0051} + \underset{(.009)}{.019}\cdot B - \underset{(.008)}{.022}\cdot B_{-1} + \underset{(.086)}{1.354}\cdot \log IP_{-1} - \underset{(.090)}{.355}\cdot \log IP_{-2}$$

$$DW = 2.02, \quad R^2 = .982, \quad SE = .0249 .$$

Sample period: January 1920 - June 1929.

The B variables are significant, and the standard error has dropped from 0.0253 in equation (4) to 0.0249. There is thus a slight improvement in explanatory power. The coefficient estimate for B is positive and that for B_{-1} is negative, as expected. The sum of the two coefficients is negative, which is not as expected, although the sum is small and not significant.[20]

Table 3 presents forecasts using equations (1) - (3) and (5) and the rolling reestimated versions of these equations. As in Table 1, which

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period witnessed steady growth.

[20]The sum is -.003 with a t-statistic of -0.6.

reports the forecasts of B for the same system, the mid-summer forecast (column 2) shows no evidence of an imminent collapse of the economy. Interestingly, the October forecast in column 3, which is the last one before the crash, does show a moderate decline in output (6.4 percent over two years). About the same rate of decline is predicted in the next month's forecast (column 4), which is based on initial conditions that include the crash. In subsequent months, however, the forecasted levels remain flat.

We have so far been following the six to twelve month timing relationships seen in the data by the Harvard analysts. For the next exercise we drop these relationships and instead estimate a second order vector autoregressive (VAR) model for the A, B, and C indices. We use this model to forecast A, B, and C. We also estimate an IP equation, where log IP is regressed on a constant, log IP lagged once and twice, and A, B, and C unlagged and lagged once. The beginning month for all the estimation periods is March 1919. The estimated equations for the period ending in June 1929 are:

$$\underset{(.0454)}{.0737} + \underset{(.094)}{1.058}\cdot A_{-1} - \underset{(.099)}{.027}\cdot A_{-2} + \underset{(.139)}{.114}\cdot B_{-1} - \underset{(.136)}{.205}\cdot B_{-2} - \underset{(.277)}{.165}\cdot C_{-1} + \underset{(.280)}{.118}\cdot C_{-2} \qquad DW = 1.97,\ R^2 = .976,\ SE = .4088 \tag{6}$$

$$\underset{(.031)}{.046} + \underset{(.063)}{.063}\cdot A_{-1} - \underset{(.067)}{.042}\cdot A_{-2} + \underset{(.093)}{.941}\cdot B_{-1} - \underset{(.092)}{.072}\cdot B_{-2} + \underset{(.187)}{.357}\cdot C_{-1} - \underset{(.189)}{.405}\cdot C_{-2} \qquad DW = 2.07,\ R^2 = .909,\ SE = .2757 \tag{7}$$

$$\underset{(.013)}{-.010} + \underset{(.028)}{.057}\cdot A_{-1} - \underset{(.029)}{.053}\cdot A_{-2} + \underset{(.041)}{.050}\cdot B_{-1} - \underset{(.040)}{.029}\cdot B_{-2} + \underset{(.082)}{1.514}\cdot C_{-1} - \underset{(.083)}{.526}\cdot C_{-2} \qquad DW = 1.95,\ R^2 = .985,\ SE = .1210 \tag{8}$$

$$(9)\quad \log IP = \underset{(.0690)}{.1769} - \underset{(.005)}{.003 \cdot A} + \underset{(.005)}{.006 \cdot A_{-1}} + \underset{(.008)}{.014 \cdot B} - \underset{(.008)}{.016 \cdot B_{-1}}$$

$$+ \underset{(.015)}{.059 \cdot C} - \underset{(.015)}{.069 \cdot C_{-1}} + \underset{(.076)}{1.232 \cdot \log IP_{-1}} - \underset{(.074)}{.300 \cdot \log IP_{-2}}$$

$$DW = 2.10, \quad R^2 = .985, \quad SE = .0219$$

Sample period: March 1919 - June 1929.

Series A, which is dominated by the stock market, is, not surprisingly, approximately a random walk. Shocks to series B are also very persistent, although the financial series A and C do enter with the appropriate signs. Again, series C is close to having a unit root. Series B does, however, enter the equation significantly (on a joint test), and so the HES view that causality runs only from C to B can be rejected. In the IP equation both B and C are significant.

The forecasts from equations (6) - (9) and the rolling reestimated versions are presented in Table 4. The July 1929 forecast (column 2) provides some support for the view that the A, B, and C indices contained evidence for an adverse outlook in the summer of 1929. For this forecast IP falls almost 15 percent over two years. As it turned out, such a forecast was optimistic in light of the events, but it is very pessimistic when viewed from the prospective of the strong performance of the 1920's. The pessimism of the statistical forecast is driven by the decline in the speculation index during the second quarter of 1929 from its peak in March. The index had lost over ten percent of its value from March to June. This decline was also probably the source of the pessimism in the HES's verbal discussion at this time. The outlook had, however, turned optimistic by the October forecast (column 3). The optimism is driven by the increases in the speculation index. Even the crash was not enough to make the November

forecast (column 4) show a decline in IP, although subsequent forecasts become more and more pessimistic. The burst of optimism in mid 1930 is due to a transitory, sharp increase in the speculation index.

The mid-summer 1929 forecast based on the HES VAR does provide some weak support for the account that the HES data signalled the coming downturn. This forecast is driven by the decline in the speculation index in the spring. That decline was not present in other stock price indices and may be spurious. Consequently, Crum may have been justified in suppressing its implications in the verbal pronouncements. His action was justified by the upturn in the summer and fall of the speculation index, and hence, the general outlook.

To summarize, our statistical analysis of the HES data produces the same, persistently negative forecast errors as found in the HES's verbal pronouncements.

