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THE CHANGING CYCLICAL VARIABILITY OF ECONOMIC ACTIVITY IN THE UNITED STATES

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ABSTRACT

This paper examines the changing cyclical variability of economic activity in the United States. It first shows that the decline in variability since World War II cannot be explained by changes in the composition of economic activity or by the avoidance of financial panics. We then show that increased automatic stabilization by the government, and the increased availability of private credit after World War II combined to stabilize consumption and reduce the variability of aggregate demand. The main argument of the paper holds that greater price rigidity in recent times may have contributed to economic stability by preventing destabilizing deflations and inflations. Empirical evidence is presented to support this proposition.

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Perhaps the most striking feature of business cycles is that their amplitude varies widely from era to era and from country to country. While there do seem to be striking regularities in the pattern of covariation exhibited by variables connected with the business cycle, there are large changes in the magnitude of the cycle itself. These differences in cyclical variation should properly be a subject of study by economists. The existence of these differences suggests that "universal" models of business cycles--models which neglect institutional determinants of business cycle behavior--will not be adequate to explain the phenomenon of the business cycle.

This paper extends discussions by Burns (1960) and Baily (1978) of the changing extent of cyclical variability in the American economy. We seek to link this changing variability to changing institutional factors. In the process, we are led to a view of the role of price flexibility in cyclical fluctuations which, while consistent with Keynes's own views, diverges sharply from the views characteristic both of modern Keynesians and of classical macro-economists of the new and old schools.

Our paper begins with an examination of the extent of cyclical variability over different parts of the 1893-1982 period. Using a variety of measures of variability and several different statistical techniques, clear evidence emerges that the amplitude of cyclical fluctuations is much lower after than it was before World War II. This result holds even if the Great Depression is excluded from the pre-World War II sample period.

There is weak evidence that output shocks have had more persistence in the post-World War II than in the pre-World War II period. This casts doubt on the hypothesis that the successful application of discretionary stabilization policy is a significant cause of improved post-World War II macro-economic performance. A number of structural explanations for this phenomenon, including the declining role of agriculture, the increasing role of government, and the declining share of investment, have been suggested. Our examination of the data indicates that only the increasing role of government can account for even a small part of the decline in the cyclical variability of output and employment that is observed when the pre- and post World War II periods are compared.

A clear distinction between the patterns of pre- and post-World War II data is the larger size of aggregate demand shocks during the earlier interval. We attribute this to two factors. First, the growth of government between the two eras led to significant changes in the relationship between disposable income and GNP. The existence of a large and progressive tax system in the post-World War II period tended to mitigate cyclical fluctuations in disposable income. This effect was accentuated by the growth of counter-cyclical entitlement programs, such as unemployment insurance. But large fluctuations in disposable income do not necessarily have any consequences for the behavior of aggregate demand if all consumers can borrow and lend freely. Hence the importance of the second major factor: a decline in the fraction of consumption accounted for by liquidity-constrained households. Growth in the availability of consumer credit of various types led to a reduction in the number of consumers who were forced to cut back their consumption as a result of transitory declines in disposable income. These two factors combined to substantially reduce the Keynesian

multiplier,[1] and therefore to enhance stability.

Most of the major institutional changes in the economy during this century have had the effect of making the economy less "Walrasian." Both the size of the government and the extent of government regulation have increased markedly. Labor and product markets have become more concentrated with the growth to significance of unions and conglomerates. The attachment between workers and firms was less and wage flexibility was greater in magnitude before World War II than it has been after. In sum, the pre-World War II economy was much closer to the perfectly competitive, atomistic ideal of economic theory than was the post-World War II economy.

Conventional macro-economic theory of both the Keynesian and classical variety suggests that macro-economic performance should have been better in the pre-World War II economy because it was relatively free of institutional rigidities and imperfections. Yet this was not the case. We raise the possibility that the increasing institutionalization of the economy may have contributed to macro-economic stability by preventing destabilizing deflations, and by facilitating private arrangements to smooth production and employment. This possibility, noted by Keynes, has been largely ignored by both American Keynesian and classical macro-economists.[2] The much greater cyclical variance in real interest rates observed in the pre-World War II period is a piece of evidence in favor of this alternative hypothesis. Further evidence on the importance of this Keynes effect in explaining the changing character of the business cycle is provided by an investigation of vector auto-regression systems.

1/Blanchard (1981) concludes that in America today there is essentially no multiplier.

2/A prominent exception is Tobin (1975).

The paper is organized as follows: Section I profiles the changing size of cyclical fluctuations over the 1893-1982 period. Section II discusses the role of stabilization policies in accounting for the decline in output variability in the post-War period. Section III examines the relationship between the "Walrasian" character if the economy, price flexibility and output flexibility. Section IV discusses a number of sources of evidence suggesting that the increasing institutionalization of the economy may have contributed to economic stability. Section V offers a short restatement of our conclusions.

I. THE CHANGING CYCLICAL VARIABILITY OF OUTPUT

The sharp reduction in the size of cyclical fluctuations in output and employment between the pre- and post-World War II periods has been noted many times. In his amazingly prescient 1959 Presidential Address to the American Economic Association Arthur Burns noted that "its [the business cycle's] impact on the lives and fortunes of individuals has been substantially reduced in our generation.... There is no parallel for such a sequence of mild - or such a sequence of brief contractions, at least during the past hundred years in our own country." Figures 1 and 2 respectively plot the rate of change of annual GNP and the percentage deviation of GNP from trend over the 1893-1982 period. They show clearly the declining variability of real output.

An indication of the magnitude of the decline in cyclical variability is provided by a comparison of the peak to trough decline in output between pre- and post-War recessions as defined by the NBER chronology. During the post-War period, the median decline was 0.2 percent and the maximum decline was 1.8 percent during the 1973-1975 recession. During the 1893-1940 period the median decline was 3.8 percent and the maximum decline was 37 percent between 1929 and 1933.[3/] Similar conclusions are obtained using data on employment or industrial production. For example, the median decline from peak to trough in industrial production was 12 percent during the 1893-1940 period compared to a maximum decline in industrial production of 9 percent during the post-War period.

A somewhat more systematic examination of the changing variability of GNP is presented in Table 1. Three alternative measures of variability

3/Calculated on an annual basis.

Figure 1

Annual Percentage Changes
in Real GNP

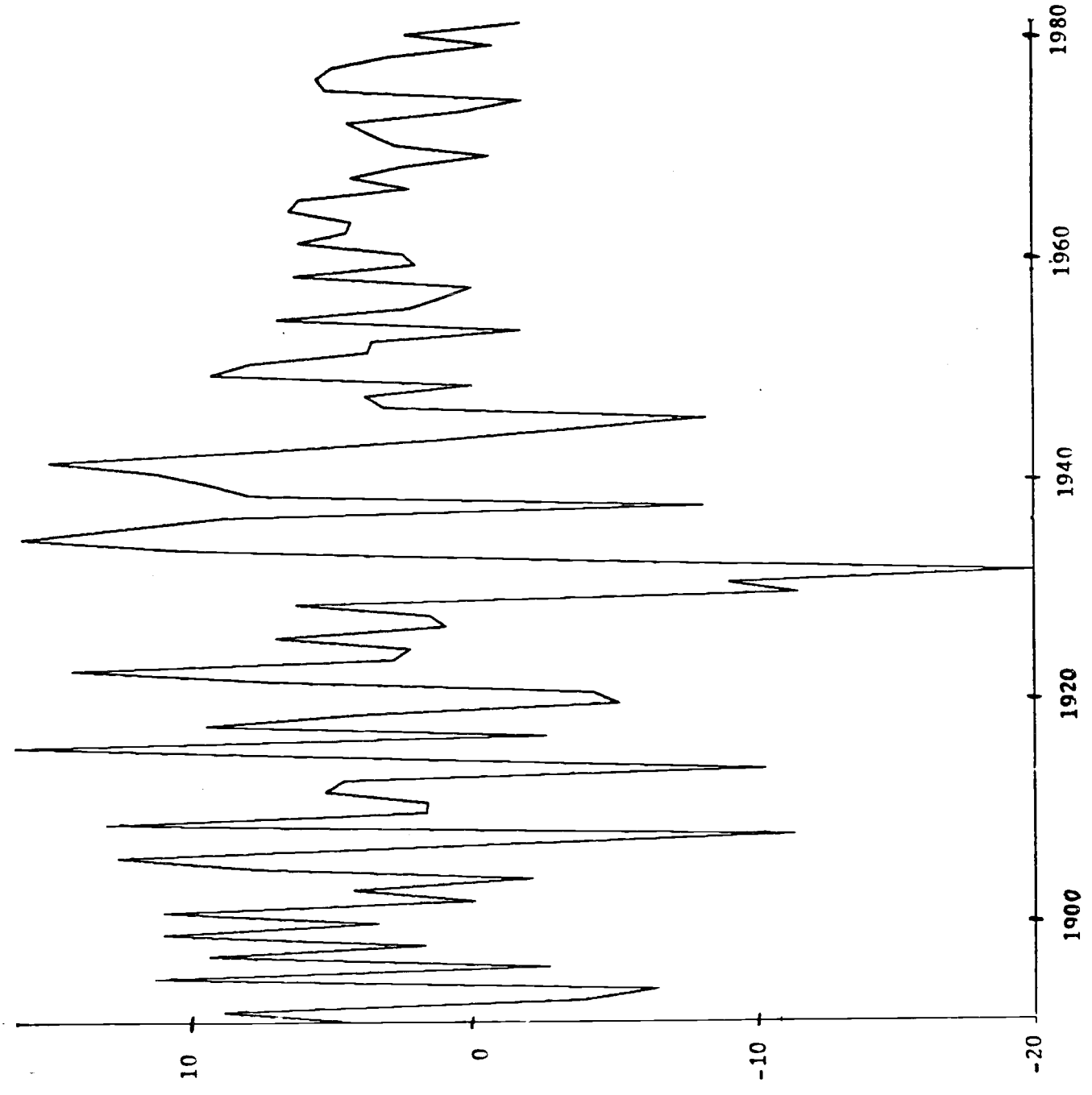


Figure 2

Percent Deviation of Real GNP from
Natural GNP

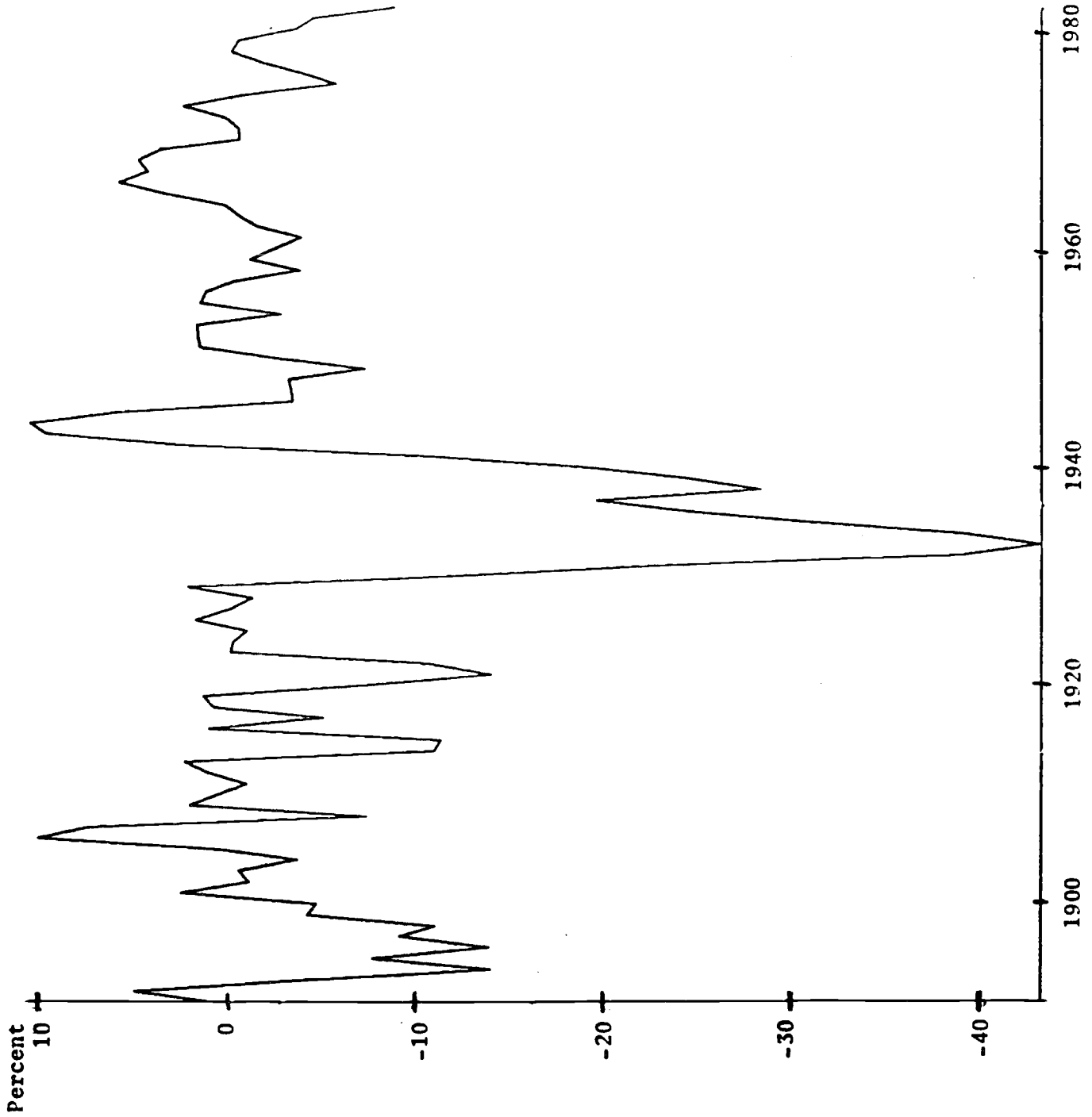


Table 1

The Changing Cyclical Variability of Output

Period	$\sigma^{a}_{\Delta y}$	σ^{b}_{y/y_n}	$\sigma^{c}_{y/y_{trend}}$
1893-1915	.046	.061	.087
1893-1915/23-40	.044	.118	.138
1923-1940	.041	.142	.160
1947-1982	.011	.034	.046
1947-1970	.011	.036	.037
1971-1982	.011	.027	.051

Note: All calculations are based on GNP data described in Gordon (1982a).

a. Standard deviation of the quarter-to-quarter change in the log of real GNP.

b. Standard deviation of the difference between the log of real GNP and the log of natural real GNP.

c. Standard deviation of the difference between the log of real GNP and its piecewise-linear trend (breakpoints at 1915, 1922, 1940, 1946, and 1970).

are used. The first is the standard deviation of the growth rate of quarterly GNP as estimated by Gordon (1982a). The second is the standard deviation of the output gap as estimated using Gordon's natural GNP estimates. The third measure is the standard deviation of the residuals when a continuous piecewise-exponential trend is fit through the GNP series. Estimates of volatility over a number of sub-intervals are presented. The 1915-1918 and 1941-46 periods are omitted because of the special effects of wars on economic activity. We also omit the four year aftermath of World War I because rapid inflation and subsequent deflation make this period uncharacteristic of the remaining American economic experience.

