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PRICE FLEXIBILITY, CREDIT RATIONING, AND ECONOMIC FLUCTUATIONS: EVIDENCE FROM THE U.S., 1879-1914

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ABSTRACT

The reawakening of interest in links between price flexibility and fluctuations in economic activity calls for a reconsideration of models of price and quantity adjustment. We examine relationships between credit disturbances and real activity under flexible prices, using monthly data on real and financial variables over the period from 1879-1914.

Recent theoretical and empirical work has focused on models and institutions of the post World War II period. Historical episodes of pronounced business cycles, however, challenge our present formulations of the causes of fluctuations in output and employment. In this paper we pursue two goals: (i) to demonstrate that substantial price flexibility existed during the period to point out that models of economic fluctuations relying on sticky prices are not appropriate for analyzing the period, and (ii) to consider the effects of deflationary shocks on real variables in such a world. Our principal findings are two. First, we present evidence from several empirical tests to corroborate the stylized fact of price flexibility during our period of study (relative to patterns of flexibility observed in postwar data). Contrary to conclusions of many models applied to postwar data, we find that shocks to inflation rates produce positive and persistent effects on output. Second, extending earlier examinations of credit rationing as an outcome under imperfect information, we motivate this link by considering the impact of deflation on credit availability. The addition of measures of credit rationing accompanying deflation contributes substantially to our empirical explanation of output fluctuations during the period.

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I. INTRODUCTION

Much of modern macroeconomics grapples with the implications for policy of how markets clear. Indeed, the adjustment of prices and quantities lies at the heart of analyses of business cycles and the effectiveness of stabilization policies.[1] Variations in cyclical patterns provide a natural focus for economic analysis, because of their importance for understanding how public policy and the organization of markets -- for labor, products, and credit -- figure in explanations of business cycles.[2] In this paper, we examine the importance of price flexibility and credit availability in explaining cyclical fluctuations.

In a textbook, "perfect-markets" model of aggregate price and quantity adjustment, inertial price adjustment must lead to market clearing through greater movements in output in response to demand shocks. Institutional motivations for increasing wage and price rigidity during this century have been discussed by Okun (1981), and Sachs (1980) has provided empirical evidence of a trend toward sticky wages and prices. Institutional changes notwithstanding, some observations about the business cycle remain surprisingly robust over time. Gordon (1980) and James (1985) find a consistent Phillips-curve pattern of association between prices and output for the U.S. in the nineteenth and twentieth centuries. The robustness of the Phillips curve to changes in the product mix, structure of markets, and degree of price stickiness presents a puzzle for those who interpret the Phillips curve as a measure of price rigidity.

The emphasis on price flexibility is particularly important for analyzing these effects of the organization of markets on fluctuations in economic activity. Recent theoretical and empirical work has focused

primarily on models and institutions of the post World War II period. Quantity fluctuations are amplified by price rigidity stemming from institutional or contractual arrangements in labor and product markets. Alternatively, confusion related to government policy uncertainty produces departures from desired outcomes. Historical episodes of pronounced business cycles in the U. S. and Europe challenge our present formulation of the causes of fluctuations in output and employment. Indeed, little attention has been directed toward explaining the existence of business cycles in an environment where prices are flexible and where policy uncertainty is not important.

Understanding cyclical fluctuations in a regime of flexible prices may contribute substantially to our understanding of the modern economy.[3] It is often asserted, for example, that greater price flexibility would reduce the economic costs of adverse aggregate demand and supply shocks, or of disinflationary monetary policy. Any positive link between price flexibility and output fluctuations raises questions about the supposed stabilizing effect of wage and price flexibility. Keynes (1936) himself discussed aspects of this channel, emphasizing the likely increase in real interest rates accompanying wage deflation.

In particular, we argue that such flexibility can have adverse effects on macroeconomic performance through constraints on the availability of credit in the presence of nominal contracting in financial markets. In section II, we examine links between price flexibility and credit rationing within the imperfect-information models suggested by Stiglitz and Weiss (1981) and others. Our principal findings there are two — that (i) price flexibility makes worse the potential rationing of credit to "information-intensive" borrowers noted

by Stiglitz and Weiss, and (ii) the coexistence of Walrasian "full-information" credit markets and "information-intensive" bank credit markets complicates the definition of a sufficient statistic for credit scarcity (i.e., "'the' interest rate" is not enough) and sharpens credit rationing to information-intensive borrowers when the supply of funds to that market is reduced.

We test these hypotheses and the potential real effects of bank credit rationing in section III. Throughout the paper, we use vector autoregressions (VARs) to focus on short-run dynamics of inflation, output, and credit-market variables. We need, of course, a period in which prices are flexible, and we constructed a monthly data base on real and financial variables covering the period from 1879 to 1914 (see the detailed description in the Appendix).[4] The period from the late nineteenth century to the creation of the Federal Reserve System provides an excellent laboratory for testing alternative models of price adjustment, financial-market equilibrium, and economic fluctuations. Fluctuations in output were pronounced in the last half of the nineteenth century and the early years of the twentieth century, with much greater variability of output than in the extensively studied modern period (see Sachs, 1980; Gordon, 1980; DeLong and Summers, 1984; Taylor, 1984; James, 1985).[5]

We demonstrate that substantial price flexibility existed during the period, to point out that models of economic fluctuations relying on sticky prices are not appropriate for analyzing the period. Contrary to the conclusions of many models applied to postwar data, we find that shocks to inflation rates produce positive and persistent effects on output. The finding of a negative effect of deflationary shocks on

output, consistent with the recent results of Delong and Summers (1984), suggests the importance of isolating structural channels.

We motivate this link by considering the impact of deflation on credit availability. The special role of banks in financial intermediation for information-intensive credit can create real effects of bank credit rationing. We do not argue for a strict "banking panic" view of credit rationing (see also the arguments of Cagan, 1965; DeLong and Summers, 1984; and Bordo, 1985);[6] we explore local changes in credit under a regime of flexible prices rather than extreme cases associated only with systematic collapse. Specifically, we focus on the potential real effects of deflation and credit rationing, given imperfect information in credit markets.

We find strong support for the importance of credit rationing and its links to deflation. Output fluctuations are predicted by a set of credit-market indicators. Deflationary shocks in our VARs provide additional evidence, with negative effects on loans and output, and a positive effect on interest rates in "price-clearing" credit markets.

It is important to note that these arguments are made against a background of a passive monetary policy. The active presence of a lender of last resort might forestall much of the credit rationing and illiquidity accompanying deflation in our model.[7] We abstract from the role of a central bank for two reasons. Conceptually, we want to illustrate the role of market failures in credit markets in explaining the **potential** destabilizing effects of flexible prices. In addition, we argue that these effects were present in the period prior to the creation of the Federal Reserve System, the period we study here.

II. PRICE FLEXIBILITY, CREDIT MARKETS, AND ECONOMIC ACTIVITY

Background

Previous discussions of links between banking system instability and output fluctuations during our period of study can be divided into two principal camps with respect to their assumptions about price flexibility. The first--the "monetarist" approach associated with descriptions in Friedman and Schwartz (1963) and Cagan (1965) -- considers "bank panics" important because of their effect on the nominal money stock and hence (if prices are sticky) on real activity. Friedman and Schwartz, and Cagan focus on the decline in public confidence in the banking system attendant to panics, which raised the currency-deposit ratio[8] and the reserve-deposit ratio, and precipitated a decrease in the nominal money supply.