Irving Fisher did not publish an indicator of business activity. His service was more immediately concerned with financial markets. Nonetheless, his articles made clear statements about the performance of the economy. The real indicators should be linked to the financial ones in Fisher's view. "Every enlargement of the dollar tends to hurt business shortly afterward and every shrinkage of the dollar tends temporarily to boost business. Thus the dollar's changes forecast, so far as any one factor can do, the volume of trade and unemployment" [Fisher (1934, p.386)]. For our last exercise we consider a VAR model using Fisher's stock and commodity price indices, denoted S and P. We estimate a second order VAR model for log S and log P and an IP equation with log IP regressed on a constant, log IP lagged once and twice, and log S and log P currently and lagged once. The beginning

month for all estimation periods was March 1925, which is the earliest we could get all the data. The estimated equations for the period ending in June 1929 are:

$$\text{(10)}\quad \log S = \underset{(.948)}{.986} + \underset{(.626)}{.393}\cdot \log P_{-1} - \underset{(.620)}{.605}\cdot \log P_{-2} + \underset{(.146)}{1.326}\cdot \log S_{-1} - \underset{(.150)}{.322}\cdot \log S_{-2}$$

$$DW = 1.79,\ R^2 = .995,\ SE = .0527$$

$$\text{(11)}\quad \log P = \underset{(.216)}{.417} + \underset{(.143)}{1.178}\cdot \log P_{-1} - \underset{(.141)}{.269}\cdot \log P_{-2} - \underset{(.033)}{.024}\cdot \log S_{-1} + \underset{(.034)}{.024}\cdot \log S_{-2}$$

$$DW = 1.89,\ R^2 = .916,\ SE = .0120$$

$$\text{(12)}\quad \log IP = \underset{(.339)}{-.126} - \underset{(.156)}{.213}\cdot \log P + \underset{(.149)}{.279}\cdot \log P_{-1} + \underset{(.034)}{.016}\cdot \log S - \underset{(.058)}{.003}\cdot \log S_{-1} + \underset{(.145)}{.973}\cdot \log IP_{-1} - \underset{(.015)}{.064}\cdot \log IP_{-2}$$

$$DW = 2.13,\ R^2 = .964,\ SE = .0126$$

Sample period: March 1925 - June 1929.

The stock market equation has a significant second own lag, although the sum of the two coefficients is almost exactly one. These higher order dynamics may be accounted for by Fisher's procedure for changing the series in the index. Recall that Fisher's stock price index was calculated using each week's fifty best-selling stocks. Including stocks that do well might account for the acceleration of the series during the weeks before the crash. The commodity price index appears essentially unrelated to stock prices. In the IP equation the stock price variable is weak.

The forecasts from equations (10) - (12) and the rolling reestimated versions are presented in Table 5. Unlike the results in Table 4 for the Harvard system, the Fisher forecasts show strong growth during the summer and early fall of 1929. The implied growth rates of over 10 percent at

annual rate were very optimistic. As news of the crash is incorporated into the system, forecast growth remains positive, but much less strongly so. These results are consistent with Fisher's continued optimism in late 1929 and early 1930 despite the recent, rapid declines in output and asset prices.

IV. Conclusion

We have presented two types of evidence concerning the ability of the two forecasters to predict the depression. First, we have examined their verbal pronouncements over the months preceding and following the stock market crash. Both Fisher's and the Harvard Economic Services's forecasts were optimistic before the crash. After the crash, each saw the unfolding events as transitory setbacks that did not diminish prospects for growth in the future. Hence, as the economy continued to decline, the forecasters appeared to be systematically too optimistic. Second, we have used the series published by the forecasters to construct statistical forecasts of economic activity. In doing so, we have taken advantage of our superior ability to measure economic activity by using the Federal Reserve Board's index on industrial production. Thus, we have asked what the forecasters would have predicted based on their data had they been equipped with a modern indicator of economic activity and modern statistical techniques. The statistical findings -- except for the one forecast that provides mild support for Crum's account -- are broadly consistent with the verbal pronouncements. The statistical findings mirror the verbal pronouncements' systematic overprediction of economic activity. Hence, the verbal pronouncements are consistent with the underlying correlations in the data.

Examination of the estimated equations, or equivalently of the tables of forecasts, reveals why it would be incorrect to criticize the forecasters for their persistent optimism about the prospects for recovery. The dynamics of the equations for the real variables are dominated by unit roots. The levels of the forecasts are driven almost exclusively by the initial conditions; they display negligible short run fluctuations. Consequently, the view embodied in the verbal pronouncements that the economy had sustained a serious shock, but could be expected henceforth to grow much as it did in the past, is exactly what a practitioner of modern time series would read from the estimates. Neither the onset nor the persistence of the decline in the economy in the 1930's was predictable from the data for the 1920's. One might thus conclude that Harvard and Yale tied. They were both justified in holding to what turned out ex post to be an incorrect view.

Table 1
Forecasts of Curve B (Business), 1929 to 1932
HES Lag Structure

DATE	ACTUAL	FORECASTS							
	1	2	3	4	5	6	7	8	9
1929: 6	1.38	--	--	--	--	--	--	--	--
1929: 7	2.03	1.19	--	--	--	--	--	--	--
1929: 8	1.96	1.44	--	--	--	--	--	--	--
1929: 9	1.74	1.68	--	--	--	--	--	--	--
1929: 10	1.84	1.96	1.89	--	--	--	--	--	--
1929: 11	1.30	2.08	2.05	2.01	--	--	--	--	--
1929: 12	0.58	1.95	1.75	1.71	1.05	--	--	--	--
1930: 1	0.31	1.64	1.50	1.46	0.85	0.39	--	--	--
1930: 2	0.16	1.55	1.48	1.44	0.90	0.48	--	--	--
1930: 3	0.14	1.43	1.69	1.65	1.07	0.69	--	--	--
1930: 4	0.10	1.42	1.69	1.37	0.78	0.36	--	--	--
1930: 5	0.02	1.35	1.77	1.50	0.48	0.02	-0.04	--	--
1930: 6	-0.33	1.37	1.94	1.64	0.55	0.26	0.21	--	--
1930: 7	-1.04	1.41	2.06	1.67	0.51	0.22	0.18	--	--
1930: 8	-1.23	1.44	2.12	1.50	0.19	-0.06	-0.08	--	--
1930: 9	-1.32	1.48	2.19	1.47	-0.10	-0.23	-0.43	-1.38	--
1930: 10	-1.74	1.52	2.27	1.50	-0.19	-0.08	-0.19	-1.01	--
1930: 11	-2.24	1.57	2.35	1.55	-0.10	0.07	0.34	-0.46	--
1930: 12	-2.50	1.61	2.44	1.60	0.04	0.20	0.80	-0.03	--
1931: 1	-2.63	1.66	2.54	1.65	0.19	0.33	1.00	0.06	-2.50
1931: 2	-2.90	1.71	2.64	1.70	0.34	0.44	1.11	-0.13	-2.87
1931: 3	-3.25	1.76	2.74	1.75	0.47	0.53	1.16	-0.17	-2.99
1931: 4	-3.17	1.81	2.85	1.80	0.57	0.61	1.20	-0.11	-3.14
1931: 5	-3.45	1.86	2.97	1.84	0.66	0.68	1.22	0.03	-3.21
1931: 6	-3.72	1.91	3.09	1.88	0.73	0.73	1.24	0.18	-3.44
1931: 7	-3.96	--	3.21	1.92	0.78	0.77	1.25	0.34	-3.59
1931: 8	-4.14	--	3.34	1.96	0.81	0.80	1.26	0.49	-3.66
1931: 9	-4.41	--	3.47	2.00	0.84	0.82	1.26	0.62	-3.71
1931: 10	-4.84	--	--	2.03	0.86	0.84	1.26	0.72	-3.70
1931: 11	--	--	--	--	0.86	0.85	1.25	0.81	-3.61
1931: 12	--	--	--	--	--	0.86	1.24	0.88	-3.51
1932: 1	--	--	--	--	--	--	1.23	0.94	-3.41
1932: 2	--	--	--	--	--	--	1.22	0.98	-3.31
1932: 3	--	--	--	--	--	--	1.21	1.00	-3.21
1932: 4	--	--	--	--	--	--	1.19	1.02	-3.12
1932: 5	--	--	--	--	--	--	--	1.03	-3.03
1932: 6	--	--	--	--	--	--	--	1.04	-2.94
1932: 7	--	--	--	--	--	--	--	1.03	-2.87
1932: 8	--	--	--	--	--	--	--	1.03	-2.79
1932: 9	--	--	--	--	--	--	--	--	-2.72
1932: 10	--	--	--	--	--	--	--	--	-2.66
1932: 11	--	--	--	--	--	--	--	--	-2.59
1932: 12	--	--	--	--	--	--	--	--	-2.53