Regardless of which volatility measure is used, the conclusion is that output was more variable before World War II than after it. By all three measures output variability was about three times as great in the earlier interval. Surprisingly, the much ballyhooed increase in economic turbulence during the 1970s barely shows up in the data. Apparently, the 1970s were turbulent only in comparison to the remarkably placid 1960s. The data on the 1893-1915 period make it clear that the greater volatility of output during the pre-War period was not just a reflection of the Depression. However, using either measure of volatility in the level of GNP there is a noticeable increase in volatility between the 1893-1915 and the 1923-1940 subperiods. This is wholly a consequence of the protracted downturn in output represented by the Depression. No increase in the standard deviation of GNP changes appears because this measure places more weight on high frequency fluctuations.

There remain the questions of whether the declining variability in real GNP documented in Table 1 is statistically significant, and whether

it reflects a decrease in the amount of statistical noise in the GNP figures, rather than a real change. Neither possibility seems very likely to us.

It is not clear how one should go about determining the statistical significance of the differences shown in Table 1. Output movements are serially correlated and all tests of significance require some explicit model of the process generating output. We will simply note that if successive observations are treated as independent normal random variables, then the hypothesis that the variance in output is constant can be rejected at a level of confidence of less than .1 percent for annual data and .01 percent for quarterly data.

It is certainly true that the GNP data--particularly for 1893 to 1915--are somewhat shaky. Gordon's quarterly data series is based on annual estimates originally constructed by Kuznets and Kendrick. Kuznets, at least, did not regard his data for the period before 1919 with confidence. He sought to divert people into studying his estimates in the form of five- or ten-year moving averages, and he was reluctant to publish his annual estimates.[4/] It seems likely, however, that the deficiencies in the data lead us to underestimate rather than overestimate the extent of cyclical variation in the pre-World War I economy. The original annual estimates assume that the relation between commodity production and GNP before 1909 is the same as the mean relation from 1919 to 1939. The estimates thus damp out independent variation in services and transportation that is uncorrelated with commodity production. Moreover, a recent reworking of the commodity production figures that underlie these estimates suggests that the original annual estimates give too high values to investment during the exceptionally depressed 1890's and thus generate estimates for business cycle variance that are too small.[5/]

4/See the appendices to Kuznets (1961).
5/See the appendices to Lewis (1978).

On balance, we are led to conclude that the decline in the size of economic fluctuations between the pre- and post-World War II periods is a real phenomenon, a phenomenon that economists should be able to explain.

Accounting Explanations

One natural starting place in an investigation of the declining volatility of GNP is to look separately at its different components. Perhaps output has become more stable over time because the stable components in GNP have grown relative to the unstable ones. In particular, government--which is a-cyclic--has grown greatly in importance over the last century. and agriculture, which is notoriously unstable, has shrunk rapidly as a share of GNP.[6/] It has also been suggested that the share of durable goods in GNP has declined over time. Since the demand for durable goods is volatile, this is also a potential explanation for the decline in the volatility of GNP.

Table 2 presents some evidence on these issues. It does not appear that the changing composition of GNP can account for most of the decline in the magnitude of output fluctuations. The percentage variability in year-to-year changes in our estimate of private non-farm GNP declined by 56 percent between 1893-1940 and 1947-1982 compared to 67 percent for total GNP. The variance of non-agricultural GNP is only slightly less than the variance in total GNP, even in the 1893-1915 period. This somewhat surprising result occurs because the value of agricultural products demanded is actually slightly less variable than all other commodity groups except for non-agricultural perishables. The increased decline in the relative variability

6/This idea is a relatively recent one. In the 1949 conference that is the ancestor of this one, Kuznets referred to the neat coincidence of the simultaneous rise of a-cyclic services and decline of a-cyclic agriculture. See Simon Kuznets, "Comment," on Joseph A. Schumpeter "Historical Approach to Business Cycles," in Anderson (1951).

of total GNP is due primarily to the rise of government purchases, which go from approximately 5 percent of GNP in 1900 to approximately 15 percent of GNP today. Government purchases exert a stabilizing influence in Table 2 because the measure of variability used (year-to-year changes) filters out the massive swings in government expenditure in the post-World War II period associated with military purchases which occur at longer than business cycle frequences.

The last column of Table 2 shows that the standard deviation of annual percentage changes in consumption has declined dramatically from 5.5 percent in the 1893-1940 period to 1.8 percent in the post-War period. This development occurred despite a substantial increase - detailed in the Gordon and Veitch paper in this volume - in the share of consumer durables in consumption between the two periods. This suggests that the decreasing share of durable goods in GNP cannot account for a large part of the decline in the variance in output fluctuations. Moreover, the paper by Gordon and Veitch in this volume shows that if consumer durables are included then there has been no secular downwards trend in the share of GNP attributable to investment.

We have also examined a number of breakdowns of GNP by component including its industrial composition and the standard national income accounting breakdown into consumption, investment, government and net exports. None of these exercises contributed significantly to explaining the declining volatility of output, and so they are not detailed any further here.

Financial Panics and Monetarist Explanations

Many economists have argued that a major cause of the United States's superior macroeconomic performance since World War II has been the smoother path followed by the money stock. According to this line of thought, the

Table 2

The Variance of Alternative Output Measures

Period	$\sigma^{a}_{\Delta y_1}$	$\sigma^{b}_{\Delta y_2}$	$\sigma^{c}_{\Delta y_3}$	$\sigma^{d}_{\Delta y_4}$	$\sigma^{e}_{\Delta c}$
1893-1915	.069	.076	.065	.070	.040
1893-1915/23-40	.081	.093	.078	.088	.055
1923-1940	.098	.115	.094	.110	.077
1947-1982	.027	.040	.027	.039	.018

Note:
a. Standard deviation of the year-to-year change in the log of real GNP.
b. Standard deviation of the year-to-year change in the log of private GNP. For the period before 1929 government transfers were assumed to be equal to zero and data on government expenditures was taken from Goldsmith (1955).
c. Standard deviation of the year-to-year change in the log of non-farm GNP. For the period before 1929 the proportion of farm output in GNP was assumed to be the same as the proportion of agricultural commodity production in total commodity production plus construction. Figures on commodity production taken from Shaw (1947).
d. Standard deviation of the year-to-year change in the log of private non-farm GNP. Constructed according to (b) and (c) on the assumption that, before 1929, the government purchased no agricultural products.
e. Standard deviation of the year-to-year change in the log of consumption. Before 1929, "consumption" is defined according to Kuznets. Thus it includes some government purchases, but fortunately these are small in magnitude.

General data from the National Income and Product Accounts, from Kuznets (1961), Shaw (1947), and Goldsmith (1955).

Federal Reserve Board has done a good (albeit not perfect) job in the post-War period. It has kept the money stock from exhibiting the substantial year-to-year swings which characterized earlier periods.

The problem with this line of argument is that monetary aggregates are in general endogenous variables. It is very hard to determine whether movements in the money stock are causes or consequences of movements in output. This is particularly true for the period of the gold standard, during which the relation between the monetary base and the money stock was very loose. Therefore, in order to examine monetary-liquidity approaches to the business cycle, we concentrate our analysis on a class of events--financial panics--that appear likely to be exogenous with respect to output, and that are associated with substantial declines in the money stock. We conclude below that, since financial panics cannot account for a significant fraction of output variance before World War I, although they do account for a significant part of the variance in the money stock, fluctuations in monetary aggregates are perhaps best viewed as consequences of output fluctuations. Arguments (like the one above) that regard the smoother growth of aggregates as a cause of reduced variability rely on weak empirical support.

It is also important to study financial panics because a large body of thought from Bagehot (1873) to Bernanke (1983) places stress on the importance of a smoothly running financial system for good macro-economic performance and on the serious real consequences of collapses in the chain of financial intermediation.

This line of argument has typically run as follows: the financial sector is unstable--subject to sudden sharp increases in the demand for liquidity--in the absence of a lender of last resort. Finance, it is

suggested, bears a strong analogy to musical chairs; the last one to the bank during a panic walks away empty-handed. Therefore a financial system that lacks a lender of last resort will be prone to a collapse, to a sudden reduction in the amount of credit available and a sudden increase in the price of whatever credit is available.

When it occurs, this financial collapse has serious real consequences. The division of labor, the successful functioning of specialized enterprises, depends upon the existence of a credit system: agents must be able to quickly and cheaply acquire the resources to enable them to separate the time of purchase from the time of sale. In the aftermath of a panic there is a lower degree of financial sophistication, there are fewer possible paths of intermediation. This is, in some sense, a reduction in the "natural" level of output. With the financial system paralyzed as a result of the preceding panic, production opportunities that would be profitable if there were a high level of intermediation are not profitable at the lower level of intermediation prevailing.

This point of view is supported by Sprague's narrative history of American financial crises (Sprague, 1910), where Sprague recounts, to give just one example, how the unwillingness of banks to extend credit for trans-Atlantic shipments during the panic of 1873 threatened the "cessation of commodity exports," and how the news of this financial stringency in New York "partially paralyzed" the movement of crops in the midwest (pp. 58-61). This point of view is also supported by Bernanke (1983), who points out the striking correlation between financial crises during the downward slide of the Great Depression and reductions in output in excess of what one would have predicted from the behavior of the money stock alone.

To test the adequacy of this hypothesis of the important role played by financial panics we examine the effect of removing panic periods on various measures of macro-economic stability. We focus on the period from 1890-1913, before the founding of the Fed when panics should have had their greatest impact. According to one formulation of the point of view, periods immediately after financial panics have lower levels of "equilibrium" output. Therefore, under this formulation, the variance of real GNP about trend should be significantly lower if the immediate aftermath of panics is excluded from analysis.

According to an alternative formulation, panics occur at the ends of periods of "overtrading," of "speculation." Therefore the periods immediately before panics are periods of abnormally high output, and the aftermath of the panic--which sees the decline of output back to trend and then below trend to its trough--is not necessarily characterized by an excessively high variance of real GNP about trend. But in this case the aftermath of panics should show an excessively large and negative average value for the rate of change of real GNP: if the decline from overfull output to some level of low-intermediation equilibrium is to be ascribed to the panic the decline must take place quickly, before the financial system recovers its ability to provide credit. In the limit, if the economy grew at a constant rate except for panic-induced declines, then excluding panic periods would reduce the variance of the rate of growth to zero. In practice, one would still expect the exclusion of the large negative growth rates during panics to reduce the calculated variance of the growth rate.

We considered two possible ways to identify panics. First, there is the list of major panics which Sprague considers important enough to devote a chapter to in his book. In the period from 1890 to 1910, from the beginning of the Gordon output series to the publication of Sprague's book, Sprague finds incidents worth a chapter occurring in August, 1890, May through July, 1893, and October, 1907. An alternative, less judgmental definition of a "panic"--as a time in which either there is a (month-to-month) jump of one percentage point in the commercial paper rate or in which banks cease paying out deposits at par--produces twelve panics in the relevant period: 1890:4, 1893:2, 1893:3, 1896:1, 1896:3, 1898:2, 1899:4, 1901:2, 1903:2, 1905:4, 1907:4, and 1909:4. Note that two of these less judgmentally defined panics, 1893:2 and 1893:3, are really all part of one single disturbance according to Sprague.

Given these two lists of panics, we calculated variances for both the logarithm of output and the quarterly rate of change of output for several different sets of intervals. First for the entire 1890-1913 interval, then for the interval with the panic quarters and with three quarters on each side of them removed, for the interval with the panic quarter and one quarter on each side removed, and lastly with the panic quarter and the two following quarters removed. The results were as shown in Table 3.