A second school of thought--identified with Fisher (1933), Minsky (1975) and (1977), and Kindleberger (1978)--focuses on price flexibility and "debt deflation" as a link between financial crises and economic activity. Emphasis is placed on an irrational boom and bust cycle, in which upswings encourage excessively sanguine views, "overindebtedness," illiquidity, and eventually banking crises, as deflationary pressures from liquidation raise the real value of nominal debt commitments. Reductions in the price level bring about increases in real interest rates and decreases in net worth and profits. Recovery is brought about when overindebtedness is eliminated or policy stimulus is applied. The cycle then repeats itself.

Neither of these lines of inquiry provides a convincing explanation of the relationships among contractual arrangements (in labor, product, and credit markets), banking panics, and output fluctuations. For

example, against the Fisher-Minsky school, Cagan (1965) finds that U.S. panics did not in general foreshadow cyclical downturns; see also Bordo (1985). Fisher and Minsky do not explain the persistence of irrationality or the precise channels through which the degree of price flexibility in the economy and the way in which banks adjust to shocks are related. The monetarist approach depends on price rigidity to transform nominal shocks into real effects. This liquidity-preference transmission mechanism is, however, difficult to reconcile with the evidence for price flexibility in the nineteenth and early twentieth centuries.[9]

Aside from the problem of reconciling itself with the stylized fact of price flexibility, the monetarist school has been challenged by Fama (1980) and others who point out that, under the Modigliani-Miller theorem, banks are powerless to fix even the nominal supply of money. Of course, a world which includes financial intermediaries suggests _de facto_ the implausibility of the Modigliani-Miller theorem; still the challenge to macroeconomic theory remains identifying which assumptions necessary to the Modigliani-Miller theorem are violated in practice. If, as many recent authors suggest (e.g., Stiglitz and Weiss, 1981; Bernanke, 1983), banks are information-intensive financial intermediaries involved in costly monitoring in a world of asymmetric information, then banks are more than passive mutual funds a la Fama. It follows that their importance is related to the real costs of intermediation and their role as least-cost suppliers of credit, rather than their role as nominal money creators in a world of flexible prices.[10]

DeLong and Summers (1984) challenge the two schools of thought by emphasizing a link between deflation and the real interest rate. That is, to the extent that nominal interest rates are sticky, deflationary shocks would raise real interest rates. If the interest rate examined represents the full-information cost of capital, a decline in aggregate demand should follow. While their argument focuses on the important link between price flexibility and connections between financial-market outcomes and real activity,[11] three qualifications are in order. First, while long-term rates did not respond significantly to inflationary shocks (because of the price-level-reverting characteristic of the gold standard), we present evidence that, ceteris paribus, the sort of short-term rate examined by DeLong and Summers did exhibit a Fisher effect.[12] Second, interpretation of the real-interest-rate effect described by DeLong and Summers is difficult in a world with capital-market imperfections. As we will argue later, movements in commercial paper rates may reflect, inter alia, credit rationing to the banking sector, indicating that the DeLong-Summers reduced-form model may be consistent with several competing hypotheses regarding links between price shocks and economic activity. We present additional evidence in section III to distinguish among these hypotheses. Finally, the notion that sticky nominal interest rates caused changes in real rates seems inconsistent with the historical gold-standard regime in which interest rates across countries responded to one another's changes to preserve a common risk-adjusted real rate (Calomiris and Hubbard, 1985).

Our approach follows Bernanke's (1983) attempt to provide an analytical foundation for the debt-deflation view of financial crises by focusing on the role of price flexibility in linking financial

disturbances and real activity. Under fixed nominal contracting, price flexibility with the possibility of deflation can exacerbate fluctuations in real interest rates and aggregate demand and their persistence.[13] In addition, deflationary pressures can reduce aggregate demand and supply through reductions in bank credit, the erosion of borrowers' collateral and the failure of financial intermediaries as fears of potential debtor insolvency rise. This view, however, does not depend on "financial crises;" it can describe localized movements along credit supply and demand schedules.

Deflation, Bank Credit, and Economic Activity

To motivate our examination of the effects of price flexibility on macroeconomic performance, we begin with the following simple stylized macroeconomic model. Income and prices are expressed in logarithms. Let real aggregate demand be determined according to

$$\Delta y_t = \beta_0 - \beta_1(i_t - (E_t p_{t+1} - p_t)) - \beta_2 \psi_t + \varepsilon_{yt}, \ \beta_1, \beta_2 > 0,$$

where p and i denote the (log of the) price level and the nominal cost of funds under full information, respectively. $E_t p_{t+1}$ denotes the expectation at time t of the price level during period t + 1. The first term represents the standard negative impact of higher real interest rates on aggregate demand (through, say, the interest sensitivity of business investment and spending on consumer durables).

In the simplest possible model, no information problems exist, and the competitive equilibrium in a Walrasian credit market involves clearing through "price." Firms borrow to finance projects until the

marginal return on new projects no longer exceeds the cost of borrowed funds in the market. That is, $i_t - (E_t p_{t+1} - p_t)$ is an accurate proxy for the scarcity of credit. If, however, capital markets operate under imperfect information, then banks and other intermediaries may play a special role; that is, they may enjoy an advantage relative to potential or actual centralized securities markets in certain forms of intermediation due, for instance, to differences in information cost. Thus, variables which proxy for rationing of real bank credit will be marginally significant as indicators of capital scarcity when bank credit is costly to "produce" and imperfectly substitutable with other methods of intermediation. The presence of ψ in the aggregate-demand equation is designed to capture this "special" role of bank credit.

The observation by Stiglitz and Weiss (1981) that lenders ("banks") cannot necessarily distinguish "good" borrowers from "bad" borrowers implies that adverse selection will render unprofitable a price-only-clearing credit-market equilibrium. That is, with a nonzero probability of default, banks consider the potential for loan repayment as well as the interest rate charged when assessing the profitability of a loan. Past some critical interest rate, banks will be selected against by borrowers with a high probability of default; quantity rationing will be part of a competitive equilibrium in the credit market.