ACTUAL DATA: HES series B.
FORECASTS: Based on equations (1)-(3) of text estimated from January 1920 to month prior to beginning of forecast period.

Table 2
Forecasts of Industrial Production, 1929 to 1932
Univariate Autoregression

DATE	ACTUAL	FORECASTS							
	1	2	3	4	5	6	7	8	9
1929: 6	16.40	--	--	--	--	--	--	--	--
1929: 7	16.60	16.41	--	--	--	--	--	--	--
1929: 8	16.40	16.39	--	--	--	--	--	--	--
1929: 9	16.30	16.35	--	--	--	--	--	--	--
1929: 10	16.10	16.30	16.23	--	--	--	--	--	--
1929: 11	15.30	16.26	16.17	15.99	--	--	--	--	--
1929: 12	14.60	16.21	16.12	15.91	14.94	--	--	--	--
1930: 1	14.60	16.17	16.07	15.86	14.76	14.28	--	--	--
1930: 2	14.50	16.12	16.03	15.81	14.67	14.12	--	--	--
1930: 3	14.30	16.08	15.99	15.76	14.61	14.03	--	--	--
1930: 4	14.20	16.04	15.94	15.72	14.56	13.98	--	--	--
1930: 5	14.00	16.00	15.90	15.68	14.52	13.94	14.14	--	--
1930: 6	13.60	15.96	15.86	15.64	14.49	13.92	14.10	--	--
1930: 7	13.00	15.92	15.82	15.60	14.45	13.89	14.07	--	--
1930: 8	12.70	15.88	15.79	15.56	14.42	13.87	14.04	--	--
1930: 9	12.40	15.84	15.75	15.52	14.39	13.84	14.02	12.57	--
1930: 10	12.10	15.81	15.71	15.49	14.37	13.82	13.99	12.53	--
1930: 11	11.80	15.77	15.68	15.45	14.34	13.80	13.97	12.51	--
1930: 12	11.50	15.74	15.65	15.42	14.31	13.78	13.95	12.51	--
1931: 1	11.50	15.71	15.61	15.39	14.29	13.77	13.93	12.52	11.39
1931: 2	11.50	15.68	15.58	15.36	14.26	13.75	13.91	12.54	11.36
1931: 3	11.80	15.64	15.55	15.33	14.24	13.73	13.89	12.55	11.38
1931: 4	11.80	15.61	15.52	15.30	14.21	13.71	13.87	12.56	11.41
1931: 5	11.70	15.58	15.49	15.27	14.19	13.70	13.86	12.58	11.45
1931: 6	11.40	15.56	15.46	15.24	14.17	13.68	13.84	12.59	11.49
1931: 7	11.20	--	15.43	15.21	14.15	13.67	13.82	12.60	11.53
1931: 8	10.80	--	15.41	15.18	14.13	13.65	13.81	12.61	11.57
1931: 9	10.30	--	15.38	15.16	14.11	13.64	13.79	12.63	11.61
1931: 10	9.90	--	--	15.13	14.09	13.63	13.78	12.64	11.65
1931: 11	9.80	--	--	--	14.07	13.61	13.76	12.65	11.69
1931: 12	9.70	--	--	--	--	13.60	13.75	12.66	11.73
1932: 1	9.50	--	--	--	--	--	13.74	12.67	11.76
1932: 2	9.20	--	--	--	--	--	13.72	12.68	11.80
1932: 3	9.10	--	--	--	--	--	13.71	12.69	11.83
1932: 4	8.50	--	--	--	--	--	13.70	12.70	11.86
1932: 5	8.20	--	--	--	--	--	--	12.70	11.89
1932: 6	7.90	--	--	--	--	--	--	12.71	11.92
1932: 7	7.70	--	--	--	--	--	--	12.72	11.95
1932: 8	7.90	--	--	--	--	--	--	12.73	11.98
1932: 9	8.40	--	--	--	--	--	--	--	12.00
1932: 10	8.70	--	--	--	--	--	--	--	12.03
1932: 11	8.70	--	--	--	--	--	--	--	12.05
1932: 12	8.60	--	--	--	--	--	--	--	12.08

ACTUAL DATA: Federal Reserve Board Industrial Production series.
FORECASTS: Based on equation (4) of text estimated from March 1919 to month prior to beginning of forecast period.