Given the results of this simple exercise, it is hard to argue that there is any way in which more than 20 percent of the standard deviation of either output or its rate of change could be ascribed to the influence of financial panics. Since nearly 40 percent of the variance in nominal monetary grwoth is attributable to panic periods, this suggests that financial and monetary shocks are less important sources of depression than we had

Table 3

Contribution of Financial Panics to Macroeconomic Instability

Measure of Variability	1890-1910	Sprague Panics Removed: 3-quarter window	Sprague Panics Removed: 7-quarter window	Sprague Panics Removed: 3-quarter, 1-sided window	Interest Rate Panics Removed: 3-quarter window	Interest Rate Panics Removed: 7-quarter window	Interest Rate Panics Removed: 3-quarter, 1-sided window
log (y/y^n)	.0661	.0686	.0657	.0619	.0641	.0612	.0548
Δ (log y)	.0526	.0522	.0540	.0455	.0489	.0445	.0438

Note: Numbers are standard deviations of measures of variability on the left for the period 1890-1910 and for various subperiods which have dates associated with financial panics removed (as described) in the text.

3-quarter window: preceding, panic, and following quarters removed from sample
7-quarter window: three preceding, panic, and three following quarters removed from sample
3-quarter, 1-sided window: panic and two following quarters removed from sample.

Basic data from Gordon (1982a). Panics calculated as described in the text from Sprague (1910) and from the 4-6 month commercial paper rate.

suspected. Note that this exercise places an upper bound on the influence of financial panics: if whatever causes steep recessions also increases the probability of financial panics the pattern shown in Table 3 could be generated easily without any direct path of transmission from financial panics to the macro-economy.

Are the numbers generated by the above exercise reasonable? Is there any way to rationalize the apparent lack of strong links between financial uproar and real recession? We believe that the conclusions of the above exercise are reasonable, because the effects of financial panics upon the rest of the real economy are smaller than is usually realized.

The 1907 Panic

We illustrate this by considering in some detail one typical panic. Consider the panic of 1907, which occurred two quarters into a recession that saw a year-over-year decline in output of approximately 6.4 percent. This panic was marked by the typical features of Sprague's major panics: nominal interest rates suddenly increase, banks outside of New York City attempt to reduce their loan portfolios, everyone scrambles for liquidity, banks refuse to pay out cash on demand at par to depositors, and "business activity" slumps by 26 percent from the quarter before to two quarters after the panic (see Sprague, 1910).

But what is most interesting is the small magnitude of the movements in the variables that link the financial sector to real businesses. When banks refuse to pay out cash for deposits at par, $1.00 in bank deposits suddenly becomes a commodity with a cash price; in the panic of 1907, the "price" of deposits followed the smooth path given in Table 4. Similarly, with the breakdown of the regular system of intermediation, $1,000.00 in deposits in New York suddenly became a commodity with a price in Philadelphia or St. Louis.

These deviations from par are all small, taking the values as of 10/26 (they are within the normal range) as a basis for comparison. Even at the height of the crisis a bank in St. Louis could still obtain deposits in New York by paying a premium of less than 1 percent. Similarly, the premium required on cash to make depositors willing to keep their deposits in banks never rose above three percent.

It is likely that these prices do not give a good idea of the full extent of the panic. Agents may well have attempted to preserve the good will of their traditional customers by continuing to trade with them on "normal" terms of trade; "new" customers may have faced prices significantly further from par than those given above. It is clear that the deviations from par values of bank deposits could have had a decisive effect on the profitability of any enterprise only if it were leveraged to an extraordinary degree. If the quantity of credit were rationed to familiar customers at "normal" prices, the panic could have had significant real effects without these effects leaving their traces in the numbers of Table 4.

But the quantity of credit outstanding was not significantly reduced during the panic of 1907, at least according to Sprague. Between August 22 and December 3, the volume of loans outstanding decreased by only two percent. Sprague concludes that for the crisis of 1907 at least "it seems fair to assume that positive loan contraction was a comparatively slight disturbing factor." The fall in output from August to December was far greater, proportionately, than the decline in credit outstanding.

Moreover, the New York Clearing House banks, the linchpins of the financial system, increased their loans--from 712 to 775 million dollars. A reduction in the quantity of credit available on account of the panic

Table 4

Financial Disturbances Associated with the Panic of 1907

Date	Average Discount on Deposits[a] for that Week (%)	Price of $1,000 in New York in:[b] Boston	St. Louis	New Orleans
10/28	0	$999.75	$999.75	$999.00
11/2	2.6	999.75	1,000.00	998.50
11/9	3.0	1,000.30	1,003.50	998.50
11/16	3.0	1,001.50	1,007.00	997.50
11/23	2.4	1,002.00	1,007.00	997.00
11/30	1.1	1,000.00	1,004.50	1,000.00
12/7	1.1	999.75	1,002.50	1,000.00
12/14	1.5	999.70	1,004.50	1,000.00

Note: a. Average weekly discount from par of bank deposits priced in currency.
b. For bank-to-bank transactions.

From Sprague (1910) and Andrew (1908).

could not have had severe repercussions on the level of real output.

How, in the face of the scramble for liquidity on the part of depositors that was one of the major characteristics of the panic, did banks manage to avoid a major contraction in the volume of loans? Two ways--the first was the suspension of cash payments to depositors at par that has already been mentioned. The second way was by the creation of new reserves by the banking system. On the assumption that privately-created reserves functioned as the equal of high-powered money, private actions increased the monetary base by 10 percent during the later months of the panic. Privately created reserves were of limited acceptability, it is true, but within the banking system the $238,000,000 of large-denomination certificates issued by the New York Clearing House and backed by the long-run assets of the Clearing House banks functioned perfectly well as high-powered money. And these $238,000,000 of extra reserves were also augmented by $23,000,000 of small clearing house certificates, by $12,000,000 of clearing house checks, by $14,000,000 of cashiers' checks, and by $47,000,000 of manufactuers' pay checks--all of which functioned in at least some spheres as substitutes for currency (see Andrew (1908), reprinted in Sprague (1910)).

The small changes in the prices of financial resources during the panic of 1907 and the quick action of private agents to take over the function of the nonexistent lender of last resort--the function of providing additional reserves--seem to indicate that the American national banking system had developed a pattern of behavior by the panic of 1907 which kept financial stringency from having devastating effects on the real economy.[7/]

These considerations lead us to doubt that the reduced volatility of output during the post-War period was primarily the result of the avoidance

7/Cagan (1965) also notes the existence of unauthorized money creation during panics.

of financial panics. We do not mean however to imply that panics never had real effects. In particular, during the Great Depression when the presence of the Fed discouraged banks from taking collective action to avoid disastrous consequences, but the Fed itself was passive, financial panics may well have played an important role. But the view that financial panics were a principal cause of economic instability in the pre-World War II period does not seem to be strongly supported. This finding weakens the monetarist argument linking output variability to erratic monetary growth, by showing that only relatively little of the variability in output observed before World War II can be linked to exogenous changes in the money stock. We return to the question of changing monetary policy in Section IV.

The analysis so far suggests that it is unlikely that either structural or monetary factors can account for the decline in the variability of output since World War II. The one plausible lead that we have uncovered is the increasing role of government. We investigate the role of stabilization policy in the next section.

II. THE EFFECTS OF STABILIZATION POLICIES

A major difference between the pre- and post-World War II periods was the government's acceptance after World War II of an obligation to stabilize the economy. This obligation was recognized by statute in the Employment Act of 1946 and pragmatically in the speeches and actions of various high officials. It is natural to conjecture that this change in attitudes and policies contributed to the decline in the volatility of output observed in the post-World War II period. It is also frequently argued that automatic stabilization in the form of a progressive tax system and counter-cyclical expenditure measures such as unemployment insurance have contributed to enhanced economic stability by reducing the multiplier. Econometric exercises support this hypothesis: Hickman and Coen's (1976) estimates of the real autonomous expenditures impact multiplier drop from 3.23 in the inter-War period to 1.88 in the post-War period. This section examines the contribution of both automatic fiscal stabilizers, and discretionary policies in explaining the post-War improvement in economic performance.

Automatic Stabilizers

The traditional argument that automatic stabilization has improved macro-economic performance emphasizes the role of taxes and transfers in mitigating the effects of changes in GNP on disposable income.[8/]

This account is less satisfactory than it appears at first. Modern theories of the consumption function presume the ability on the part of consumers to smooth out fluctuations in disposable income by borrowing and lending. If consumers, in fact, possess this ability, it is not clear why the government's smoothing the path of disposable income through fiscal actions should have real effects. Automatic stabilization policies

8/See for example the treatment in Burns (1960), Gordon (1984), or Baily (1978).

will have important real effects only if a sizeable fraction of consumption represents purchases by liquidity constrained consumers. Thus establishing the existence of liquidity constrained consumers is necessary to a demonstration of the efficacy of automatic stabilization policy. But this discussion raises another possibility. Perhaps the multiplier has changed over time because the fraction of liquidity constrained consumers has declined due to growth in the availability of consumer credit.

This subsection explores these issues. We begin by documenting the changing relationship between GNP and disposable income fluctuations over time, and then we turn to an examination of the importance of liquidity constraints.

We have already emphasized the importance of the increasing size of government. The extent to which this growth has changed the nexus between GNP and disposable income can be seen in Table 5 which reports the results of regressions of disposable income on GNP for various sub-periods of the 1898-1982 interval. We use slightly different subperiods here than in the preceding sections because data on disposable income do not go all the way back to 1890. The results indicate a dramatic change in the relationship between the pre- and post-War periods. During the 1949-1982 interval a marginal dollar of GNP raised disposable income by $.39 compared to $.82 during the pre-War period. There is no strong evidence of any change between the pre-World War I and the interwar period in the share of GNP changes which fall on disposable income.

The changing relationship between GNP and disposable income is well illustrated by the two recent serious U.S. recessions. During the

Table 5

Response of Disposable Income
to a Change in Total Income

Period	Coefficient of Δy	$\bar{R}^2$	D.W.
1898-1916	.76 (.16)	.54	0.97
1923-1940	.95 (.24)	.61	1.70
1949-1982	.39 (.06)	.59	2.07

Note: Equation estimated in real magnitudes,

$\Delta y^d = c_0 + \alpha(\Delta y) + \varepsilon$,

$E(\varepsilon^2)$ proportional to Y^2.

Annual data taken from Kuznets (1961), Goldsmith (1955), and the N.I.P.A. Before 1929, "disposable income" is approximated by nominal income minus the sum of federal, state, and local government revenues, and minus corporate gross internal saving.

1981-82 recession when GNP fell by 1.8 percent disposable income actually rose by 1.0 percent. During the 1973-1975 precession when output fell by a comparable amount, disposable income rose by 1.1 percent.

Fiscal policies are not the only determinant of the linkage between GNP and disposable income. Other considerations including the cyclical effects on the distribution of factor incomes, and corporate payout policies also impinge on the relationship. We briefly examined these issues but were able to find little evidence suggesting that changes in these other factors have worked to stabilize disposable income in the post-War period. We thus credit fiscal policies with almost all the changes shown in Table 5. This conclusion runs somewhat counter to Burns' (1960) somewhat impressionistic discussion but we do not pursue the issue here.

The foregoing discussion is relevant to the behavior of real economic activity only if liquidity constraints are an important factor in the determination of aggregate consumption. To identify the extent of liquidity constraints we model aggregate consumption as a combination of the consumption of unconstrained consumers whose consumption evolves according to a random walk as specified in Hall (1978), and liquidity constrained consumers whose consumption is assumed to be a constant fraction of disposable income.

For convenience we work with the data in logarithmic form.[9/] We postulate that consumption on non-durable goods and services evolves according to:

$$(8) \qquad C_t = C_t^u + m(YD_t)$$

where C_t^u represents unconstrained consumption and m indicates approximately the fraction of disposable income spent by liquidity constrained consumers.

9/We also worked with the model in level form, but we found that the overidentifying restrictions present in the model presented below were more frequently rejected.

The polar case where m=0 gives rise to the pure permanent income hypothesis. When m=1 consumption just depends on current disposable income.

The argument of Hall (1978) implies, assuming that the real rate of return can be approximated as a constant, that

$$(9) \qquad C_t^u = b_1 C_{t-1} + U_t$$

where U_t is uncorrelated with any information available at time t-1.

In order to estimate m we proceed as follows. First we assume that YD evolves according to a second order autoregression process. That is

$$(10) \qquad YD_t = \rho_0 + \rho_1 YD_{t-1} + \rho_2 YD_{t-2} + \rho_3 t + u$$

Combining (8) and (9) and (10) we obtain the estimable equation:

$$(11) \qquad C_t = b_0 + b_1 C_{t-1} + m\left[\rho_0 + (\rho_1 - b_1) YD_{t-1} + \rho_2 YD_{t-2} + \rho_3 (t)\right]$$

where e_t is a residual that is uncorrelated with the variables on the right hand side of (11). Now (10) and (11) can be estimated jointly to yield estimates of m. The overidentifying restrictions implied by the model can be tested by estimating (10) and (11) in unconstrained fashion.