This story is complicated by the fact that many markets for credit exist side by side, differing in quality of borrowers and the terms of loans. These markets effectively sort borrowers along dimensions of "information intensity." Borrowers with significant financial resources and reputations (e.g., the federal government and large, publicly traded corporations) have access to "full-information" Walrasian credit markets

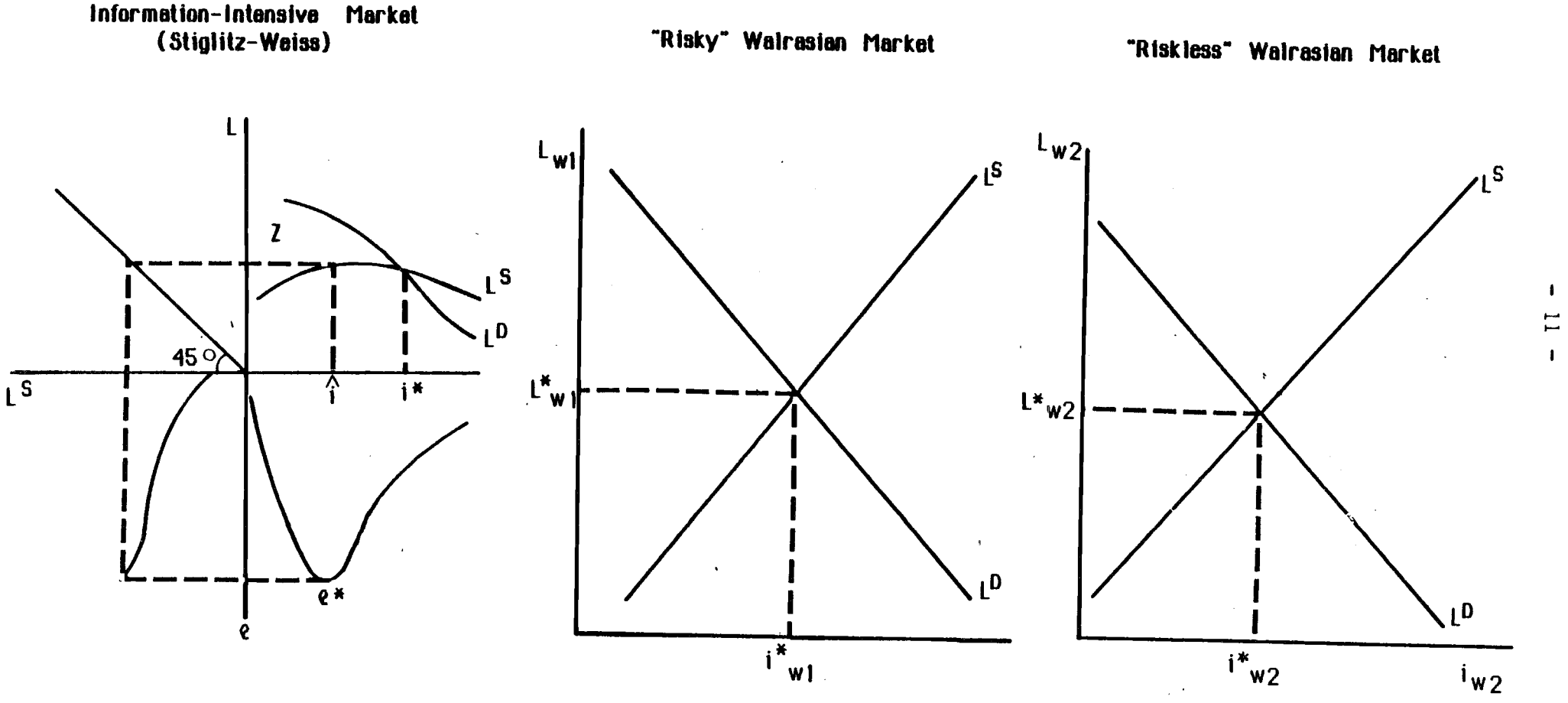
(such as those for commercial paper or for long-term bonds), while information-intensive borrowers (e.g., small businesses and households) require more monitoring and are typical of the transactors in the most basic version of the Stiglitz-Weiss model.[14]

Information-intensive and Walrasian markets exist side by side, with borrowers of the highest quality able to participate in all markets, and so on down to the restriction of borrowers in the lowest class to the confines of the bank market. Borrowers allocate their borrowings according to portfolio considerations, as do suppliers of credit. In the price-clearing markets, we expect the interest rate to decline with the risk class. There is no presumed risk relationship between the bank interest rate and the rates charged in the Walrasian markets.

Suppose for simplicity that one can divide the credit market into three categories: (i) banks (servicing information-intensive borrowers), (ii) a Walrasian market servicing risky full-information borrowers (W_1), and (iii) a Walrasian market servicing full-information borrowers (W_2). The sequential-market-clearing approach outlined above implies that there is no single sufficient statistic to describe credit conditions. To assess real effects of credit rationing, one must look at changes in three components of the "state of the credit market": the full-information risky rate i_{w1}, the quantity of credit provided in the information-intensive sector, and the spread between the risky and safe Walrasian rates ($i_{w1} - i_{w2}$). This last consideration measures the portfolio reallocation effect on the supply side of the credit market (see the related discussion of this point in Bernanke, 1983).

Figure 1

Equilibrium in the Credit Markets



We illustrate our discussion of sequential market clearing in Figure 1. For simplicity, we consider the case of two Walrasian markets, for risky and riskless securities. The first panel represents the market for information-intensive credit per the Stiglitz-Weiss model. In that panel, ρ^* and Z represent the maximum return to banks from making loans and the extent of credit rationing, respectively. i^* and $\hat{i}$ represent the "Walrasian" and "rationed equilibrium" interest rates. Interest rates in the full-information, Walrasian credit markets are determined by the intersection of supply and demand schedules.

The mechanism linking price flexibility and credit rationing can be formalized as follows. First, nominal project returns available for debt service will be riskier in a regime where there is uncertainty over both prices and real project returns. Second, the value of collateral will vary in a regime of flexible prices both because of variation in the price level and because of the likely correlation between project returns and the value of collateral (particularly with "specific" industry capital or farm land).

As in the Stiglitz-Weiss model, let the bank's nominal gross return ρ represent the minimum of the sum of the realized return R and the collateral value V and the nominal payment contracted for. That is, under nominal contracting, with a debt of B,

$$\rho = \min (R + V, (1 + \hat{i})B).$$

Of course, both R and V are random variables so that the expected return $E\rho$ is just

$$E\rho = \min (ER + EV, (1 + \hat{i})B).$$

Price flexibility increases the nominal riskiness of R and V (which was a constant <u>ex ante</u> and <u>ex post</u> in the Stiglitz-Weiss model), so that

for any quoted interest rate $\hat{i}$ on loans, the likelihood of default is higher than under the case of uncertainty only over real project returns. That is, the ρ function in the lower-right-hand quadrant of Figure 1 becomes more shallow, magnifying the credit rationing for borrowers with access to only the information-intensive market in the model outlined above. For such borrowers, more projects with positive net expected value ex ante will not be undertaken. Credit rationing to information-intensive borrowers is likely to be more significant in a regime of flexible prices.

In addition, within a flexible-price regime, credit allocation will be affected by deflationary shocks. The process of sequential market clearing and credit rationing in response to deflationary shocks can be described as follows. In the presence of nominal financial contracting in the information-intensive ("banking") sector the financial system is prone to instability. In particular, unanticipated deflation weakens confidence in the viability of information-intensive loans, causing a shift in the supply of funds from the banking sector. That is, the L^S schedule in Figure 1 shifts in, further restricting bank credit. Supplies of funds to the Walrasian markets increase. The tightening of bank credit causes those borrowers with comparatively large stocks of information capital who need additional loans to move into the Walrasian market (although at higher interest rates ex post). Bank loan rates may or may not rise; increased quantity rationing allocates bank loans. Interest rates in the risky full-information market rise because of the spillover from the bank market. Rates on safe assets may even fall, because of the influx of funds to that market.