Table 3
Forecasts of Industrial Production, 1929 to 1932
HES Lag Structure

DATE	ACTUAL	FORECASTS							
	1	2	3	4	5	6	7	8	9
1929: 6	16.40	--	--	--	--	--	--	--	--
1929: 7	16.60	16.37	--	--	--	--	--	--	--
1929: 8	16.40	16.44	--	--	--	--	--	--	--
1929: 9	16.30	16.53	--	--	--	--	--	--	--
1929: 10	16.10	16.63	16.28	--	--	--	--	--	--
1929: 11	15.30	16.67	16.29	16.04	--	--	--	--	--
1929: 12	14.60	16.61	16.16	15.89	14.92	--	--	--	--
1930: 1	14.60	16.45	16.00	15.72	14.70	14.29	--	--	--
1930: 2	14.50	16.35	15.93	15.64	14.64	14.22	--	--	--
1930: 3	14.30	16.26	15.95	15.66	14.67	14.26	--	--	--
1930: 4	14.20	16.21	15.93	15.55	14.58	14.18	--	--	--
1930: 5	14.00	16.16	15.92	15.54	14.45	14.05	14.14	--	--
1930: 6	13.60	16.15	15.95	15.56	14.44	14.10	14.23	--	--
1930: 7	13.00	16.15	15.95	15.55	14.43	14.13	14.27	--	--
1930: 8	12.70	16.15	15.93	15.46	14.34	14.06	14.22	--	--
1930: 9	12.40	16.15	15.90	15.40	14.24	14.01	14.12	12.57	--
1930: 10	12.10	16.15	15.87	15.37	14.21	14.07	14.20	12.66	--
1930: 11	11.80	16.16	15.83	15.36	14.27	14.17	14.43	12.88	--
1930: 12	11.50	16.16	15.79	15.35	14.37	14.27	14.68	13.12	--
1931: 1	11.50	16.15	15.74	15.33	14.48	14.36	14.82	13.24	11.39
1931: 2	11.50	16.15	15.70	15.32	14.59	14.45	14.90	13.24	11.24
1931: 3	11.80	16.14	15.65	15.30	14.69	14.51	14.93	13.22	11.15
1931: 4	11.80	16.13	15.59	15.27	14.77	14.57	14.93	13.25	11.08
1931: 5	11.70	16.11	15.53	15.24	14.83	14.61	14.92	13.31	11.03
1931: 6	11.40	16.10	15.46	15.21	14.88	14.64	14.90	13.38	10.95
1931: 7	11.20	--	15.39	15.17	14.91	14.66	14.87	13.46	10.88
1931: 8	10.80	--	15.31	15.13	14.94	14.67	14.84	13.54	10.84
1931: 9	10.30	--	15.23	15.09	14.95	14.68	14.81	13.61	10.81
1931: 10	9.90	--	--	15.05	14.95	14.68	14.78	13.67	10.81
1931: 11	9.80	--	--	--	14.95	14.67	14.74	13.71	10.83
1931: 12	9.70	--	--	--	--	14.67	14.70	13.74	10.87
1932: 1	9.50	--	--	--	--	--	14.67	13.76	10.92
1932: 2	9.20	--	--	--	--	--	14.63	13.77	10.97
1932: 3	9.10	--	--	--	--	--	14.59	13.77	11.02
1932: 4	8.50	--	--	--	--	--	14.55	13.77	11.06
1932: 5	8.20	--	--	--	--	--	--	13.76	11.11
1932: 6	7.90	--	--	--	--	--	--	13.74	11.15
1932: 7	7.70	--	--	--	--	--	--	13.72	11.19
1932: 8	7.90	--	--	--	--	--	--	13.70	11.23
1932: 9	8.40	--	--	--	--	--	--	--	11.27
1932: 10	8.70	--	--	--	--	--	--	--	11.30
1932: 11	8.70	--	--	--	--	--	--	--	11.34
1932: 12	8.60	--	--	--	--	--	--	--	11.37

ACTUAL DATA: Federal Reserve Board Industrial Production series.
FORECASTS: Based on equations (1)-(3) and (5) of text estimated from January 1920 to month prior to beginning of forecast period.

Table 4
Forecasts of Industrial Production, 1929 - 1932
HES Data VAR

DATE	ACTUAL	FORECASTS							
	1	2	3	4	5	6	7	8	9
1929: 6	16.40	--	--	--	--	--	--	--	--
1929: 7	16.60	16.13	--	--	--	--	--	--	--
1929: 8	16.40	15.84	--	--	--	--	--	--	--
1929: 9	16.30	15.60	--	--	--	--	--	--	--
1929: 10	16.10	15.41	16.22	--	--	--	--	--	--
1929: 11	15.30	15.26	16.21	15.56	--	--	--	--	--
1929: 12	14.60	15.14	16.24	15.20	14.15	--	--	--	--
1930: 1	14.60	15.03	16.31	15.04	13.16	14.21	--	--	--
1930: 2	14.50	14.94	16.40	15.02	12.48	14.06	--	--	--
1930: 3	14.30	14.85	16.50	15.10	12.12	14.05	--	--	--
1930: 4	14.20	14.77	16.61	15.23	12.03	14.14	--	--	--
1930: 5	14.00	14.70	16.73	15.40	12.16	14.29	14.45	--	--
1930: 6	13.60	14.63	16.84	15.57	12.48	14.46	14.82	--	--
1930: 7	13.00	14.56	16.97	15.74	12.94	14.64	15.22	--	--
1930: 8	12.70	14.49	17.09	15.91	13.50	14.82	15.62	--	--
1930: 9	12.40	14.43	17.22	16.08	14.14	15.00	16.02	12.76	--
1930: 10	12.10	14.37	17.35	16.23	14.80	15.16	16.41	12.97	--
1930: 11	11.80	14.31	17.49	16.37	15.47	15.31	16.78	13.25	--
1930: 12	11.50	14.26	17.63	16.51	16.10	15.44	17.13	13.57	--
1931: 1	11.50	14.21	17.78	16.63	16.66	15.55	17.47	13.91	11.47
1931: 2	11.50	14.16	17.93	16.74	17.13	15.64	17.78	14.27	11.53
1931: 3	11.80	14.11	18.09	16.84	17.50	15.72	18.08	14.63	11.63
1931: 4	11.80	14.07	18.26	16.94	17.75	15.78	18.36	14.98	11.75
1931: 5	11.70	14.03	18.44	17.02	17.88	15.82	18.61	15.33	11.88
1931: 6	11.40	13.99	18.62	17.10	17.91	15.86	18.85	15.66	12.03
1931: 7	11.20	--	18.81	17.18	17.84	15.87	19.06	15.97	12.18
1931: 8	10.80	--	19.02	17.25	17.70	15.88	19.25	16.27	12.34
1931: 9	10.30	--	19.23	17.31	17.48	15.88	19.42	16.55	12.51
1931: 10	9.90	--	--	17.37	17.23	15.86	19.57	16.80	12.68
1931: 11	9.80	--	--	--	16.94	15.84	19.70	17.03	12.85
1931: 12	9.70	--	--	--	--	15.82	19.81	17.24	13.01
1932: 1	9.50	--	--	--	--	--	19.91	17.42	13.17
1932: 2	9.20	--	--	--	--	--	19.99	17.58	13.33
1932: 3	9.10	--	--	--	--	--	20.06	17.71	13.47
1932: 4	8.50	--	--	--	--	--	20.11	17.82	13.61
1932: 5	8.20	--	--	--	--	--	--	17.91	13.74
1932: 6	7.90	--	--	--	--	--	--	17.98	13.86
1932: 7	7.70	--	--	--	--	--	--	18.03	13.96
1932: 8	7.90	--	--	--	--	--	--	18.06	14.06
1932: 9	8.40	--	--	--	--	--	--	--	14.15
1932: 10	8.70	--	--	--	--	--	--	--	14.23
1932: 11	8.70	--	--	--	--	--	--	--	14.29
1932: 12	8.60	--	--	--	--	--	--	--	14.35