Estimates of both restricted and unrestricted forms of the system (10) and (11) using annual data on the consumption of non-durables and services are presented in Table 6 for various intervals. The results for the pre-War periods are quite striking. For the interval 1899-1916 the data support the hypothesis that essentially all consumption was done by liquidity constrained consumers. Moreover, the overidentifying restrictions implied by the model are accepted comfortably. The results for the entire pre-War period are also supportive of this conclusion though they are less satisfactory. In the constrained equation case the point estimate of m is 1.4 which is implausibly large. The overidentifying restrictions

Table 6

Estimates of the Extent of Liquidity Constraints

Period	Restricted	Y_{-1}	Y_{-2}	t	C_{-1}	t	m	log L
1949-1982	No	1.02	-.30	.012	.73	.014	.28	192.32
		(.19)	(.18)	(.077)	(.13)	(005)	(.31)	
1949-1982	Yes	.77	.06	.056	1.00	--	.50	189.89
		(.15)	(.14)	(.14)	(.02)		(.46)	
1899-1916	No	.35	-.05	.02	-.1	.01	1.1	70.28
		(.22)	(.23)	(.01)	(.3)	(.01)	(1.2)	
1899-1916	Yes	.33	.20	.014	-.1	--	1.1	69.35
		(.17)	(.12)	(.005)	(.2)		(.1)	
1899-1916	No	1.17	-.35	.003	.43	.013	.54	99.14
1922-1940		(.16)	(.15)	(002)	(.14)	(.004)	(.41)	
1899-1916	Yes	1.07	-.31	.005	.62	--	1.4	97.63
1922-1940		(.12)	(.10)	(.002)	(.09)		(.2)	

Note: The left hand side reports estimates of (10) while estimates of (11) are on the right hand side. Numbers in parentheses are standard errors.

are also less well satisfied. These less satisfactory results probably occur because our autoregression is not a satisfactory predictor of future income during the Depression. When (in results not shown) the Depression years are dropped from the sample but the 1920s are included, the results look very much like those for the 1899-1916 interval.

Unfortunately, the extent of liquidity constraints in the post-War process is difficult to gauge because disposable income was not far from following a random walk. However, the point estimates of both the constrained and unconstrained versions of the model suggest that some but not all consumers were liquidity constrained. Unfortunately, the data have the power to reject neither of the interesting polar hypotheses. Hence nothing definitive can be said.[10/]

Taken together these estimates confirm that liquidity constraints matter for aggregate consumption, as already asserted by Flavin (1981). This suggests a role for automatic stabilizers in explaining why output was less volatile in the post-War period. They also indicate however that progress in financial intermediation may have contributed to stability by enhancing the consumer's ability to smooth fluctuations in income by borrowing. Certainly households have had much easier access to liquidity in the post-War than in the pre-War period. The most striking rise is in the volume of consumer credit outstanding: from $6 billion in 1945 or 5 percent of consumption to $380 billion or 23 percent of consumption in 1982. The growth of nonfarm mortgage debt has also been remarkable: from $27 billion or 54 percent of consumption in 1934 to $1,548 billion or 82 percent of consumption in 1982. By and large, before World War II American households had (except for some mortgages and loans intended to support

10/We also examined quarterly data for this interval, but did not find that they shed much light, so no results are reported here.

the leveraged purchase of securities) little access to credit markets. According to Robert A. Gordon's paper in Anderson (1951), the post-World War I construction boom was primarily an apartment - not a single family house - boom. Since World War II households have had a great deal of access. It would be surprising if this structural shift had had no macro-economic effects.

Discretionary Stabilization Policy

The most direct way of examining the efficacy of discretionary stabilization policies would be to examine whether or not discretionary policy was counter-cyclical in the post-War period, and to estimate its effects. This is much easier said than done. Distinguishing the discretionary from the automatic component of policy is difficult to do. Moreover, given uncertainties about lags, gauging the effects of policies is also problematic. Exercises such as the one performed by Eckstein and Sinai in this volume tend to suggest that monetary policy caused at least as many recessions as it prevented, and do not find much evidence for the success of discretionary fiscal policies. We do not attempt such an exercise here. Rather we turn to a less direct test of the possible efficacy of discretionary stabilization policies.

The essential idea of our test is as follows. The variance in real GNP depends on both the size of initial shocks to it, and the extent to which they persist. Discretionary stabilization policies presumably work by reducing the persistence of shocks to GNP, not by limiting the size of initial shocks. Thus if discretionary stabilization policies became more efficacious in the post-War period one would expect to see a decline in the persistence of output shocks during this interval.

Table 7 presents estimated impulse response functions for GNP for various intervals. The variance of shocks is also presented. All calculations are based on autoregressions of annual GNP data.[11/] The

11/The data are taken from Friedman and Schwartz (1983), who try to construct consistent annual time series back to 1865.

Table 7

Persistence of Output Shocks

Period	0	1	2	3	4	Standard Deviation of Shocks
1893-1915						
AR(1)	1.00	.39	.15	.06	.03	.062
		(.19)	(.14)	(.09)	(.06	
AR(2)	1.00	.42	.11	.02	.00	.063
		(.22)	(.18)	(.11)	(.09)	
AR(3)	1.00	.42	.08	.08	.06	.064
		(.23)	(.19)	(.18)	(.19)	
1923-1940						
AR(1)	1.00	.87	.76	.66	.57	.095
		(.12)	(.21)	(.28)	(.32)	
AR(2)	1.00	1.33	1.25	.97	.64	.083
		(.21)	(.25)	(.24)	(.25)	
AR(3)	1.00	1.37	1.26	.95	.62	.086
		(.26)	(.29)	(.30)	(.28)	
1949-1982						
AR(1)	1.00	.70	.49	.35	.22	.026
		(.15)	(.21)	(.22)	(.21)	
AR(2)	1.00	.81	.47	.22	.09	.026
		(.19)	(.23)	(.32)	(.27)	
AR(3)	1.00	.82	.46	.24	.12	.027
		(.20)	(.27)	(.35)	(.33)	

Note: Annual GNP data from Friedman & Schwartz (1983). Standard errors--generated by stochastic simulation--in parentheses.

calculations reveal that if anything the persistence of output fluctuations increased between the pre-World War I and post-World War II periods. Concommitantly, the decline in the variance of output shocks between the two intervals exceeds the decline in the variance of real GNP. Thus the data provide little support for discretionary stabilization policy argument.

A more subtle form of the discretionary policy argument, noted in Baily (1978), runs as follows. Whether or not stabilization policy is actually efficacious, it is perceived as effective. Because recessions are expected to be short, consumers and investors do not cut back on spending plans as much as they otherwise would. The prophecy is therefore self-fulfilling and the economy is more stable. This argument is also put forth to explain greater wage and price rigidity in the post-War period. It is suggested that because the economy is expected to return to equilibrium more quickly workers and producers feel less pressure to cut wages and prices in the face of shortfalls in demand. This argument like the more direct one predicts that serial correlation in output should have declined in the post-War period. As just noted, this prediction is refuted by the data.

The pattern followed by stock market prices provides a further way to test arguments about confidence in the face of economic downturns if one is willing to accept the following two assumptions: first, that the expectations implicit in the stock market's guesses about the discounted value of the future profitability of American enterprise are the same as the expectations of those who decide on investment. We recognize the weakness of this support of our argument, but we see no way to avoid making it that will allow us to use the information found in the pattern

of stock prices. Second, that the relation between the profitability of those companies counted in stock market averages and the macro-economic performance of the economy has remained constant. As a test of this second assumption, we examined the cyclical variability of dividends paid by companies listed in the Standard and Poor's 500 index; we cannot find any significant changes in the cyclical flexibility of dividends, and so we are led to tentatively accept this second assumption.

The stock market is a leading indicator. It typically reaches its real peak several quarters before output. The agents whose expectations set prices in the stock market know that a recession is coming. The magnitude of the decline in profitability that they expect can be seen in the magnitude of the decline in the stock market. And so the elasticity of the level of the stock market with respect to future values of the GNP gap is a measure of the "sanguinity" of stock market investors, is a measure of the subjective probability assigned to the possibility that the recession may be the beginning of a deep, long period of subnormal output rather than a short, shallow correction to the economy.

Accordingly, we regressed the log of the real value of two stock market indices (the Dow-Jones industrial and Standard and Poor's composite) on a quadratic in time and on five, six, and nine leads (for quarterly data) of the difference between the log of GNP and the log of natural GNP. We also corrected for (substantial) serial correlation. Because the behavior of the two indices was nearly identical, only the S&P results are reported here. The parameter of interest is ΣB_i.

Interpretations of these results, which are displayed in Table 8, are dubious, because the exceptionally large degree of serial correlation

Table 8

Stock Market Elasticities

Period	n=5 $\Sigma\beta_i$ (Sum of Leads)	n=5 rho	n=5 $\bar{R}^2$	n=6 $\Sigma\beta_i$	n=6 rho	n=6 $\bar{R}^2$	n=9 $\Sigma\beta_i$	n=9 rho	n=9 $\bar{R}^2$
1893-1915	1.75	.73	.975	2.12	.73	.975	2.20	.76	.977
	(.50)	(.08)		(.57)	(.08)		(.79)	(.08)	
1922-1940	1.81	.82	.905	1.69	.81	.905	1.56	.75	.912
	(.59)	(.07)		(.61)	(.07)		(.56)	(.08)	
1947-1970	3.51	.95	.945	2.33	.94	.953	1.05	.93	.965
	(.92)	(.03)		(.99)	(.03)		(1.07)	(.04)	
1947-1980	2.90	.93	.929	2.32	.92	.934	1.13	.90	.944
	(.83)	(.03)		(.90)	(.03)		(1.06)	(.04)	
1970-1980	3.52	.78	.987	3.59	.78	.987	3.17	.78	.987
	(1.47)	(.10)		(1.57)	(.10)		(1.98)	(.11)	

Estimation procedure described in text.

in the residuals tells us that whatever is moving stock prices (1) does not follow a simple trend, and (2) dominates those movements induced by the near-term (within two years) cyclical outlook. There is also an errors-in-variables problem here: the value of the independent GNP gap used is the ex-post realized value, rather than the ex-ante expected value. To the degree that agents do not correctly forecast the near-term cyclical outlook, the estimates of the sum of the lag coefficients are not consistent.

Nevertheless, simple inspection of the various sums of the lead coefficients does not lend support to the hypothesis of the increasing "sanguinity" of investors. A given cyclical movement in the GNP gap over the two years to come seems to be preceded by a relative decline in the stock market that is, if anything, larger since World War II than it was before. A given expected decline in real GNP relative to trend seems to be associated with a slightly greater decline in the discounted value of future profits--as measured by the stock market--than before World War II. This simple exercise seems to indicate that those investing in the stock market do not expect the same initial decline in GNP to be recouped more quickly--due to government stabilization policies--after World War II than before World War II.

The analysis in this section suggests that automatic stabilizers have contributed to the reduction in the variance of GNP that has been observed since World War II. There is little evidence that discretionary policies have played an important role. Indeed, the persistence of output shocks has actually increased. But it seems unlikely that automatic stabilization can account for the whole of the decline in the variance of output. The declines in the volatility of investment that have been observed since

the War exceed the declines in the volatility of consumption. Moreover, quantitative estimates of the change in the Keynesian multiplier such as those provided by Hickman and Coen (1976), are not large enough to account for a three fold decline in the variance of output shocks reported in Table 7. We therefore turn in the next section to an examination of other structural changes which may contribute to explaining the declining variance of output.

III. PRICE AND OUTPUT FLEXIBILITY

Some common contemporary explanations of business cycles focus on the role of institutional factors which lead to deviations from the atomistic competitive model of classical economic theory. For example, long term nominal labor contracts are sometimes invoked to explain how nominal shocks can have real effects on economic activity. Alternatively, long term attachments between workers and firms combined with asymmetrical information--in a phrase, implicit contracts--are sometimes invoked to account for involuntary unemployment and cyclical fluctuations.

The evidence presented in that section suggests that this focus may well be misplaced. We show in the first part of this section that, in a variety of ways, the American economy has become much less "Walrasian" over the same century that has also seen a pronounced trend toward greater macro-economic stability. This suggests that the sources of economic instability do not lie in the non-Walrasian character of certain economic institutions.[12/] We then demonstrate that plausible macro-economic models imply that increased price rigidity will increase rather than reduce macro-economic stability. Finally, we suggest that price flexibility by raising real interest rates may have exacerbated the 1929-1933 economic downturn.

The extent to which the economy was "Walrasian" in the past is obviously impossible to gauge precisely. Market power depends not only on the extent of concentration in product and labor markets, but also on

12/Of course it is possible that, as argued by John Taylor in his paper in this volume, increasing price rigidity did exacerbate cyclical fluctuations, but this influence was more than offset by other factors. We return to Taylor's analysis in section IV.

factors such as costs of search and the extent of information asymmetries. All these factors share the characteristic of being very hard to quantify. However, the available evidence suggests that the American economy was significantly more competitive prior to World War II than it has been since the war.

One indicator is the increased role of government after World War II. The share of GNP passing through the public sector rose from approximately 4 percent around 1900 to approximately 10 percent in 1929-1937 and to about 16 percent by 1970. Of potentially greater importance is the greatly increased scope of government regulation: by the estimates of Nutter and Einhorn (1969), close to 22 percent of GNP produced in 1958 was produced in sectors of the economy in which government was a predominant presence. And this estimate predates the rise in the 1960s and 1970s of what is termed the "regulatory state."