Stated differently, a deflationary shock increases the debt burden of borrowers and decreases their net worth. The resulting increased probability of default leads to a rise in the reserve-to-loan ratio as banks attempt to reduce the riskiness of their portfolios and brace themselves for potential deposit liquidation. At the same time, depositors react to increased risk by reducing their deposits. The depletion of collateral increases the cost of monitoring loans or, alternatively, reduces the availability of collateralized debt. If some banks do fail, the idle information capital of failed intermediaries will disrupt the flow of credit to certain borrowers. All of these channels cause backward shifts of the real loan supply function. The increased scarcity of bank credit may not lead to higher interest rates if, as Stiglitz and Weiss (1981) suggest, higher interest rates are associated with greater risk taking; deflationary shocks which reduce collateral may lower the upper bound on interest rates and increase excess loan demand.

These links among deflation, price flexibility, and the provision of bank credit were not lost on contemporary chroniclers; indeed illustrations of the transmission mechanism abound in the scholarly literature.[15] Three economic themes emerge from the historical discussion. First, there appears to be sequential market clearing, in which credit markets close down, starting with those for lowest-quality borrowers and moving to those for higher-quality borrowers. Second, the use of short-term credit is one means of rationing available credit to some high-quality borrowers. These phenomena are particularly visible during the Panic of 1907 when credit became increasingly quantity-rationed and short-term, as Exhibit 1 shows. Note that the market for

short-term bank loans was the only market cleared by interest rates rather than quantity rationing in November of 1907. Perhaps most important for our analysis, there appears to be a recognized linkage between deflationary shocks and the rationing of credit -- (i) from the public to the banking system (through a decrease in deposits) and (ii) from the banking system to the public (through a reduction in loans relative to reserves, and quantity rationing to low-quality borrowers).

In the next section, we test for the real effects of this rationing, examining links between price flexibility and economic fluctuations and the importance of credit channels. We first present evidence that prices were indeed "flexible" during our period of study. Estimates of time-series relationships among inflation, financial variables, and real variables follow.

III. MEASURING REAL EFFECTS OF PRICE FLEXIBILITY

Modeling the Relation Between Output and Price

Evidence for price flexibility and for persistent effects of deflationary shocks on output would fit well with neither the "Keynesian" nor "new classical" views on the origins of business cycles. For example, implicit in the Keynesian model is the view that shocks to money supply or demand, or to autonomous expenditure are transmitted through changes in real balances or interest rates to cause fluctuations in aggregate demand. Because aggregate output adjusts more rapidly than price in that framework, changes in the movement of the price level are revealed only after output movements. The price level is assumed to respond to its own lagged values and the level of nominal demand. Such a view could not explain a significant positive link from

prices to output (e.e., deflationary shocks followed by a reduction in output).

An alternative classical theory associated with Phelps (1970) and Lucas (1973) suggests that if the economy were composed of a large number of scattered markets and information flows among them were costly, suppliers of goods would have difficulty distinguishing relative price changes from general movements in the price level. The presence of imperfect information leads to a positive association of price and output changes in the short run as suppliers misinterpret general price level changes for relative price changes. For the nineteenth century when transportation and communication were significantly more costly than today, such a characterization of markets may be appropriate. In its empirical formulation, the new classical approach holds that lagged price changes should be useless as predictors of current deviations of the price level from its expected level, and hence of current output movements.

Evidence on Price Flexibility

Early evidence on price flexibility for many commodities during the period is presented in Mills (1927).[16] The lack of short-run price predictability during this period has been demonstrated by Klein (1975), who notes significant negative autocorrelation in rates of price change. In Calomiris and Hubbard (1985), we show that prices were linked to international markets even over reasonably short periods, and commodity price arbitrage between the U.S. and England was quite rapid. Below we present some of that evidence.

Measuring price flexibility directly is problematic because "flexibility" refers to the **responsiveness** of wages and prices rather then simply to their volatility. In the traditional interpretation of the Phillips curve, wage and price rigidity is the sine qua non of the explanation of the relationship between prior deviations of output growth from trend and subsequent departures from "core" inflation. The Phillips curve relation is necessary but not sufficient evidence of wage or price rigidity. It must also be shown that statistical information flows from quantity deviations to price deviations rather than vice-versa. We estimated traditional specifications of the Phillips curve using monthly data and found contemporaneous correlation between output and price deviations,[17] but the pattern of intertemporal priority between output and prices was reversed from that of the post World War II period.

To explore formally the role of price flexibility more carefully, we estimate a reduced-form vector autoregression[18] with eight (monthly) lags of the commercial paper rate, the rate of change of the wholesale price index, and the growth rate of output. For output we use pig iron production.[19] The well-known Persons (1931) index of industrial production relies mainly on bank clearings and other variables of questionable relevance for output. Another alternative, the level of imports, is unattractive for our purposes because price effects on imports are contaminated by the terms-of-trade effect. Our sample period, 1879-1914, runs from the end of the "Greenback Ear" to the origins of the Federal Reserve System. This is a peacetime period for the U.S. during which counter-cyclical fiscal and monetary policy intervention was negligible.

In this reduced form model, if the short-term nominal interest rate contains ex ante inflation expectations, then a Lucas confusion effect would imply significant marginal predictive power of output for inflation in a VAR which includes inflation, output growth, and the interest rate. Moreover, there should be no marginal information from inflation for output growth changes. Alternatively, in a sticky price model, aggregate shocks would influence quantities before prices, and the predictions for the VAR are broadly the same as in the Lucas model.

The estimation and simulation results in Tables 1A and 1B indicate that inflation and interest rates are (i) statistically significant in the determination of output, and (ii) important contributors to the forecast variance of output. In addition, lagged coefficients on the inflation variable are positive and statistically significant, so that shocks to inflation exert a **persistent** effect on output. Current and lagged output levels are neither significant nor important in predicting inflation; note, for example, that while inflation accounts for 6 precent of the long-run forecast variance of output growth, output growth accounts for only 1 percent of the forecast variance of inflation. These findings are not consistent with either the confusion or the sticky-price model.

Additional evidence for the flexibility of wages and prices is provided by examining the intertemporal linkages between factory employment and the real wage. Using quarterly data for 1889-1914 and 1953-1984 on factory employment, manufacturing wages, and wholesale prices, we estimated reduced-form equations for inflation, employment, and the real wage; data sources are given in the Appendix. The results are presented in Table 2.

The significance and importance of patterns of prediction among these series differ substantially between the two samples. In the recent period, all three variables contain significant and important information for predicting prices, while in the historical sample prices are, for all intents and purposes, unresponsive to past movements in prices, employment, and real wages. Moreover, in the modern period, employment is a far better predictor of real wages than in the historical sample, while variation in real wages is important and significant for employment only in the historical sample.

Though not reported here, we also considered the importance of price-clearing channels in international markets (specifically between the United States and England) as evidence for price flexibility. In a vector autoregression of interest-rate differentials for commercial paper of similar maturity and quality in England and the U.S., gold flows into England, gold flows out of the U.S., the U.S. trade balance, and the log of relative prices between the two countries, we find the lagged quantity variables are not significant predictors of relative prices. In addition, relative prices are both statistically significant and economically important contributors to explaining movements in the trade balance.