ACTUAL DATA: Federal Reserve Board Industrial Production series.
FORECASTS: Based on equations (6)-(9) (second-order VARS) of text estimated from March 1919 to month prior to beginning of forecast period.

Table 5
Forecasts of Industrial Production, 1929 - 1932
Fisher Data VAR

DATE	ACTUAL	FORECASTS						
		1	2	3	4	5	6	7
1929: 6	16.40	--	--	--	--	--	--	--
1929: 7	16.60	16.49	--	--	--	--	--	--
1929: 8	16.40	16.60	--	--	--	--	--	--
1929: 9	16.30	16.72	--	--	--	--	--	--
1929: 10	16.10	16.85	16.40	--	--	--	--	--
1929: 11	15.30	16.99	16.51	16.09	--	--	--	--
1929: 12	14.60	17.13	16.63	16.12	14.88	--	--	--
1930: 1	14.60	17.26	16.75	16.19	14.66	14.41	--	--
1930: 2	14.50	17.40	16.87	16.26	14.56	14.43	--	--
1930: 3	14.30	17.55	17.01	16.34	14.53	14.53	--	--
1930: 4	14.20	17.69	17.14	16.43	14.55	14.65	--	--
1930: 5	14.00	17.84	17.29	16.52	14.59	14.78	14.21	--
1930: 6	13.60	17.98	17.43	16.61	14.63	14.90	14.26	--
1930: 7	13.00	18.14	17.59	16.70	14.68	15.00	14.31	--
1930: 8	12.70	18.29	17.74	16.79	14.73	15.10	14.37	--
1930: 9	12.40	18.44	17.90	16.88	14.77	15.19	14.43	--
1930: 10	12.10	18.60	18.06	16.98	14.81	15.27	14.49	--
1930: 11	11.80	18.76	18.23	17.07	14.85	15.34	14.55	--
1930: 12	11.50	18.92	18.41	17.17	14.88	15.40	14.61	--
1931: 1	11.50	19.09	18.58	17.27	14.91	15.46	14.67	--
1931: 2	11.50	19.26	18.76	17.36	14.94	15.52	14.73	--
1931: 3	11.80	19.42	18.95	17.46	14.96	15.57	14.79	--
1931: 4	11.80	19.60	19.14	17.56	14.99	15.62	14.85	--
1931: 5	11.70	19.77	19.33	17.66	15.01	15.67	14.91	--
1931: 6	11.40	19.95	19.53	17.76	15.03	15.71	14.96	--
1931: 7	11.20	--	19.73	17.86	15.05	15.75	15.01	--
1931: 8	10.80	--	19.94	17.96	15.06	15.79	15.07	--
1931: 9	10.30	--	20.16	18.07	15.08	15.83	15.12	--
1931: 10	9.90	--	--	18.17	15.09	15.87	15.17	--
1931: 11	9.80	--	--	--	15.11	15.90	15.22	--
1931: 12	9.70	--	--	--	--	15.94	15.26	--
1932: 1	9.50	--	--	--	--	--	15.31	--
1932: 2	9.20	--	--	--	--	--	15.35	--
1932: 3	9.10	--	--	--	--	--	15.40	--
1932: 4	8.50	--	--	--	--	--	15.44	--

ACTUAL DATA: Federal Reserve Board Industrial Production series.
FORECASTS: Based on equations (10)-(12) (second-order VARs) of text estimated from March 1925 to month prior to beginning of forecast period.