A similar conclusion is suggested by the available data on industrial concentration. The percent of national income originating in proprietorships dropped from 28 percent in 1929 to 18 percent in 1969. In 1918, 35 percent of total manufacturing assets were held by the nation's 100 largest manufacturing corporations. Their share had reached 49 percent by 1970.

Perhaps the most dramatic changes have occurred in the character of the labor market. Some information on the changing character of labor markets is presented in Table 9. A clear pattern emerges. Long term contracts were essentially nonexistent prior to the passage of the Wagner Act. A small proportion of workers were in unions, and the prevailing political climate offered unions few of the sources of institutionalized strength that legal procedures gave them in the post-War period. The share of unionized non-farm

Table 9

Unionization and Occupational Structure

Year	Union Members as a Percent of Labor Force	Union Members as a Percent of Non-Farm Labor Force	Percent of Workers Holding White Collar Jobs	Percent of Workers Holding Blue Collar Jobs	Percent of Workers Holding Farm Jobs
1900	3	4	17	36	38
1910	5	8	21	38	31
1920*	12	16	25	41	26
1930	7	9	29	39	21
1940	14	17	31	40	17
1950	24	29	36	41	12
1960	26	29	42	39	6
1970	26	27	48	37	3

*More than one-third of these unions were broken during the deflation that followed 1920.
Source: Historical Statistics.

workers was only 9 percent in 1930 compared to 29 percent in 1950. Likewise the fraction of workers in institutionalized settings has increased dramatically. The fraction working on farms has fallen from 38 percent in 1900 to 3 percent in 1970, and, in 1900, close to half of all farmers were owner-operators. And the fraction of workers in white-collar jobs has increased from 17 percent in 1900 to 48 percent in 1970. This is an interesting statistic in light of the fact that a substantial proportion of white-collar workers are engaged in what one might call non-market-oriented coordination of production.

Perhaps the strongest evidence of the changing character of labor markets comes from information on separations. Ross (1958) examines the argument that a new industrial feudalism developed in the U.S. following World War II. As Table 10 indicates, the quit rate in manufacturing (the only sector on which data is available) declines from over 6 percent before World War I to close to 2 percent recently. The total separation rate declined by about 42 percent between 1920-23 and 1973-79, implying an equal percentage increase in average manufacturing job tenure. Even though most turnover involves the young, these data still are indicative of a substantial increase over time in the importance of something that might be called job-specific human capital, and therefore in implicit long term labor contracts.

Quantifying the extent of deviations from the Walrasian ideal due to more subtle factors such as increased labor market specialization, and increased product differentiation is obviously not possible. However a number of factors suggest those factors have increased in importance. Expenditures on advertising and promotion have surely increased faster

Table 10

Peacetime Business Cycle Averages
of Quit and Separation Rates

Cycle	Manufacturing Quit Rate	Manufacturing Layoff Rate
10-13	6.8	-
20-23	4.2	1.5
23-26	2.9	1.0
28-29	2.5	1.0
29-37	1.3	3.4
48-53	2.5	1.7
53-57	1.7	1.9
57-60	1.3	2.3
60-89	1.9	1.5
69-73	2.2	1.5
73-79	1.9	1.5

Source: Historical Statistics and Ross (1958).

than the GNP suggesting a greater role in firms facing downward sloping product demand areas. The educational level of the work force has expanded greatly, as has the number of different occupations. To gauge the extent of imperfections in today's economy, one need only ask how many firms are indifferent to selling more output at prevailing prices? Or, how many workers are indifferent to losing their jobs.

It seems very likely that increased economic stability has been a byproduct of these developments. Permanent attachments between workers and firms, for example, slow the response of employment to fluctuations in demand. This in turn reduces the extent to which demand shocks are propagated by increasing the stability of disposable income. More formally, it is possible to demonstrate in a variety of implicit contracting models that because of workers' desire for insurance, employment is more stable than it would be if a Walrasian equilibrium were attained every period. Likewise, increasing conglomeration of firms, and the resulting increased reliance on internal finance reduces the liquidity effects of economic downturns. It is also natural to conjecture that regulatory policies are likely to keep the output of regulated firms at relatively stable levels.

It is unquestionably the case that price volatility in the American economy declined in conjunction with the changes discussed above. The standard deviation of annual rates of inflation from trend was 1.5 percent for 1949-1982, compared with 2.4 percent for 1893-1915 and 4.8 percent for 1923-1940. It is less clear whether wages and prices have become more flexible in response to output shocks of a given size. Cagan (1975) and Sachs (1980) report that wholesale prices have been less sensitive to movements in aggregate demand during the postwar period. However,

Schultze (1980) argues that there was little change in the sensitivity of prices - measured by the non-farm GNP deflator - between the pre- and post-War periods. Gordon (1980) finds that the initial response of prices to nominal demand has not changed, but notes the increasing persistence of inflation in the post-War period.[13/]

It is not easy to make a coherent interpretation of these findings. We suspect that there has been a small decline in short-run price flexibility (a decline in the slope of the short-run aggregate supply curve), but that this decline has been so small that it is not apparent in the less sensitive GNP deflator and can be seen only in measures of producer prices. We do conclude that there has been an increase in the persistence of price movements. Below, we present a simple model to analyze the effect of an increase in such persistence on macro-economic performance. Before examining this issue, it is important to emphasize that the evidence presented in the preceding section suggests that greater price rigidity in the post-War period cannot be attributed to greater certainty that downturns would be temporary. This possibility is refuted by the evidence suggesting that output shocks have become more not less persistent and that the sensitivity of the stock market to output shocks has if anything declined.

Is Price Flexibility Destabilizing?

In the remainder of this section, we entertain the hypothesis that greater price flexibility in the pre-World War II period was a cause of greater instability in output. This is, of course, the exact opposite of the canonical Keynesian nominal-rigidities point of view which leads, in John Taylor's words, to the assertion that "less flexible wages and prices should lead to a deterioration of macroeconomic performance."

13/And Schultze also finds increasing persistence after 1967, which he interprets as a shift in the inflation norm.

But John Maynard Keynes disagreed, and in Keynes (1936) argued against this very proposition, claiming instead that:

> it would be much better that wages should be rigidly fixed and deemed incapable of material changes, than that depression should be accompanied by a gradual downward tendency of money-wages, a further moderate wage reduction being expected to signalize each increase of, say, one percent in the amount of unemployment. For example, the effect of an expectation that wages are going to sag by, say, two percent in the coming year will be roughly equivalent to the effect of a rise of two percent in the amount of interest payable for the same period. (quoted in Tobin (1975))

Keynes seeks to argue that the simple solution to involuntary unemployment - lowering the nominal wage - will not work. For the economy is not a static object converging to a stationary equilibrium. The lowering of wages (and prices) required to get the quantity of real balances up to its full-employment equilibrium value itself creates an additional intertemporal disequilibrium. For changes in the aggregate price level disturb what is perhaps the single most important price in the whole economy, the real interest rate.

This point of view deserves a more formal examination, which we provide within the framework of a simple macro-economic model. The model highlights the fact that it is the ex-ante real - not the nominal - interest rate that should enter into the determination of investment. It also provides for a distinction between price flexibility and price persistence stressed by Gordon (1980).

We treat all variables (except interest and inflation rates) as log deviations from trends. Solving out an IS-LM system, where the

nominal interest rate enters the LM equation and the real interest rate enters the IS equation, yields an aggregate demand curve of the form:

$$(12) \qquad q_t = \beta_1(m_t - p_t) + \beta_2(E_t p_{t+1} - p_t) + \varepsilon_t$$

We model expectations by assuming perfect foresight on the part of investors:

$$(13) \qquad E_t p_{t+1} = p_{t+1}$$

The aggregate supply side of the model is somewhat more complex. An easy way to model the independent dimensions of short-run price flexibility and of price persistence is to adopt a multiperiod nominal contract framework. Workers are divided into n+1 equal groups. Group j negotiates an n+1 period contract, with a fixed nominal wage, in all periods for which $(t)_{\text{mod } n+1} = j$. That is, using superscripts to denote worker groups:

$$(14) \qquad W^j_{t+1} = W^j_t \ , \ j \neq (t)_{\text{mod } n+1}$$

$$(15) \qquad W^j_{t+1} = W^j_t + \frac{1}{n} \sum_{i=1}^{n} \left(W^{(j-i)_{\text{mod } n+1}}_{t+1-i} - W^{(j-i)_{\text{mod } n+1}}_{t-i} \right) + \alpha q_t$$

In the contract period, group j's nominal wage is renegotiated for the next n+1 periods. The wage rise won by group j in these negotiations is the average of the wage rise won by the other n groups in their negotiations plus or minus a term (αq_t) which is supposed to capture the effect of labor market tightness. In their negotiations, workers are backward-looking. Since we are working within the Keynesian tradition, we do not think that this is an important defect in the model.[14/] Moreover, any attempt to model the wage determination process fully within an optimizing framework would be hopelessly complex.

14/In subsequent work, we hope to examine the issues here within a model like that of Taylor (1979) where contracts are partly forward and partly backward looking. It seems unlikely that this will alter qualitative conclusions.

To close the model, the price level is taken to be a simple average of the prevailing wage levels:

$$(16) \qquad p_t = \sum_{i=1}^{n+1} W_t^i$$

$$(17) \qquad (1+n)(p_{t+1} - p_t) = \frac{1}{n}\left((n+1)\left[(p_t - p_{t-1}) + \ldots + (p_{t-n+1} - p_{t-n})\right]\right) + \alpha q_t$$

$$(18) \qquad p_{t+1} - p_t = \frac{1}{n}(p_t - p_{t-n}) + \frac{\alpha}{n+1} q_t$$

which, with (1) and (2), results in workable solutions for p_t and q_t

$$(19) \qquad q_t = \frac{(\beta_2 - n\beta_1)p_t - \beta_2 p_{t-n} + n\beta_1 m_t + n\varepsilon_t}{n - \beta_2\alpha(\frac{n}{n-1})}$$

$$(20) \qquad p_t = (1 + \frac{1}{n} + \frac{\frac{\alpha}{n}(\beta_2 - n\beta_1)}{n+1-\beta_2\alpha})p_{t-1} - \frac{1}{n - \beta_2\alpha(\frac{n}{n+1})} p_{t-1-n} + \frac{\alpha\beta_1}{n+1-\beta_2\alpha} m_{t-1}$$

$$+ \frac{\alpha}{n+1-\beta_2\alpha} \varepsilon_{t-1}$$

In this framework, increases in the contract period - n+1 - can be interpreted as increases in price persistence. Increases in the labor-market conditions coefficient - increases in α - can be interpreted as increases in short-run aggregate price flexibility. Because the model is designed to highlight the effects of inflation on output, it has no role for discretionary fiscal policy and no source of shocks other than ε_t, the shock to aggregate demand. We take monetary policy to be completely non-accomodative: m_t is equal to its trend value (zero) always. This rules out the possibility that the driving force behind economic instability is inappropriate government policy (a bad monetary reaction function) rather than

the internal dynamics of the model itself. We wish to use this model to show only that the conventional wisdom holding that an increase in nominal rigidities (either in the form of a smaller response of wages to labor market conditions or in the form of a longer contract period - more "persistence) is harmful to macro-economic stability, rests on shaky theoretical foundations.

We assume a white-noise, unit variance generating process for the demand shock ε_t, and simulate the model for various parameter values. Recall that a high value of β_1 implies that either the direct ("liquidity") effect of a decline in real balances is large or that the effect of a decline in real balances on the interest rate is large, that is, that the elasticity of money demand with respect to the interest rate is small. A high value for β_2 implies that the expected inflation effects on aggregate demand are large, due either to real interest effects or redistributions between debtors and creditors. The parameter estimates are chosen to be reasonable. For example, if $\beta_1 = 1.0$, and $\beta_2 = 1.6$, the standard IS-LM Keynesian multiplier is 1.5.[15/] Experimentation with parameter values outside the range displayed frequently resulted in instability but did not alter the qualitative conclusions.

Three conclusions emerge from Table 11 where the variance of output is calculated for various parameter values. First, in many cases the economy is unstable under the assumption that monetary policy is non-accomodative with respect to output shocks. This result parallels that of Tobin (1975). Second, in the cases where stability is attained, the variance of output decreases with increases in the contract length.[16/] When the length of the period over which wages remain fixed increases,

15/Assuming that the constant-interest-rate multiplier is 3.0.
16/Except for cases in which a high adjustment parameter combined with a long contract length leads to negative feedback so strong that it is destabilizing.

Table 11

Output Variance Generated by a Unit-Variance White-Noise Demand Shock

β_1=1.0 β_2=1.6

	Contract Length				
	2	3	4	5	6
α = .25	*	*	*	2.1	1.2
.5	*	*	*	1.5	1.4
1.0	*	*	3.9	2.3	1.9

β_1=1.0 β_2=2.4

	Contract Length				
	2	3	4	5	6
α = .25	*	*	*	14.4	1.4
.5	*	*	*	6.2	1.6
1.0	*	*	*	4.2	2.9

β_1=2.0 β_2-1.0

	Contract Length				
	2	3	4	5	6
α = .25	*	*	1.3	1.1	1.1
.5	*	2.9	1.4	1.3	1.2
1.0	*	*	*	13.1	*

β_1=2.0 β_2=0.5

	Contract Length				
	2	3	4	5	6
α = .25	*	*	1.2	1.1	1.1
.5	*	1.6	1.3	1.2	1.1
1.0	*	*	*	2.4	*

*Model unstable for these parameter values.

the volatility of output declines. This result implies that increasing wage flexibility by reducing the length of the contract period might well worsen macro-economic performance. This inference is strengthened by noting that increasing the length of the contract period increases the likelihood that the economy will be stable at all. Third, increases in the sensitivity of current wages to output have an ambiguous effect on the volatility of output.