Evidence on Credit Rationing

The evidence from Tables 1A and 1B indicates that the positive association between output and price for the period 1879-1914 is mainly explained by shocks which originate in price. This result is supportive of the debt-deflation view, and suggests extending the empirical model to include variables more directly related to credit rationing.

From our discussion in section II, two transmissions of rationing are important: (i) depositors' rationing to banks, and (ii) banks rationing to borrowers. In the former, because information-intensive bank loan portfolios are most sensitive to fears about deflationary shocks, the public's supply of funds to the banking sector will be curtailed, reducing deposits, and forcing more conservative behavior by banks. As depositors ration banks, even the full-information cost of credit from banks goes up — as reflected in the "double-name, choice" commercial paper rate.[20] Commercial paper rates probably reflect the full shadow price of funds to borrowers in that segment of the credit market. If historical highs are indicators of the latitude for price clearing in the high-grade commercial paper market, then the commercial paper rate was well within the range of price-clearing levels during the late nineteenth and early twentieth centuries.[21]

Second, as noted before, in a world with capital-market imperfections, focusing on one interest rate is inappropriate. Banks will charge even higher rates to less desirable borrowers, and employ quantity rationing for least desirable borrowers. That is, borrowers of differing "quality" will have differential access to credit, with credit rationing of distressed firms and individual borrowers (see Stiglitz and Weiss, 1981; Friedman, 1981; and Bernanke, 1983). The two transmission mechanisms we emphasize can be independent. For example, Bernanke (1983) notes that banks held substantial excess reserves during the depth of the Great Depression of the 1930s, indicating that the second mechanism served as the binding constraint.

In our empirical work, we construct a set of instruments which proxy for the credit scarcity effect (Ψ) . These instruments

approximate the difference between the cost of capital under full information and the actual cost of borrowed funds. In addition to the commercial paper rate, our price indicator of credit scarcity due to depositors' rationing of banks, we consider three types of measures: (i) interest rate differentials on commercial papers of different "quality," [22] (ii) indicators of quantity rationing in the banking system, and (iii) proxies for the influence of nonfinancial business failures. Detailed descriptions of the construction of the variables are presented in the Appendix.

First, we include the differential between 60-90 day averages of highs and lows for end-of-month "single-name, good" commercial paper of 4-6 months maturity (i^{cg}) and "single name, prime" commercial paper of 4-6 months maturity (i^{cp}). This spread reflects the interest premium charged on paper of lower quality but with similar maturity.[23] Inclusion of such interest differentials permits a test of effects of credit availability on output.[24] That is, if interest rate movements in response to deflationary shocks reflect only adjustment in the full-information cost of capital, interest rate differentials (on securities with similar maturities) should be unaffected. Responses of the differentials to such shocks reflect credit rationing in securities of low quality and the movements of borrowers with access to multiple sources of credit.

That the various commercial paper rates may be imperfect indicators of bank credit crunches implies that quantity flows may contribute explanatory power at the margin above that contributed by the price of funds. For this reason we include the real change in loans ($(L_t - L_{t-1}) / P_{t-1}$), where L and P denote the stock of loans and the price level, respectively).[25]

Finally, we also consider the monthly percentage change in the liabilities of business failures (Δf) ; this variable is constructed from the monthly series reported by Dun and Company. To the extent that the rate of change of prices and proxies for credit channels are still statistically significant and economically important factors in explaining output movements, the "credit-availability explanation" is strengthened.[26] Indeed, the use of Δf in the models we estimate uniformly improves the statistical significance and economic importance of the effects of inflation on output.[27]

To test for the effects of price flexibility and credit availability on output described above, we examine vector autoregressions of inflation, output, and financial variables. While such models are not structural, they are well suited for examining the dynamic properties of the interactions. Though not reported here, we also estimated the regression models suggested by Bernanke (1983), and obtained similar results — (i) that current and lagged "price surprises" are important for explaining deviations of output from trend, and (ii) that the addition of real changes in loans provides additional explanatory power for output.

In Table 3 we present results illustrating the four credit measures suggested in section II. The reduced-form model includes eight lags of the following variables: the real flow of loans, the commercial paper rate, the interest differential between "single-name, good" and "single-name, prime" commercial paper of 4-6 months maturity, the rate of change of the wholesale price index, the growth rate of pig iron production, and the percentage change in the liabilities of business failures. Measures of statistical significance and of the importance of variables

in accounting for long-run forecast variance are reported in Tables 3A and 3B, respectively. The contemporaneous correlation matrix of residuals is also presented in Table 3B. In estimations and simulations, we find statistically significant and economically important effects connecting credit proxies, inflation, and output.

As before, inflation is statistically exogenous to the other variables, as indicated by the results in Table 3A. Inflation predicts output significantly, and accounts for 10.7 percent of the long-run (40 month) forecast variance of output growth in simulations. The percentage contribution of inflation shocks to output growth forecast variance reaches a peak of 14.3 percent at the three-month time horizon. Inflation is also statistically significant in predicting the interest differential. The near significance of the commercial paper rate for predicting short-run inflation is probably best explained by the Fisher effect, while the small contribution of shocks to the commercial paper rate to the forecast variance of inflation indicates the "causes" of inflation are not channelled through interest rates.

Output growth is predicted by our credit-market indicators — the commercial paper rate, the real flow of loans, and the percentage change in liabilities of business failures — all of which turn out to be important in simulation. The percentage change in the liabilities of business failures is predicted by the real change in loans, the commercial paper rate, and the interest differential. The lack of significance and importance of the interest-differential proxy is to be expected since it is endogenous and not an independent source of credit rationing.

Examining the contemporaneous correlation matrix of residuals permits some identification of shocks. While these are results from reduced-form models, the pronounced negative correlation (-0.41) between interest-rate and loan shocks indicates the predominance of shocks to the **supply** of bank credit over shocks to credit demand. That the debt-deflation-cum-credit-rationing effect is important is also reflected in the negative associations between shocks to output growth and the change in liabilities of failures, between shocks to inflation and the change in liabilities of failures, and between output growth and the commercial paper rate; and in the positive association between output growth and inflation.

Results from the impulse-response functions for the model reported in Table 3 are broadly supportive of the dominance of credit supply shocks. First, positive loan shocks exert persistent negative effects on the commercial paper rate and positive effects on output. Shocks to interest rates exert effects in the same direction for the liabilities of business failures and in the opposite direction for output. Positive shocks to the interest differential have a persistent negative effect on loans. Perhaps most interesting, shocks to inflation provide an impressive corroboration of the credit channel, with positive effects on loans and output and a negative effect on the interest differential.

Our results presented here strongly suggest the importance of deflationary shocks for financial markets and of constraints on the availability of credit for real activity. That these effects are both economically important and persistent emphasizes the importance of studying more carefully the dynamics of market clearing across various credit markets in the presence of nominal financial contracting. Hence

the banking panics occurring during our period of study may be best studied as symptoms of the problems of providing credit in a world of flexible prices. Our approach is relevant for localized changes in aggregate supply and demand due to small changes in credit quality and information, so that we avoid any dependence on "panic" explanations.