FIGURE 1

THE HES TEST-PERIOD INDEX, 1903-14
Speculation, Business and Money

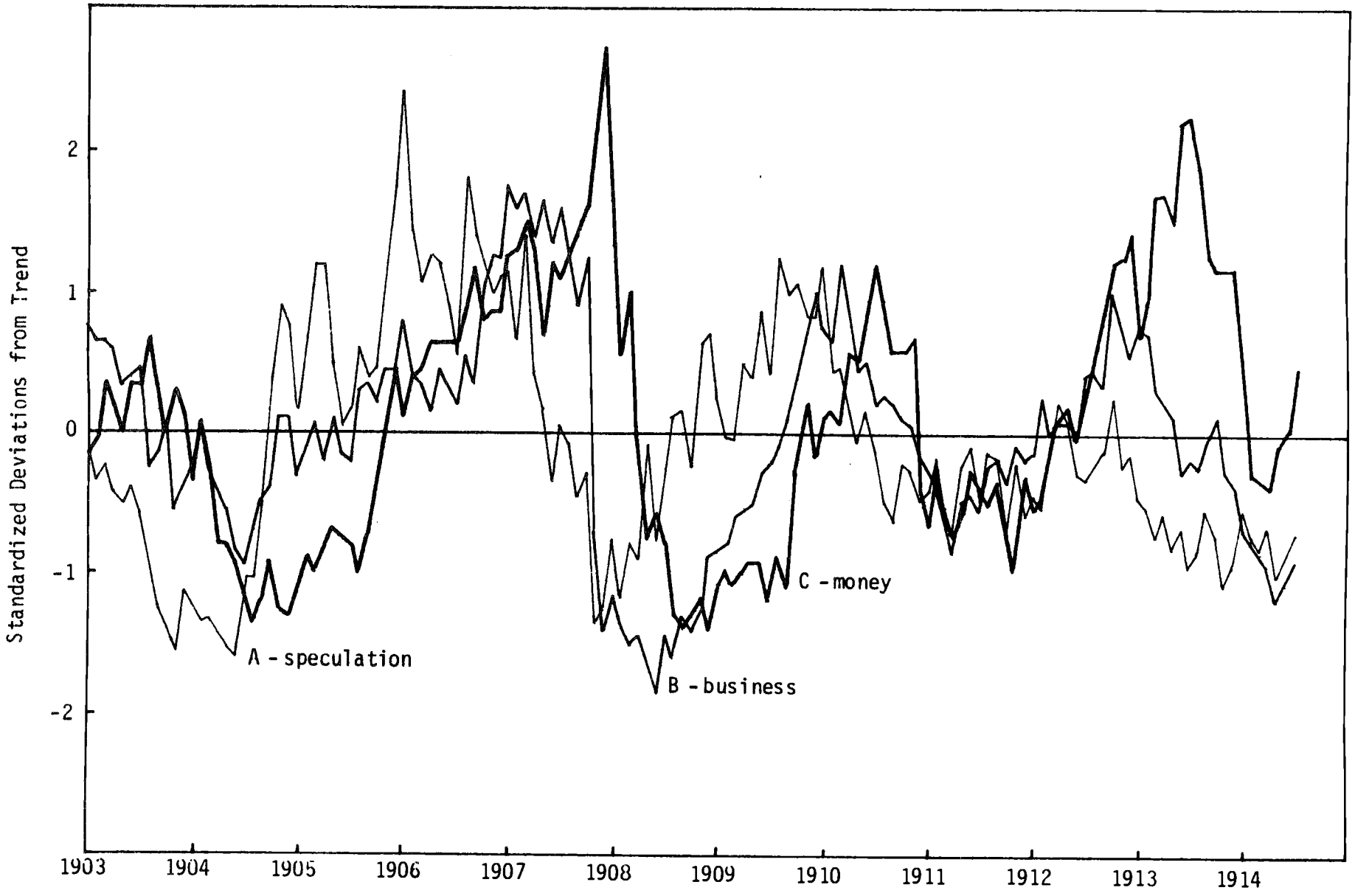
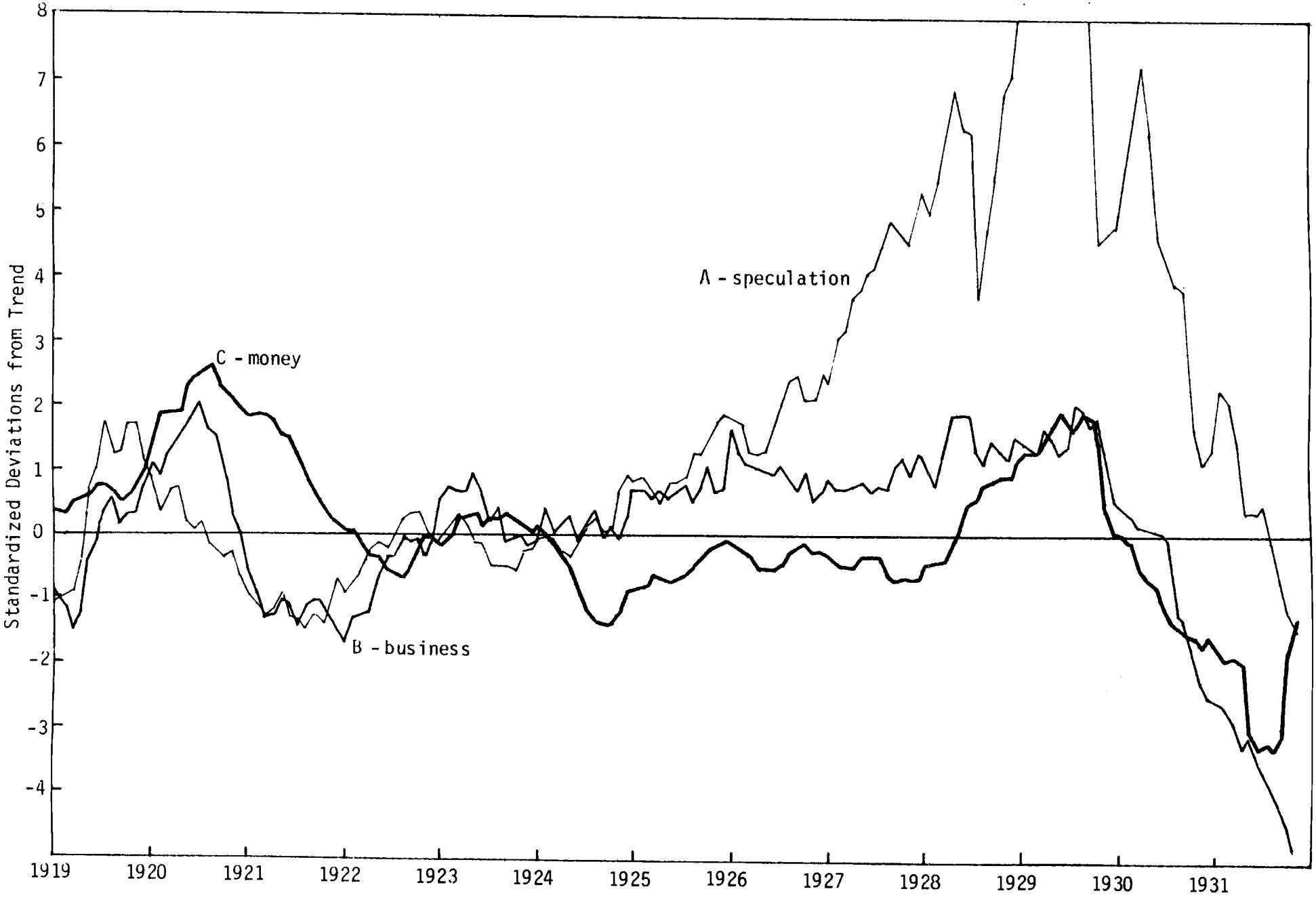


FIGURE 2

HES INDEX, 1919-1931
Speculation, Business and Money



Appendix

This appendix contains the raw data used by the HES and Fisher forecasting services, respectively, as well as the Federal Reserve Board's Industrial Production Index. Data sources are as follows:

Harvard Economic Service's Curve-A, Curve-B, and Curve-C were collected from various issues of the Review of Economics and Statistics 1919-1922, and the Harvard Weekly Letter 1923-1931.

Fisher's Wholesale Price Index appeared in various issues of the Journal of the American Statistical Association 1923-1930, a revised series appeared in JASA Reprint, September 1930.

Fisher's Stock Index was collected from Fisher Scrapbooks 1925-1927 (Yale Manuscript and Archive Collection) and Index Number Institute releases 1928-1930.