These results are entirely attributable to the fact that the real interest rate - and so $E_t p_{t+1}$ - enters into the determination of aggregate demand.

The model considered here is obviously highly stylized. No role is allowed for lagged responses of output or money demand to changes in real interest rates. Deflation has no direct effect on aggregate demand, operating only through its impact on real interest rates. Thus, the distributional effects emphasized by Tobin (1975) are suppressed entirely. Perhaps most importantly, we assume no response of monetary or fiscal policy variables to demand shocks. This exercise hardly proves that price flexibility increased the volatility of economic activity prior to World War II. But it does strongly suggest that deviations of the real interest rates from its general equilibrium value caused by the process of equilibration in product and labor markets, may contribute as much or more to economic instability as deviations in product prices or wages from their static equilibrium values.

It might be objected that our analysis here misses the point since we assume an aggregate supply mechanism which implies that a change in the monetary rule could have a long run effect on output. Such an objection

is made by McCallum (1983) to analyses similar to the one presented here. This objection is miplaced. At one level, the criticism is irrelevant since we do not use our model to consider alternative monetary rules. At a more fundamental level, it ignores the need for economic theory to provide a theory of how prices move to clear markets. As Fisher (1983) and others have eloquently argued it is insufficient to assert that economies will always reach their Walrasian equilibria, without describing how they get there. Some sort of price-adjustment equation like (18) is an indispensible part of any fully articulated economic model.

A macroeconomic view that places stress on the dangerous potential for destabilizing deflation present under a regime of flexible prices can avoid some of the problems that economists have traditionally encountered while trying to analyze the origins of the Great Depression in the U.S. Economists like Temin (1974), who attempt to account for the Great Depression by a decline in exogenous spending induced by falling "animal spirits," have a difficult time explaining why those who make investment decisions suddenly become more pessimistic. Without making reference to the destabilizing effects of deflation, it is also difficult to account for rising real interest rates in the face of an autonomous decline in spending.

Economists like Friedman and Schwartz (1963), who attempt to account for the Great Depression in terms of an inappropriately contractionary monetary policy, have a difficult time accounting for the behavior of the real money supply. As Figure 3 shows, the real money supply actually increased slightly between 1929 and 1933 while output was falling by close to 50 percent. Since aggregate demand should be closely linked to the real money supply, it is hard to see how a monetary impulse could have

Figure 3

Percent Deviation of the Real Money Supply
(M1) from Its Average 1926-1929 Value

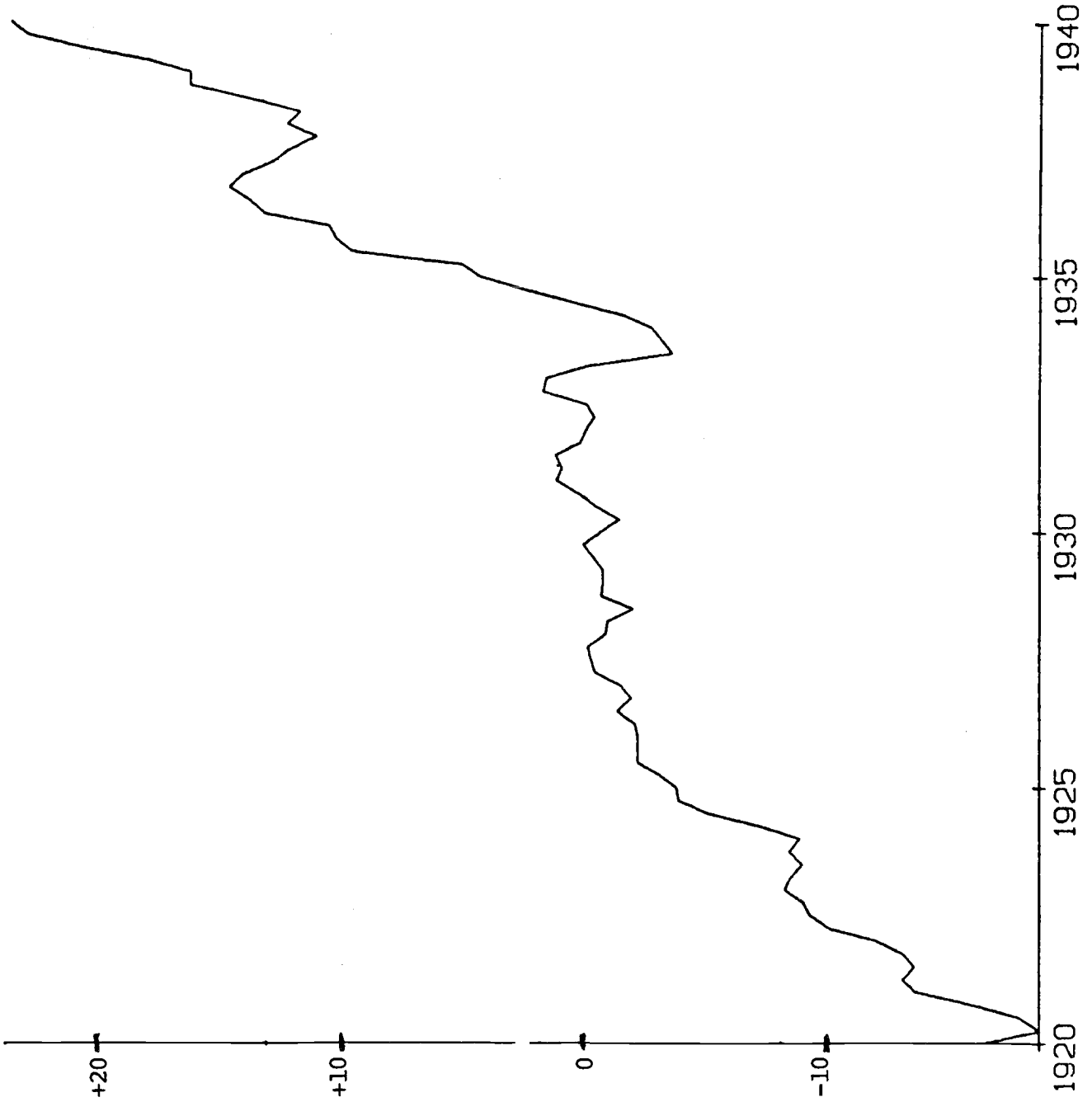
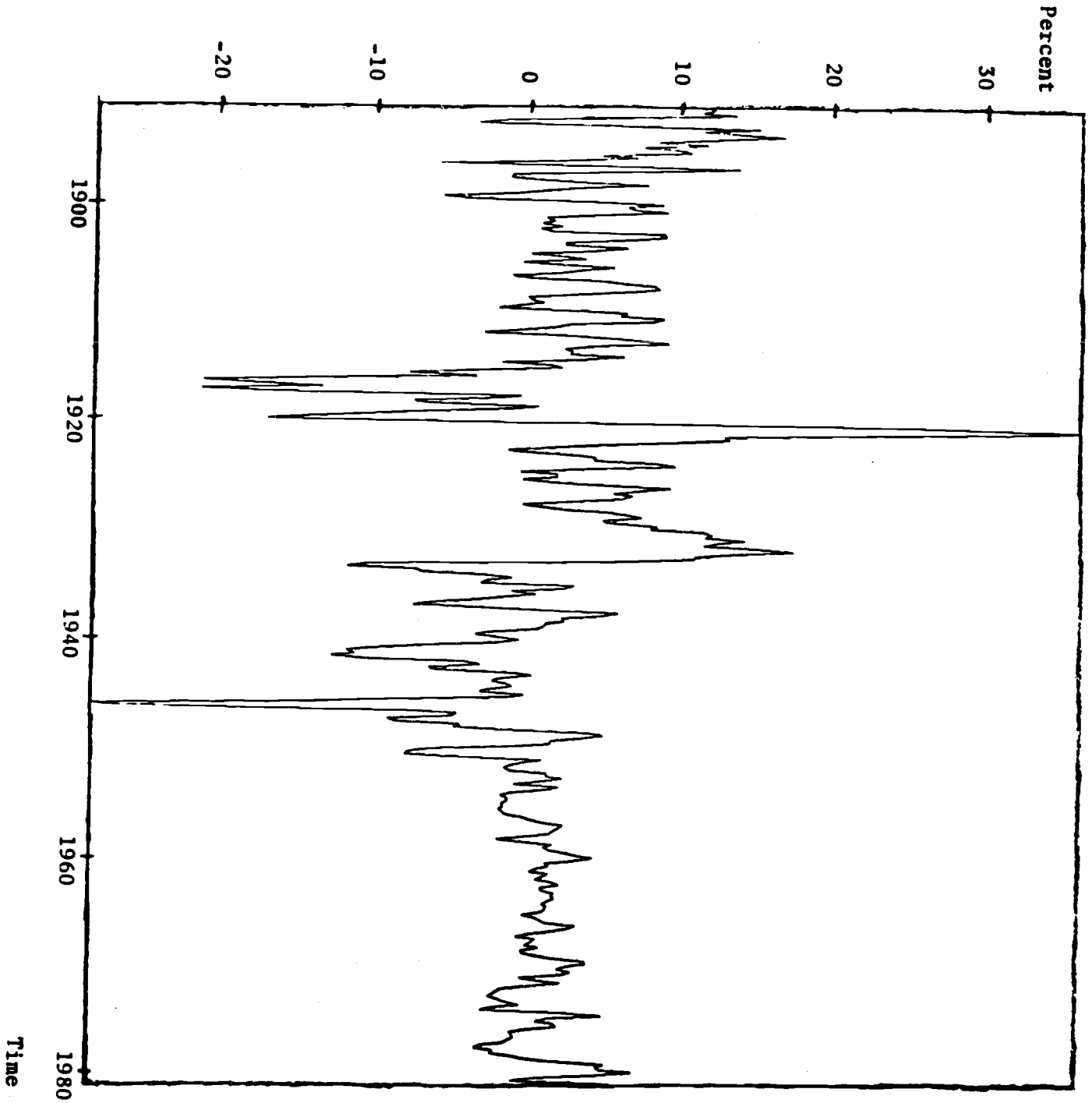


Figure 4

Ex-Post Short-Term Real
Interest Rates



a monetary impulse could have caused the Depression without ever reducing real money balances. Moreover, without making reference to the effects of deflation, it is hard to explain why nominal interest rates fell in the face of a monetary shock.

More generally evidence for the view that increased price flexibility is destabilizing comes from an examination of the changing behavior of real interest rates plotted in Figure 4. The standard deviation of ex-post real rates on an annual basis was 3.10 percent in the 1893-1915 interval, compared to .57 percent in the 1949-1970 interval and 1.37 percent in the 1971-1982 interval.[17/] Before 1979, the highest real interest rate observed on a quarterly basis was 6 percent in 1974, and in only five quarters in the pre-1979 post-World War II period were real rates greater than 4 percent observed. On the other hand, real rates greater than 6 percent occurred in every single reference-cycle recession (except 1903-04) during the pre-World War I period. It seems clear that these variations in real rates should have contributed greatly to economic instability.

17/The behavior of real rats since 1979 is, in the context of the rest of the post-World War II period, anomalous. A glance at recent real rates seems to suggest that American economic policymakers are attempting to restore the pattern of real rates characteristic of the 1890s.

IV. IS AGGREGATE PRICE FLEXIBILITY DISTABILIZING?

In section III we argued that in the standard aggregate demand-aggregate supply framework there are no strong theoretical reasons for believing that a small increase in aggregate price flexibility - defined either as an increase in the responsiveness of wages to labor market conditions or as a decrease in "persistence" - would reduce the variance of output. We also expressed our suspicion that, in the United States, the relationship between price and output flexibility goes the other way from that typically assumed. We suggested that some of the relative macro-economic good fortune of the United States since World War II can be traced to the possibility that a flatter short run aggregate supply curve dampens fluctuations in the real interest rate and so dampens fluctuations in output.

We put forth this potential explanation because the other mechanisms that we have identified cannot account for all of the decline in the variability of output from the pre- to the post-War period. The rising share of government expenditures can account for a small fraction of the decline in variance, and the smoothing of purchases of consumer non-durables and services as a result of automatic stabilizers and commercial credit can account for a significant portion. But there remains a substantial decline in the relative variance of "long-term" expenditures - construction, business investment, and consumer durable purchases - that is documented in Robert Gordon and John Veitch's paper in this volume. The standard explanation is that this decline in the variability of "long-term" expenditures is due to the expectation of successful stabilization policy. But, since we cannot find the traces in other economic variables that we

expected to find if this were indeed the correct explanation, we believe that the decline in the variance of "long-term" expenditures needs further explanation. And since "long-term" expenditures are, in theory, very much dependent on the real interest rate, we advance the hypothesis that the primary channel through which price flexibility affects macro-economic performance is through the instability induced by aggregate price flexibility in the real interest rate.