IV. CONCLUSIONS AND IMPLICATIONS

Modern theoretical and empirical research on U. S. business cycles has in general relied on models with limited ability to explain cyclical fluctuations when prices are flexible and little uncertainty exists about government policy. In particular, the existence of pronounced swings in economic activity during the period between the Civil War and World War I, a period in which prices exhibit little rigidity, does not fit well with these approaches.

In contrast to many recent conclusions about links between price rigidity and the adjustment of output to demand and supply shocks, we put forth an approach in which such flexibility can be destabilizing through market failures in credit markets. We present a model of credit markets in which "imperfect-information" markets of the sort put forth by Stiglitz and Weiss (1981) coexist with "full-information" Walrasian credit markets. The potential for deflation magnifies credit rationing for information-intensive borrowers and projects, and deflationary shocks precipitate a sequential market clearing among classes of lenders in which the supply of credit to borrowers in information-intensive markets is reduced.

In section III, we test for price flexibility and for aggregate real effects of our credit-rationing channel. Three conclusions

underscore the principal findings of the paper. First, we demonstrate that prices were indeed flexible during our sample period relative to their behavior in the post World War II period studied by modern macroeconomists. Second, contrary to the predictions of current theories about the sources of business cycles, we find that shocks to the rate of change of prices produce positive and persistent effects on output. Finally, we analyze ways in which deflationary pressures can affect real activity through disruption of the information-intensive financial intermediation involved in the provision of bank credit.

We are currently pursuing two extensions of this research. First, the issue of why nominal financial contracts were used (given the frequent realization of substantial losses ex post) is of particular interest. Though it lies beyond the scope of this paper to show why nominal debt contracts might be optimal ex ante, there are several possible explanations. For example, fully contingent contracts may be costly to monitor and enforce; indeed, as Bernanke (1983) points out, the very existence of bankruptcy indicates the costliness of contingent contracting. Why nominal debt contracts are superior to indexed contracts, however, remains to be demonstrated.[28] Our approach to analyzing credit rationing lends itself well to extended analyses of models in which short-term instruments along with quantity rationing serve as equilibrating mechanisms when access to longer-term nominal financial contracts is restricted.[29]

Second, although our emphasis is on a historical episode of price flexibility, our results do not imply that credit rationing may not be important for economic activity in a world with substantial price rigidity. One sector of the modern economy for which our approach is

particularly relevant is the farm sector. Agricultural prices (and hence farm land values, the principal asset of farmers) are relatively flexible. If the sort of market failures discussed in this paper have aggregate effects, a likely place for them to be observed is in a link between farm bank failures and credit rationing and farm incomes. More broadly, to the extent that banking-system difficulties and loan restrictions have important real effects, important implications for monetary and regulatory policy may follow.

Notes

[1] See the survey and review of alternative theoretical models in Gordon (1981). As discussed in Zarnowitz (1985), the search for "universal" models of business cycles which do not rely on institutional factors has proven to be difficult.

[2] See the discussions by Burns (1960), Baily (1978), and DeLong and Summers (1984) of the changing extent of cyclical variability in the U.S. economy.

[3] Many recent contributions in macroeconomics (e.g., Fischer, 1977; and Taylor, 1979) have emphasized the economic costs of wage and price rigidity.

[4] Previous uses of annual data, of course, make studies of cyclical fluctuations difficult. The more frequently collected data reported by the Comptroller of the Currency (see for example Gorton, 1984) are not evenly spaced.

[5] Romer (1985) has challenged the view that early business cycles were so volatile. Her reinterpretations of the data on employment, output, and industrial production provided by Lebergott, Kuznets, and Frickey, respectively, have in turn been challenged by Weir (1985) and Lebergott (1985). None of Romer's suggested adjustments, however, would indicate that historical business cycles were less or equally severe than those of the post World War II era.

[6] Historical accounts (e.g., the classic studies of Bagehot, 1873; Sprague, 1910; and Mitchell, 1913) usually point to "financial panics" before the creation of the Federal Reserve System, though little effort is made to connect instability in financial markets per se with macroeconomic variables.

[7] Of course, as the 1930s show well, nothing about the existence of a central bank per se guarnatees that these problems will be mitigated.

[8] Gorton (1984) emphasized the predictability of bank panics, as changes in the perceived riskiness of bank deposits affects the currency-deposit ratio.

[9] Contemporary accounts emphasized the credit (as opposed to the liquidity preference) transmission mechanism. Brown (1910) notes: "...it is not the saving of capital in the form of coinage which brings after it a lower rate of interest. Rather is it, that either is absolutely conditional on the other, that the lower interest charge made possible by the banking function enables bank credit, in open competition, to substitute itself for cash, or induces among banks the policy of lending in general only their own credit." (p. 748)

[10] Greenbaum, Kanatas, and Deshmukh (1984) discuss the importance of bank credit rationing for small businesses in the current environment.

[11]DeLong and Summers do note that increases in price flexibility magnify the impact of deflationary shocks on output, though the result comes from a model of gradual price adjustment based on labor contracts, a model not as well suited for the nineteenth century as for the post World War II period.

[12]This finding is consistent with a model of financial contracting in which short-term price variability exceeds long-term price variability (as it would under a gold standard), leading to more "indexed" rates in the short run.

[13]Discussion of a model emphasizing the problem of destabilizing deflation accompanying price flexibility is also useful for analyzing the behavior of aggregate demand during the Great Depression of the 1930s. Researchers like Temin (1976), who blame declining "animal spirits" lack a convincing motivation. Furthermore, that real interest rates rose in the face of a decline in aggregate demand confounds explanation without analyzing the contributions of deflation.

[14]That is, "information capital" can also be considered a factor of production, so that reductions in the availability of bank credit will reflect real effects on aggregate supply as well as aggregate demands. Hence increases in Ψ unambiguously reduce real output. Blinder (1985) considers working capital in a similar context, emphasizing the notion of a "credit multiplier" (see also Bernanke, 1981): "Firms may have a desired or 'notional' supply based on relative prices, expectations, and other variables. But they may need credit to produce the goods. If the required credit is unavailable, there may be a 'failure of effective supply' in which firms fail to produce as much as they can sell?" (p. 2)