The Industrial Production Index is a revised seasonally adjusted series published by the Federal Reserve Board in Statistical Release G12.3, July 18, 1985.

Table A1
HES, Fisher and IP Data from 1919 to 1931

	HES			FISHER DATA		INDUSTRIAL
	SPECULATION	BUSINESS	MONEY	COMMODITY	STOCK	PRODUCTION
DATE	GROUP A	GROUP B	GROUP C	PRICES	PRICES	INDEX
Jan-19	-1.13	-0.88	0.39	NA	NA	10.2
Feb-19	-1.00	-1.14	0.36	NA	NA	9.7
Mar-19	-0.96	-1.46	0.45	NA	NA	9.5
Apr-19	-0.44	-1.23	0.55	NA	NA	9.6
May-19	0.62	-0.40	0.56	NA	NA	9.7
Jun-19	1.00	-0.16	0.73	NA	NA	10.3
Jul-19	1.69	0.35	0.74	NA	NA	10.9
Aug-19	1.22	0.54	0.64	NA	NA	11.1
Sep-19	1.24	0.18	0.52	NA	NA	10.9
Oct-19	1.63	0.26	0.61	NA	NA	10.8
Nov-19	1.62	0.34	0.83	NA	NA	10.6
Dec-19	1.16	0.76	1.02	NA	NA	10.8
Jan-20	0.88	1.07	1.46	NA	NA	11.8
Feb-20	0.38	0.95	1.87	NA	NA	11.8
Mar-20	0.82	1.20	1.91	NA	NA	11.5
Apr-20	0.88	1.44	1.93	NA	NA	10.9
May-20	0.15	1.76	2.27	NA	NA	11.2
Jun-20	0.05	1.94	2.44	NA	NA	11.3
Jul-20	0.14	2.02	2.50	NA	NA	11.0
Aug-20	-0.19	1.68	2.61	NA	NA	11.1
Sep-20	-0.28	1.50	2.33	NA	NA	10.7
Oct-20	-0.36	0.84	2.20	NA	NA	10.3
Nov-20	-0.34	0.35	2.17	NA	NA	9.4
Dec-20	-0.64	-0.01	1.95	NA	NA	8.8
Jan-21	-0.97	-0.58	1.85	NA	NA	8.3
Feb-21	-1.10	-0.88	1.87	NA	NA	8.2
Mar-21	-1.24	-1.27	1.73	NA	NA	7.9
Apr-21	-1.20	-1.25	1.68	NA	NA	7.9
May-21	-0.95	-1.09	1.57	NA	NA	8.2
Jun-21	-1.30	-1.14	1.53	NA	NA	8.1
Jul-21	-1.36	-1.42	1.10	NA	NA	8.1
Aug-21	-1.46	-1.16	0.85	NA	NA	8.3
Sep-21	-1.31	-1.08	0.63	NA	NA	8.4
Oct-21	-1.41	-1.09	0.46	NA	NA	8.9
Nov-21	-1.04	-1.35	0.24	NA	NA	8.8
Dec-21	-0.74	-1.44	0.20	NA	NA	8.7
Jan-22	-0.94	-1.66	0.07	NA	NA	9.1
Feb-22	-0.74	-1.34	0.07	NA	NA	9.5
Mar-22	-0.60	-1.25	-0.06	NA	NA	10.0
Apr-22	-0.24	-1.20	-0.26	NA	NA	9.6
May-22	-0.14	-0.64	-0.35	NA	NA	10.1
Jun-22	-0.20	-0.38	-0.46	NA	NA	10.6
Jul-22	-0.02	-0.38	-0.55	NA	NA	10.6
Aug-22	0.20	-0.08	-0.61	NA	NA	10.4
Sep-22	0.28	-0.14	-0.39	NA	NA	11.0
Oct-22	0.30	-0.10	-0.22	NA	NA	11.6
Nov-22	-0.02	-0.34	-0.06	NA	NA	12.1
Dec-22	-0.12	0.10	-0.06	NA	NA	12.4

Table A1 - continued

	HES			FISHER DATA		
	SPECULATION	BUSINESS	MONEY	COMMODITY	STOCK	INDUSTRIAL PRODUCTION
DATE	GROUP A	GROUP B	GROUP C	PRICES	PRICES	INDEX
Jan-23	-0.04	0.52	-0.14	100.6	NA	12.2
Feb-23	0.14	0.71	-0.01	103.2	NA	12.3
Mar-23	0.24	0.69	0.24	106.7	NA	12.7
Apr-23	0.12	0.72	0.27	107.6	NA	13.0
May-23	-0.12	0.98	0.31	104.5	NA	13.2
Jun-23	-0.17	0.62	0.14	101.2	NA	13.1
Jul-23	-0.43	0.20	0.22	97.0	NA	13.0
Aug-23	-0.48	0.38	0.22	96.9	NA	12.7
Sep-23	-0.49	-0.13	0.29	98.8	NA	12.4
Oct-23	-0.56	-0.06	0.20	100.0	NA	12.4
Nov-23	-0.34	-0.03	0.14	98.4	NA	12.4
Dec-23	-0.24	-0.16	0.07	97.8	NA	12.1
Jan-24	-0.16	-0.14	0.09	98.0	NA	12.4
Feb-24	-0.09	0.39	0.00	99.9	NA	12.6
Mar-24	-0.10	0.01	-0.12	98.0	NA	12.4
Apr-24	-0.26	0.10	-0.25	96.6	NA	12.0
May-24	-0.33	0.24	-0.45	96.0	NA	11.5
Jun-24	-0.18	-0.12	-0.76	95.4	NA	11.0
Jul-24	0.03	0.16	-1.14	97.3	NA	10.8
Aug-24	0.21	0.36	-1.29	98.9	NA	11.2
Sep-24	0.09	-0.01	-1.32	99.2	NA	11.6
Oct-24	0.08	0.10	-1.35	101.4	NA	11.9
Nov-24	0.62	-0.08	-1.20	102.6	NA	12.1
Dec-24	0.93	0.24	-0.92	103.5	NA	12.4
Jan-25	0.84	0.66	-0.81	106.7	74.6	12.8
Feb-25	0.90	0.66	-0.79	107.5	76.5	12.8
Mar-25	0.74	0.58	-0.59	107.3	74.7	12.8
Apr-25	0.50	0.66	-0.63	103.5	73.0	13.0
May-25	0.79	0.56	-0.67	103.5	77.7	12.9
Jun-25	0.82	0.64	-0.63	104.0	82.1	12.8
Jul-25	0.94	0.78	-0.60	105.8	85.3	13.1
Aug-25	1.26	0.50	-0.49	105.6	88.5	12.9
Sep-25	1.26	0.69	-0.37	104.6	93.5	12.7
Oct-25	1.50	1.06	-0.21	103.6	102.4	13.2
Nov-25	1.78	0.64	-0.17	105.2	106.8	13.5
Dec-25	1.87	0.75	-0.12	105.2	107.8	13.7
Jan-26	1.82	1.65	-0.14	105.4	111.2	13.5
Feb-26	1.74	1.28	-0.24	104.2	114.4	13.5
Mar-26	1.35	1.11	-0.27	101.0	101.2	13.6
Apr-26	1.24	1.06	-0.47	99.6	94.9	13.6
May-26	1.34	1.01	-0.49	100.5	95.5	13.5
Jun-26	1.75	0.98	-0.50	100.5	105.0	13.7
Jul-26	2.04	1.14	-0.43	98.8	114.1	13.7
Aug-26	2.40	0.84	-0.27	97.5	127.2	13.9
Sep-26	2.46	0.74	-0.18	97.9	127.2	14.1
Oct-26	2.18	0.99	-0.14	98.0	117.9	14.1
Nov-26	2.19	0.55	-0.23	99.7	119.4	14.1
Dec-26	2.47	0.65	-0.23	97.3	126.3	14.0