John Taylor's Analysis

John Taylor in his contribution to this volume reaches exactly the opposite conclusion, finding that improved macro-economic performance has taken place in spite of rather than because of the increased rigidity of wages and prices in the post-war period. Our explanation has the virtue of parsimony. We attribute the major change in economic performance to the major change in economic structure rather than telling a complex story involving offsetting effects. Moreover Taylor provides no explanation of the forces that have accounted for the huge decline in the variance of aggregate demand shocks which he claims took place. As we shall argue below Taylor's theory that monetary policy has become less accomodative over time also seems implausible. Taylor rests his conclusions on bivariate time series analysis of prices and output. We begin by showing that his conclusions can be reproduced in a model where increased price flexibility increases macro-economic instability and then turn to other aspects of his argument.

Begin with an aggregate demand curve similar to that in section III:

(22) $$q_{t+1} = \beta_1(m_t - p_t) + \beta_2(E_t p_{t+1} - p_t) + \varepsilon_t$$

and assume perfect foresight for investors:

(23) $$E_t p_{t+1} = p_{t+1}$$

Equation (1) contains q_{t+1} in order to make the timing come out right: think of firms placing orders for investment goods this period, orders which do not show up in output until next period.

For simplicity, specify a simpler aggregate supply equation than in section II;

(24) $$p_{t+1} - p_t = p_t - p_{t-1} + \alpha q_{t+1}$$

The inflation rate accelerates or declerates depending on the output gap. This aggregate supply equation is the simplest that is both "superneutral" and exhibits "persistence."

In order to close the model, a money supply rule is needed. The simple assumption of section II, the assumption of no movement in the money stock at all, will not be a satisfactory underpinning for empirical analysis. We assume:

(24) $$m_t = (1-\lambda)p_t + \lambda p_{t-1}.$$

The money stock accomodates to the price level partially within the period and fully after two periods. A value of one for λ would imply no accomodation within the period; a value of zero would imply complete accomodation within the period.

Denoting $p_t - p_{t-1}$ by $\dot{p}_t$, solving the model produces:

(25) $$\dot{p}_t = \frac{1-\alpha\lambda\beta_1}{1-\alpha\beta_2}\dot{p}_{t-1} + \frac{\alpha}{1-\alpha\beta_2}\varepsilon_t$$

$$(26) \qquad q_t = \frac{\beta_2 - \lambda\beta_1}{1-\alpha\beta_2}\,\dot{p}_{t-1} + \frac{1}{1-\alpha\beta_2}\,\varepsilon_{t-1}$$

Stability requires that:

$$(27) \qquad \lambda > \beta_2/\beta_1$$

$$(28) \qquad \alpha < \frac{2}{\beta_2+\lambda\beta_1}$$

If ε_t follows a white-noise process with unit variance, then solving for the inverse of the variance of output leads to the equation:

$$(29) \qquad \frac{1}{\sigma_q^2} = 1 - \left(\frac{3}{2}\,\beta_2 + \frac{1}{2}\,\beta_1\lambda\right)\alpha + \left(\frac{\beta_2^2}{2} + \frac{\beta_1\beta_{2\lambda}}{2}\right)\alpha^2$$

Therefore further increases in the price flexibility parameter α are destabilizing, <u>increase</u> the variance of output, so long as

$$(30) \qquad \alpha < \frac{1}{2\beta_2} + \frac{1}{\beta_2+\beta_1\lambda}$$

But (27) and (28) imply that α must satisfy (30). In this model, the variance of output is least when α equals zero, when there is no flexibility at all in the aggregate price level.

And yet empirical analysis of a system generated by (1) through (4) would produce results that might mimic quite closely those obtained by Taylor for the post-War period. If the economist knew the timing of the aggregate supply equation she might be able to recover it exactly:

$$31) \qquad \dot{p}_t = \dot{p}_{t-1} + \alpha q_t$$

And if she attempted to estimate a combined aggregate demand-monetary reaction function equation, she would come up with:

$$(32) \qquad q_t - q_{t-1} = \left(- \frac{\lambda\beta_1 - \beta_2}{1-\alpha\beta_2} - \frac{1}{\alpha} \right) \dot{p}_{t-1} + \left(\frac{\lambda\beta_1 - \beta_2}{1-\alpha\beta_2} + \frac{1-\alpha\lambda\beta_1}{\alpha(1-\alpha\beta_2)} \right) \dot{p}_{t-2}$$

where $\lambda\beta_1 - \beta_2$, $1-\alpha\beta_2$, and $1-\alpha\lambda\beta_1$, are all positive.

These coefficients are too large to be taken seriously. However, their size (but not their sign) is clearly an artifact of the model. The coefficients on $\dot{p}_{t-1}$ and $\dot{p}_{t-2}$ are highly correlated, and the introduction of a supply shock or of serial correlation in the demand shock would quickly bring them down to more reasonable values - their large size in (32) is due to the fact that the difference between $\dot{p}_{t-1}$ and $\dot{p}_{t-2}$ carries lots of information about ε_{t-1} . It is interesting to note that (31) and (32) might be rewritten as:

$$(33) \qquad \dot{p}_t = \dot{p}_{t-1} + \alpha q_t$$

$$(34) \qquad q_t - q_{t-1} = -\pi_1 \dot{p}_{t-1} + \pi_2 \dot{p}_{t-2} + u_t$$

which bear a close resemblance to Taylor's (5) and (7):

$$(35) \qquad \dot{p}_t = .88\dot{p}_{t-1} + .25q_t$$

$$(36) \qquad q_t - q_{t-1} = -1.03\dot{p}_{t-1} + .73\dot{p}_{t-2}$$

Therefore we conclude that Taylor's empirical findings are neither evidence for nor evidence against the hypothesis that an increase in persistence has led to an increase in stability. By assuming that the size of the shocks is independent of the structure of the model, he can reach one conclusion. By specifying a different underlying model - one that stresses the role of variations in the real interest rate in producing variations

in the real interest rate in producing variations in output - the opposite conclusions emerge.[18/]

It is a striking feature of Taylor's structural analysis that in explaining the changes in cyclical patterns between the World War I period and the present one, he finds that all the structural parameters in his model change. Particularly surprising are his conclusions about monetary policy. He finds that it has become less accommodative under the current fiat money regime than it was under the earlier gold standard. He attributes the looseness of short run monetary policy under the gold standard to the effects of foreign price shocks which should have led to specie inflows. There are at least two important flaws in this argument. First, it is implausible that, at a time when imports represented only about six percent of GNP, foreign price shocks were the principal source of inflation shocks, especially using the GNP deflator to measure prices. Second, analyses of the gold standard surveyed in Bordo and Schwartz (1984), have made it clear that short-run specie flows in response to price shocks were negligible during the gold standard period. There thus seems to be little evidence for the monetary policy assumptions necessary to drive Taylor's conclusions.

Reduced Form Evidence: Theory

In this sub-section we present some empirical evidence to back the hypothesis that price rigidity has contributed to macro-economic stability. We had hoped to estimate a simple structural model, and thus to test whether the data supported our hypothesis by testing whether the parameters

18/Taylor's finding that output is a decreasing function of past inflation is not evidence that the positive effect - through the real interest rate - of inflation on output is small. For Taylor's negative coefficient is for an equation that is itself not structural, that is a combination of the aggregate demand equation and the monetary policy reaction function.

of the structural model fell in a region in which aggregate price flexibility was destabilizing on the margin. But we are unable to do so. Attempts at estimation repeatedly failed to converge or converged to unstable parameter values. We appear to have been unable to nest our hypothesis in a structural model which is both tractable, in the sense of being simple enough for us to gain some analytic understanding of its properties, and believable, in the sense of not being rejected out of hand by the data.

Since the restrictions we found necessary to formulate a model that we could understand and interpret served also to destroy the fit of the model with the data, we shifted to non-structural estimation. The current practice among economists seeking to draw conclusions that are not highly sensitive to minor changes in the underlying model is to use vector autoregressions and to plot the resulting impulse response functions. In such an analysis, a positive response of output to an inflation shock might be taken as evidence in favor of our approach.

We have run analyses along these lines, but find problems in interpreting the impulse response functions as evidence for any position since we have no good idea what an "inflation shock" is, what actual economic processes it represents. Therefore we also present (quasi-) reduced forms for output, and argue that the pattern of coefficients that emerges is hard to justify with any underlying theoretical model other than our hypothesis.

According to the mainstream Keynesian macro-economic approaches, the primary determinants of output are three: lagged output, (lagged) real money balances - operating through wealth and liquidity effects - and the nominal interest rate. Lower real money balances choke off aggregate demand in general, and higher nominal interest rates reduce

the demand for investment goods in particular. Whether one believes that real balances are only a passive indicator of nominal interest rates, credit conditions, and animal spirits; or that interest rates are only an index of the underlying determinant, real balances; it remains true that output should be, in any kind of reduced form, a positive function of (present and) lagged real balances and a negative function of (present and) lagged interest rates.

Implicit in the mainstream view is a "Keynesian" picture of price adjustment. Changes in real balances or nominal interest rates cause disturbances in aggregate demand. Because in the aggregate quantity adjusts more quickly than price, the changes in the movement of the price level associated with changes in real balances and in interest rates show up - in the time period relevant to the study of business cycles - only after the movement in output. In the mainstream view, the price level responds to its own lagged values and to the level of nominal demand. The mainstream view cannot account for a significant positive link running from prices to output without abandoning the "Keynesian" interpretation of the relative speeds of price and quantity adjustment that is its foundation. There is one set of events which, according to the mainstream view, should generate a correlation between present price movements and future output. This is the case of the "supply shock," in which present jumps in prices are associated with declines in future output. But this produces a correlation with the opposite sign from that expected according to a real interest rate centered theory.

The explanation for output fluctuations usually given by classical economists follows these lines: some agents (workers, not firms) misperceive relative prices. They believe that the real wage is higher

(or lower) than it really is and so work more (or less) than is optimal. If there are intermediate goods in the production process, it is possible to claim that output depends on both the degree of relative price misperception and on lagged production of intermediate goods, on lagged output. This line of thought produces a Lucas aggregate supply function:

$$(37) \qquad q_t = \alpha_1(p_t - E_{t-1}p_t) + \alpha_2 q_{t-1}$$

Note that the new classical approach predicts that, in a reduced form of output on lagged output, present and lagged prices, and other variables, the only variables that can enter with positive coefficients are lagged output. Lagged prices are useless as predictors of $p_t - E_{t-1}p_t$, and should, in the new classical framework, not enter into the reduced form at all.[19/] Therefore we conclude that a significant positive effect of lagged prices on present output is a phenomenon that fits easily into neither the mainstream nor the new classical view of the macroeconomy. And we believe that the existence of such a positive effect is evidence in favor of an older view of business cycles, a view that places special stress on the role of the real interest rate.

With these theoretical observations in mind, we estimated vector auto-regressions for a variety of periods and specifications on quarterly data taken from Gordon (1982a) and annual data taken from Friedman and Schwartz (1983). The results provide some evidence in favor of our hypothesis. A price innovation has, looking at the impulse response functions, a positive effect on future output. And, in the reduced form for output, lagged price enters with a generally positive coefficient.

19/According to the new classical view of things, shocks have persistent effects even though lagged prices are not in the equation for q_t. Past prices affect past output, and past output enters the equation that determines present output.

We find this significant. According to the view that places stress on the importance of nominal rigidities in causing business cycles, price innovations have to (when nominal balances are held constant) have a negative effect on future output. Deflation should raise the real money stock and thus increase output. But the equations indicate, in support of our more dynamic view, that deflation may itself lower output.

Reduced Form Evidence: Empirical Results

The first set of vector autoregressions estimates the following three equation system:

$$\begin{bmatrix} \dot{p} \\ q \\ i \end{bmatrix} = \begin{bmatrix} 0 & \alpha_{012} & \alpha_{013} \\ 0 & 0 & \alpha_{023} \\ 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} \dot{p} \\ q \\ i \end{bmatrix} + A(L) \begin{bmatrix} \dot{p} \\ q \\ i \end{bmatrix} + \begin{bmatrix} \varepsilon_{\dot{p}} \\ \varepsilon_{q} \\ \varepsilon_{i} \end{bmatrix}$$

where A(L) is a 3 x 3 matrix polynomial of order five in the lag operator. The variables in this autoregression are

q - the output ratio, real GNP/natural real GNP

$\dot{p}$ - the quarter-to-quarter inflation rate

i - the commercial paper rate.

All data are taken from Gordon (1982a).

Note that the arrangement of the variables in the VAR is such as to minimize the potential impact of any innovation in p. Only that part of

$$\dot{p}_t - E_{t-1}\dot{p}_t$$

which is uncorrelated with $q_t - E_{t-1}q_t$ and $i_t - E_{t-1}i_t$ will be counted as an inflation innovation. Thus the risk that our interpretation of the results is in error, that the VAR is reading correlations between $\dot{p}$ and q that are really driven by causal links from q to $\dot{p}$ and from lagged q to q as evidence in favor of our hypothesis, is minimized.

The VAR was initially estimated for time periods 1893:1-1915-4, 1923:1-1940-4, and 1949:1-1982-4. This particular three-variable system was chosen because there is no quarterly data on the money stock available before 1907. Thus, there are not enough data to estimate a VAR including the money stock for any pre-World War I period. We are reluctant to base any arguments on a comparison of the post-World War II period with the interwar period alone. The Great Depression represents an extraordinary cumulation of shocks and so is probably not well studied using the VAR methodology.