[15]For example, Persons (1920) discusses the link between deflation and credit market instability, and Brown (1910) identifies links from deposits through bank credit to economic activity. Analyses in the Commercial and Financial Chronicle are typified by the following:
"The effect of the unstable paper currency in checking the credit system, and forcing cash transactions upon the business community, is very apparent in the returns made by the number of failures, and the amount of their liabilities, in the past few years."
(February, 1865, p. 113)
Furthermore, evidence of rationing of credit to worthy borrowers appeared frequently in the writings of contemporaries. Stevens (1894, p. 133) notes that many solvent businesses closed during the panics of 1884 and 1893, and (p. 140) that wholesale business done on a credit basis prior to the panics was done on a cash-only basis. That the rationing longer-term loans accompanying deflation in commodity prices led to more extensive and expensive reliance on short-term paper is noted as far back as 1865 by the Commercial Chronicle and Review of Hunt's Merchants' Magazine.
Sprague (1910)'s work reflects these same themes: "It would seem, then, that business distress from lack of credit facilities was due to at least three influences: The restriction of cash payments by the banks increased the requirements of borrowers; the supply of

loans was reduced by a moderate amount of contraction; and the shifting of loans involved considerable uncertainty and inconvenience." (pp. 302-303) Examples of the importance of credit rationing and credit market segmentation appear frequently in Sprague. "Their loans also must have been of high average quality after four years of thoroughgoing liquidation and recuperation in the business world." (p. 217, emphasis added)
"...it is certain that the demand for additional capital was outstripping current savings seeking investment. Increasing difficulty was experienced in marketing securities of the very highest class. (p. 237, emphasis added)
"Whatever the causes, the inability to secure capital by the sale of securities in a period of active business should have been enough in itself to inspire unusual caution in the management of banking institutions. When corporations of the highest standing are obliged to resort to short-term notes it may be assumed without question that other corporations are expanding upon an insufficient foundation of working capital, that current obligations are increasing, and that bank credits are being used to their utmost extent." (p. 238)
"Borrowers are forced to resort almost entirely to their own banks...This shifting of loans involves much strain and uncertainty and in many instances it is not possible to carry it out at all." (p. 302)

[16]Mills notes substantial differences in price flexibility across individual commodities, presenting evidence for price flexibility on average.

> Prices of the large bulk of commodities at wholesale are affected to some extent during general business revivals and recessions...The number of commodities sharing in business revivals has constituted, on the average, 79.7 percent of the commodities studied in specific cycles. This proportion has fluctuated, from cycle to cycle during the period since 1890, between 67 percent and 95 percent. The proportion affected by general price recessions has averaged 77.7 percent, and has ranged in different cycles, between 70 percent and 95 percent. (pp. 434-435)

He also, however, describes an overall decline in the monthly variability of wholesale commodity prices in the U.S. over the 1890-1913 period.

[17]In our estimates of the Phillips curve for 1879-1914 we employ monthly and quarterly data on wholesale prices and pig iron output (see the Data Appendix) to test for contemporaneous correlation between deviationsfrom trend in prices, on the one hand, and those in output on the other hand. We estimate equations with inflation as the dependent variable and two lags of inflation, monthly dummies, and deviations of output from trend as independent variables. In monthly data, the coefficient on the output variable is 0.013 with a coefficient standard error of 0.010 and a significance level of 0.19. This implies a .01 percent response in inflation to a 1 percent contemporaneous output deviation. The coefficients on

lagged inflation imply a long-run coefficient for output deviations of 0.017. In quarterly data, the output coefficient is 0.047 with a coefficient standard error of 0.020 and a significance level of 0.02. The long-run coefficient for output is 0.040.

[18]For this and all subsequent VAR models, time, time squared, the tariff on pig iron, and seasonal dummies are included as independent variables in the estimation equations.

[19]For a description of the cyclical properties of various output measures over our period of study, see Eckler (1933). Following a suggestion from Larry Neal we also used bank clearings outside New York as a substitute output proxy. In the VARs, this substitution did not change any of the results qualitatively.

[20]Commercial paper rates, may, then, fully reflect the shadow price of funds -- that is, if quantity rationing is absent in the commercial paper market, and there are players, for whom the choice is relevant, who elect to raise funds through commercial banks.

[21]Earlier in the nineteenth century commercial paper rates were frequently much higher than any level reached subsequently. For example, in October 1857, the commercial paper rate averaged 24 percent and in October 1873, it averaged 16.5 percent. In post-1879 data, the monthly average is always below 11 percent.

[22]Descriptions of the various commercial paper securities can be found in Myers (1931) and James (1978). Essentially, single-name paper is the liability of an individual borrowing to secure working capital. Double-name paper is usually the liability of both parties involved in a commercial transaction for which trade credit is needed.

[23]We also experimented with two other interest-rate spreads -- between "single-name, good" and "double-name, choice" commercial paper of 4-6 months maturity and between bank time loans of 60-days maturity and "double-name, choice" commercial paper. As the results were similar in character to those discussed in the text, we did not report them here.

[24]We also experimented with the differential between the commercial paper rate and the railroad bond yield as an indicator of the shadow price of credit. While this is admittedly a rough measure of loan scarcity, it captures a key feature of credit rationing due to asymmetric information. Riskless (demandable) loans would not be rationed as term loans would be during credit crunches; thus the interest rate differential reflects, in part, the extent of rationing in the term loan market. The results were not promining, possibly because the interest rate differential may reflect maturity differences unrelated to rationing (although long-term rates are smooth throughout the period).

[25]As a further indication of the cost of intermediation, the reserve-loan ratio serves as a measure of credit rationing, of bankers' desires to reduce the supply of credit given the reserves available. The variable contains information on shocks to the banking system; disintermediation will likely lead to an increase in the reserve-loan ratio. In addition, the shortfall of bank reserves relative to desired levels signals the potential for loan contraction and liquidation. In our empirical work, we obtained similar results using the aggregate bank reserve-loan ratio instead of using the real flow of bank loans.

[26]Gorton (1984) finds the liabilities of failed businesses to be a significant factor in explaining the riskiness of bank deposits and the banking system's currency-deposit ratio.

[27]For example, adding Δf to the model reported in Table 1, roughly doubles the contribution of shocks to inflation to the explanation of the long-run forecast variance of output.

[28]Reasons for nominal contracting in general include, inter alia. transactions costs involved with auction markets and risk aversion on the part of one or both parties (see Carlton, 1979; and Hubbard and Weiner, 1984). In addition, institutional restrictions on indexed contracts due to limited enforcement of negotiability under common law may have been important (see Nussbaum, 1939).

[29]That nominal financial contracting may lead to large losses ex post calls into question why borrowers and lenders did not index debt commitments ex ante. We are pursuing this issue as a topic for future research, and offer a couple of preliminary thoughts below. First, within the framework of the adverse selection model of Stiglitz and Weiss (1981), an indexed loan contract will in general lead to increased risk taking by risk-neutral borrowers. This is true since in "good times" (high price level realization), net cash flow after debt service is reduced, and in "bad times" (low price level realization), net cash flow is relatively increased. Such increased risk taking would lead to greater credit rationing in the Stiglitz-Weiss model, so that both borrowers and lenders might prefer nominal contracting. A second way to think about the choice of nominal contracting (outside of a credit-rationing model) is in the context of its insurance value in a world in which lenders are risk-neutral and borrowers are risk-averse. Consider two types of uncertainty — that relating to costs of intermediation services provided by banks and that related to the cash flows of borrowers' projects. Under plausible assumptions, as long as intermediation cost uncertainty is greater than cash flow uncertainty, nominal financial contracting is optimal.

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PRICE FLEXIBILITY, CREDIT RATIONING, AND ECONOMIC FLUCTUATIONS: EVIDENCE FROM THE U.S., 1879-1914

DATA APPENDIX

In order to capture short-run intertemporal linkages among credit, deflation, and output, it is necesary to employ fairly high-frequency data, but the shortage of comprehensive data on output and bank balance sheets requires the use of rough proxies. For output we use pig iron production; data are obtained from Historical Statistics of the United States, 1789-1945. We construct a single index of wholesale prices by splicing the Warren-Pearson index (for 1879-1890) and the Bureau of Labor Statistics index (for 1890-1914). In Calomiris and Hubbard (1985), we discuss results using more disaggregated data.