Table A1 - continued

	HES			FISHER DATA		INDUSTRIAL
	SPECULATION	BUSINESS	MONEY	COMMODITY	STOCK	PRODUCTION
DATE	GROUP A	GROUP B	GROUP C	PRICES	PRICES	INDEX
Jan-27	2.40	0.82	-0.28	96.0	125.1	14.0
Feb-27	3.06	0.76	-0.41	94.4	131.4	14.1
Mar-27	3.27	0.72	-0.46	92.9	139.9	14.3
Apr-27	3.63	0.76	-0.45	92.5	147.4	13.9
May-27	3.82	0.80	-0.35	92.5	156.0	14.0
Jun-27	4.08	0.66	-0.30	92.4	164.9	14.0
Jul-27	4.14	0.78	-0.32	92.2	174.1	13.8
Aug-27	4.46	0.66	-0.55	93.2	186.7	13.8
Sep-27	4.88	1.05	-0.65	95.8	207.2	13.6
Oct-27	4.66	1.20	-0.63	96.2	209.4	13.3
Nov-27	4.56	0.98	-0.62	96.4	216.9	13.3
Dec-27	5.11	1.22	-0.63	96.1	245.3	13.3
Jan-28	5.32	1.23	-0.47	95.5	260.0	13.6
Feb-28	5.07	0.79	-0.41	96.7	263.0	13.7
Mar-28	5.52	1.26	-0.41	97.6	295.4	13.9
Apr-28	6.26	1.82	-0.21	99.1	339.3	13.8
May-28	6.94	1.93	0.07	99.1	369.1	14.0
Jun-28	6.37	1.92	0.43	98.0	358.0	14.1
Jul-28	6.23	1.38	0.56	99.6	365.0	14.3
Aug-28	3.70	1.16	0.71	99.8	399.4	14.5
Sep-28	4.72	1.46	0.86	99.7	470.4	14.6
Oct-28	5.54	1.33	0.92	98.8	527.4	14.9
Nov-28	6.82	1.20	0.92	97.5	606.3	15.2
Dec-28	7.14	1.55	1.15	97.0	636.4	15.5
Jan-29	8.28	1.40	1.33	97.4	717.0	15.7
Feb-29	8.48	1.31	1.33	97.7	749.5	15.7
Mar-29	8.98	1.64	1.43	98.3	823.8	15.7
Apr-29	8.44	1.54	1.75	97.1	837.9	16.0
May-29	8.30	1.26	1.95	95.9	874.6	16.3
Jun-29	8.08	1.38	1.85	96.9	844.6	16.4
Jul-29	9.27	2.03	1.68	98.5	951.3	16.6
Aug-29	10.08	1.96	1.92	97.3	1038.3	16.4
Sep-29	10.63	1.74	1.90	96.0	1132.1	16.3
Oct-29	8.33	1.84	1.43	94.4	998.1	16.1
Nov-29	4.60	1.30	0.49	92.7	719.7	15.3
Dec-29	4.68	0.58	0.05	92.8	735.8	14.6
Jan-30	4.80	0.31	0.04	93.3	731.6	14.6
Feb-30	5.78	0.16	-0.08	92.7	808.2	14.5
Mar-30	6.48	0.14	-0.51	90.8	885.1	14.3
Apr-30	7.29	0.10	-0.63	90.6	985.2	14.2
May-30	6.31	0.02	-0.78	88.6	921.5	14.0
Jun-30	4.61	-0.33	-1.03	86.4	NA	13.6
Jul-30	4.26	-1.04	-1.27	NA	NA	13.0
Aug-30	3.96	-1.23	-1.41	NA	NA	12.7
Sep-30	3.84	-1.32	-1.47	NA	NA	12.4
Oct-30	2.26	-1.74	-1.53	NA	NA	12.1
Nov-30	1.68	-2.24	-1.66	NA	NA	11.8
Dec-30	1.16	-2.50	-1.59	NA	NA	11.5

Table A1 - continued

	HES			FISHER DATA		INDUSTRIAL
DATE	SPECULATION GROUP A	BUSINESS GROUP B	MONEY GROUP C	COMMODITY PRICES	STOCK PRICES	PRODUCTION INDEX
Jan-31	1.35	-2.63	-1.73	NA	NA	11.5
Feb-31	2.25	-2.90	-1.86	NA	NA	11.5
Mar-31	2.10	-3.25	-1.85	NA	NA	11.8
Apr-31	1.42	-3.17	-1.93	NA	NA	11.8
May-31	0.39	-3.45	-2.96	NA	NA	11.7
Jun-31	0.39	-3.72	-3.22	NA	NA	11.4
Jul-31	0.44	-3.96	-3.20	NA	NA	11.2
Aug-31	-0.08	-4.14	-3.23	NA	NA	10.8
Sep-31	-0.72	-4.41	-3.12	NA	NA	10.3
Oct-31	-1.16	-4.84	-1.87	NA	NA	9.9
Nov-31	-1.42	NA	-1.26	NA	NA	9.8
Dec-31	NA	NA	NA	NA	NA	9.7

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