An objection to estimating this particular system might be made along the following lines: the choice of variables - output, inflation, and interest rates - implies that the effects attributed to the inflation variable are only the effects of movements in accomodated inflation. Unaccomodated movements in inflation will, because the interest rate is an index of the real money stock, also appear as movements in interest rates. And so some of the depressing effect of price rises on output will appear as an effect of interest rate movements on output.

Two facts militate against this argument. First, it implies that the contemporaneous correlation between inflation and interest rates should be positive, that α_{013} should be greater than zero. Instead, α_{013} is less than zero (although not significantly so).

Second, the equations were also estimated for the four equation system consisting of inflation, the commercial paper rate, the output ratio, and the detrended nominal money stock. The variables were so ordered as to give the maximum potential scope to the monetary innovation, the second place to the output innovation, the third place to the

interest rate innovation, and the least potential scope to the inflation innovation.

Quasi reduced form equations for output are shown in Table 12. Impulse responses of output to an inflation innovation are plotted in Figures 5 and 6.

We note two things from these empirical results. First, this methodology is not suited to the interwar period. The interwar period is so strongly dominated by the Great Depression that all correlations are warped: the decline of the nominal interest rate during the onset of the Depression is the only variable the model can latch onto to account for the depression, hence the excessively large difference in the coefficients on the first and second lag of the interest rate. If one turns back to Figure 2, this should come as no surprise. The Great Depression was a unique event, and attempts to analyze the entire interwar period are, in essence, attempts to generalize from a sample of one.

Second, both the coefficients on lagged inflation in the output equation and the impulse responses of output to an inflation shock are positive and, in general, significant at at least the .90 level. This correlation is not easy to explain within either the new classical framework or the mainstream framework. The hypothesis urged here with its emphasis on real interest rate effects does provide a natural explanation.

This belief is bolstered by additional equations run (but not reported). For various combinations of interest rates, inflation rates, output ratios, real and nominal money stocks, the only equation which failed to generate a positive correlation between inflation innovations and future output and positive terms on lagged prices in the output equation was a VAR which included no interest rate variable - only the

Table 12

Quasi-Reduced Form Equations for Output

			Interest Rate				Inflation Rate				Lagged Output				Nominal Money			
Period	R^2	SEE	cont.	-1	-2	s(5)	cont.	-1	-2	s(5)	cont.	-1	-2	s(5)	cont.	-1	-2	s(5)
1893-1915	.63	.038	-.06	-1.5	.87	-2.6	--	.44	-.27	.32	--	.89	.12	.75	--	--	--	--
			(.65)	(.76)	(.80)	(.99)		(.34)	(.27)	(.70)		(.12)	(.16)	(.15)				
1923-1940	.95	.039	.05	2.22	-2.35	-.07	--	.53	-.47	.92	--	.93	.03	.96	--	--	--	--
			(.46)	(2.38)	(2.53)	(1.37)		(.46)	(.49)	(.59)		(.14)	(.18)	(.06)				
1949-1982	.94	.008	.19	-.23	-.30	-.27	--	.31	-.02	.21	--	1.10	-.01	.93	--	--	--	--
			(.10)	(.15)	(.16)	(.11)		(.14)	(.14)	(.19)		(.09)	(.14)	(.03)				
1923-1940	.96	.034	--	3.43	-3.24	1.32	--	.22	-.64	-.48	--	.83	-.06	.83	.90	1.33	-.16	.97
				(1.52)	(2.50)	(.74)		(.43)	(.45)	(.66)		(.15)	(.19)	(.10)	(.27)	(.18)	(.33)	(.03)
1949-1982	.95	.008		-.09	-.34	-.09	--	.33	.00	.15	--	1.23	-.15	.96	-.01	.02	.04	.90
				(.10)	(.14)	(.04)		(.14)	(.15)	(.18)		(.09)	(.13)	(.03)	(.02)	(.05)	(.03)	(.03)

Note: Cont.: contemporaneous coefficient of variable
s(5): sum of coefficients on five lags.

Data from Gordon (1982a).

Figure 5

Output Response to Inflation Innovations
Three Variable System.
1949-1982, 1923-1940, 1893-1915

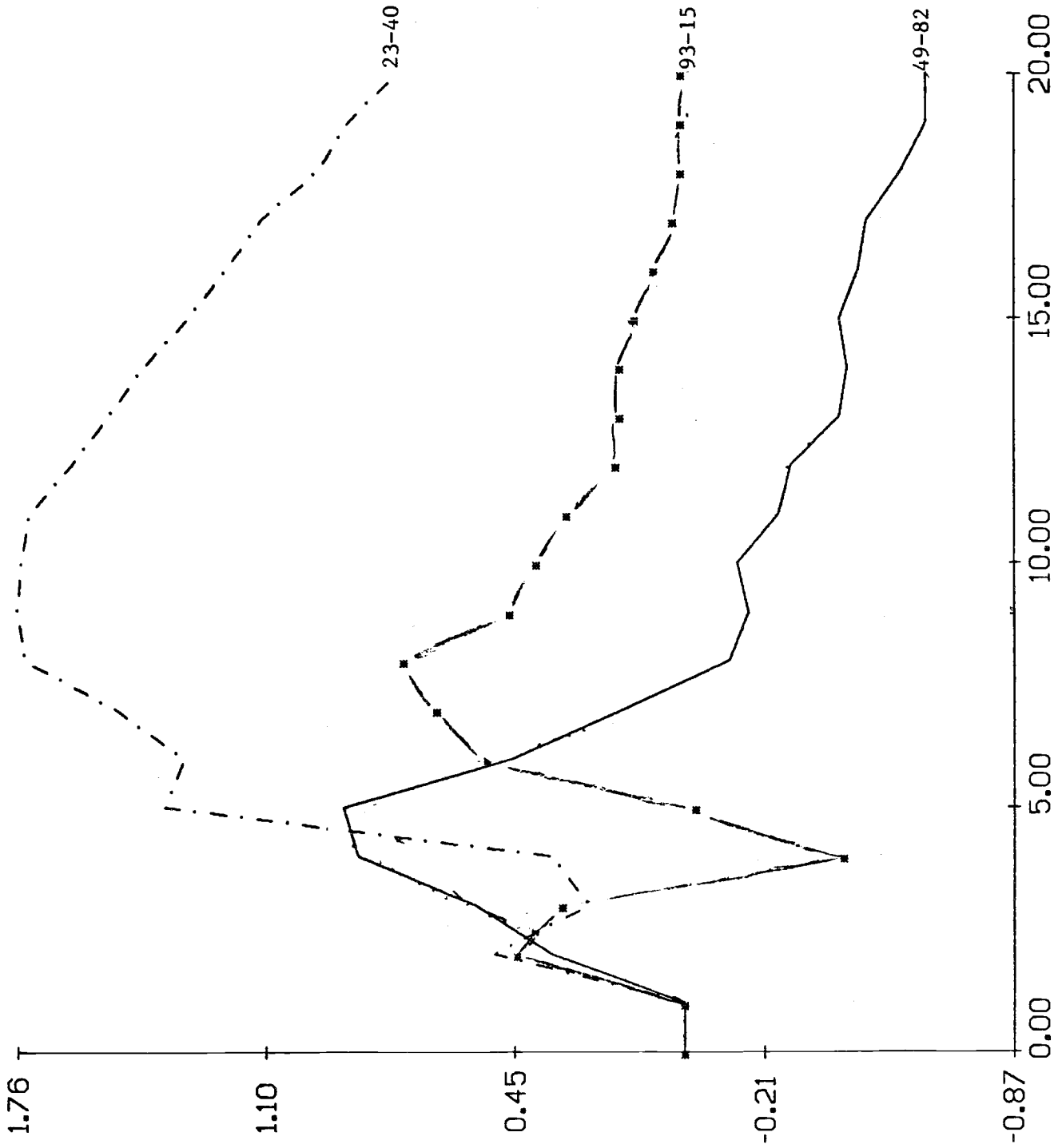
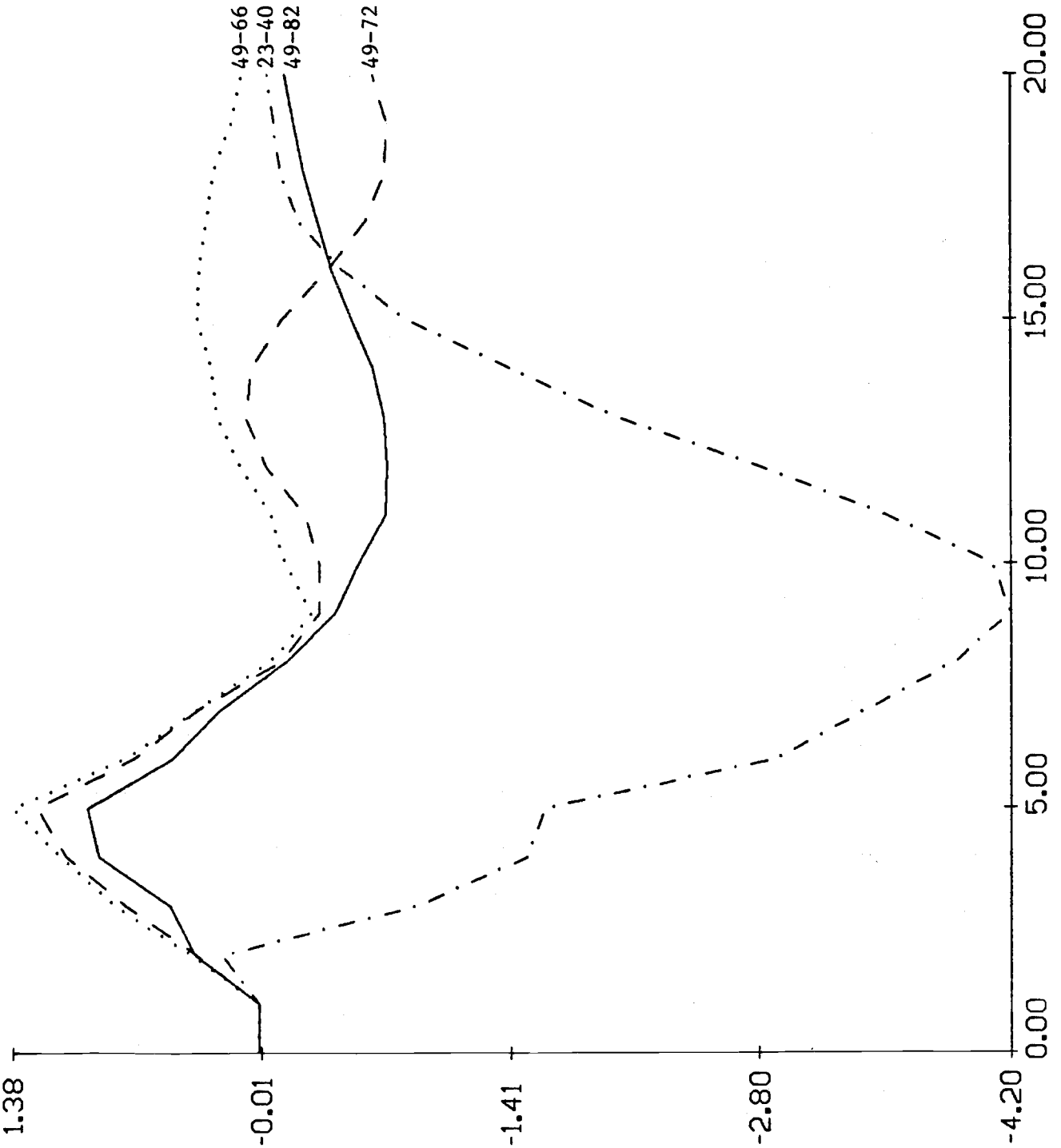


Figure 6

Output Response to Inflation Innovations
Four Variable System.
1949-1982, 1949-1972, 1923-1940



output ratio, inflation, and the nominal money stock. Furthermore, the effect of lagged inflation innovations on output is significantly greater for the four-variable system for those two post-World War II periods which do not include the supply-shock ridden 1970s. This tends to support of our hypothesis. The 1970s were dominated by supply shocks, by disturbances that first raised $\dot{p}$ and then reduced q. These shifts in the short run aggregate supply schedule should mask the effects we are looking for in the post-World War II period. The fact that these supply shocks do reduce the positive effect for the period 1949:1-1982-4, and that this masking is only partial encourages us to think that we are correctly interpreting our VARs and that the effect of price innovations is, in the United States today, strongly procyclical.

To sum up: an unstructured analysis of the correlations between macro-economic variables carried out by means of VARs produces a finding - inflation innovations have a positive effect on future output - that is hard to interpret from either an equilibrium business cycle or a nominal rigidities perspective. We cannot think of other convincing reasons for this association besides the one we advocate: changes in the aggregate price level produce changes in the real cost of capital which have effects on the level of expenditures on items that have a high interest elasticity of present value. Thus deflation at the beginning of a recession would deepen the recession by causing a further cutback in investment. This correlation suggests reducing nominal price rigidity would not diminish the seriousness of business cycles.

V. CONCLUSIONS

This paper began by suggesting that the large change in the variance of output between the pre- and post-War periods was a fact that should be explicicable within a satisfactory business cycle theory. We then argued that a number of factors frequently alleged to have led to greater stability including structural changes in the economy, discretionary stabilization policy and the avoidance of financial panics, probably contributed relatively little to enhanced stability. We conclude that the two principal factors promoting economic stability have been greater public and private efforts to smooth consumption and the increasing rigidity of prices. We attribute the latter development to the increasing institutionalization of the economy.

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