Our quarterly wage data over the 1879-1914 period are from those collected for cotton textile workers by Layer (1955). Quarterly factory employment data are drawn from Historical Statistics of the United States, 1789-1945.

We construct monthly loans and reserves data from the weekly reports of the Commercial and Financial Chronicle for banks in New York City, Philadelphia, and Boston. Though these series represent only part of the banking system, they are the only available monthly data of their kind of which we are aware.

The commercial paper rate series used in Tables 1A and 1B is taken from Macaulay (1938), and are monthly averages for 1879-1914. End-of-month interest rates used in Tables 3A and 3B for 1894-1909 — on (i) 60-90 day average of high and low for double-name choice commerical paper (analogous to Macaulay's measure), (ii) single-name, good commercial paper of 4-6 months maturity, (iii) single-name prime

commerical paper of 4-6 months maturity, and (iv) bank time loans of 60-days maturity -- are from Statistics for the United States, 1867-1909 published by the National Monetary Commission in 1910.

Dun's series on the liabilities of business failures is from Base Book of Standard Statistical Bulletin, January 1932.

TABLE 1A

VAR ESTIMATION RESULTS: INTEREST RATES, INFLATION, AND OUTPUT GROWTH

(MONTHLY, 1879:10-1914:12)

F-Tests: Significance Levels

Contemporaneous / Lagged	i^c	$\frac{\dot{p}}{p}$	$\frac{\dot{y}}{y}$
i^c	.000	.032	.000
$\frac{\dot{p}}{p}$	.268	.000	.029
$\frac{\dot{y}}{y}$	.498	.780	.000

i^c = commercial paper rate

$\frac{\dot{p}}{p}$ = rate of change in wholesale prices

$\frac{\dot{y}}{y}$ = percentage growth in pig iron production

TABLE 1B

VAR ESTIMATION RESULTS: INTEREST RATES, INFLATION, AND OUTPUT GROWTH
(MONTHLY, 1879:10-1914:12)

Decomposition of Long-Run Forecast Variance (40 months)

Contemporaneous / Lagged	i^c	$\frac{\dot{p}}{p}$	$\frac{\dot{y}}{y}$
i^c	88.73	6.69	12.38
$\frac{\dot{p}}{p}$	9.33	92.01	6.11
$\frac{\dot{y}}{y}$	1.94	1.30	81.51

Correlation Matrix of Residuals

Contemporaneous / Lagged			
i^c	1.00		
$\frac{\dot{p}}{p}$	-0.04	1.00	
$\frac{\dot{y}}{y}$	-0.10	0.08	1.00

Note: For definitions of the variables, see Table 1A.

TABLE 2
COMPARISON OF WAGE AND PRICE FLEXIBILITY
(1889-1914 AND 1953-1984 PERIODS)

	MODERN DATA (1953-1984)			HISTORICAL DATA (1889-1914)		
F-Tests: Significance Levels				**F-Tests: Significance Levels**		
Contemporaneous / Lagged	$\dot{P}/P$	N	W/P	$\dot{P}/P$	N	W/P
$\dot{P}/P$	0.036	0.691	0.024	0.417	0.653	0.082
N	0.093	0.000	0.026	0.406	0.000	0.336
W/P	0.000	0.674	0.000	0.789	0.007	0.000
Forecast Variance Decompositions				**Forecast Variance Decompositions**		
$\dot{P}/P$	72.08	13.82	42.46	87.36	13.37	31.29
N	18.48	82.89	56.33	9.78	56.55	23.66
W/P	9.45	3.29	1.22	2.85	30.08	45.05
Correlation Matrix of Residuals				**Correlation Matrix of Residuals**		
$\dot{P}/P$	1			1		
N	0.13	1		0.28	1	
W/P	-0.87	0.03	1	-0.73	-0.38	1

$\frac{\dot{P}}{P}$ = rate of change of wholesale price index

N = index of factory employment

$\frac{W}{P}$ = real wage rate

TABLE 3A

VAR ESTIMATION RESULTS: INTEREST RATES, INFLATION, OUTPUT GROWTH, BANK LOANS, INTEREST DIFFERENTIALS, AND LIABILITIES OF FAILURES (MONTHLY, 1894:10-1909:12)

F-Tests: Significance Levels

Contemporaneous / Lagged	$\frac{L-L_{-1}}{P}$	i^c	$i^{cg} - i^{cp}$	$\frac{\dot{p}}{p}$	$\frac{\dot{y}}{y}$	Δf
$\frac{L-L_{-1}}{P}$	.611	.293	.927	.568	.091	.079
i^c	.115	.000	.095	.159	.102	.012
$i^{cg} - i^{cp}$	.888	.023	.000	.269	.838	.089
$\frac{\dot{p}}{p}$	.939	.803	.017	.669	.033	.213
$\frac{\dot{y}}{y}$	.840	.350	.494	.181	.000	.394
Δf	.742	.230	.074	.528	.078	.000

L = stock of loans outstanding in major cities

i^c = commercial paper rate ("double-name, choice")

i^{cg} = commercial paper rate ("single-name, good")

i^{cp} = commercial paper rate ("single-name, prime")

$\frac{\dot{p}}{p}$ = rate of change in the wholesale price index

$\frac{\dot{y}}{y}$ = rate of growth of pig iron production

TABLE 3B

VAR ESTIMATION RESULTS: INTEREST RATES, INFLATION, OUTPUT GROWTH
BANK LOANS, INTEREST DIFFERENTIALS, AND LIABILITIES OF FAILURES
(MONTHLY, 1894:10-1909:12)

Decomposition of Long-Run Forecast Variance (40 months)

Contemporaneous / Lagged	$\frac{L-L_{-1}}{p}$	i^c	$i^{cg}-i^{cp}$	$\frac{\dot{p}}{p}$	$\frac{\dot{y}}{y}$	Δf
$\frac{L-L_{-1}}{p}$	77.25	22.43	10.88	7.39	10.98	5.38
i^c	7.60	58.89	8.46	6.49	16.40	5.05
$i^{cg}-i^{cp}$	3.27	2.08	63.57	5.51	0.82	5.90
$\frac{\dot{p}}{p}$	2.24	1.45	6.24	72.10	10.65	9.63
$\frac{\dot{y}}{y}$	4.65	12.20	5.03	4.54	53.53	3.23
Δf	5.00	2.97	5.82	3.97	7.62	70.82

Correlation Matrix of Residuals

Contemporaneous / Lagged						
$\frac{L-L_{-1}}{p}$	1.00					
i^c	-0.41	1.00				
$i^{cg}-i^{cp}$	-0.07	0.16	1.00			
$\frac{\dot{p}}{p}$	-0.07	0.003	-0.12	1.00		
$\frac{\dot{y}}{y}$	0.17	-0.33	0.01	0.22	1.00	
Δf	-0.07	0.14	0.13	-0.16	-0.20	1.00

TABLE 3C
CUMULATIVE IMPULSE RESPONSES
OF OUTPUT TO A REAL LOANS SHOCK

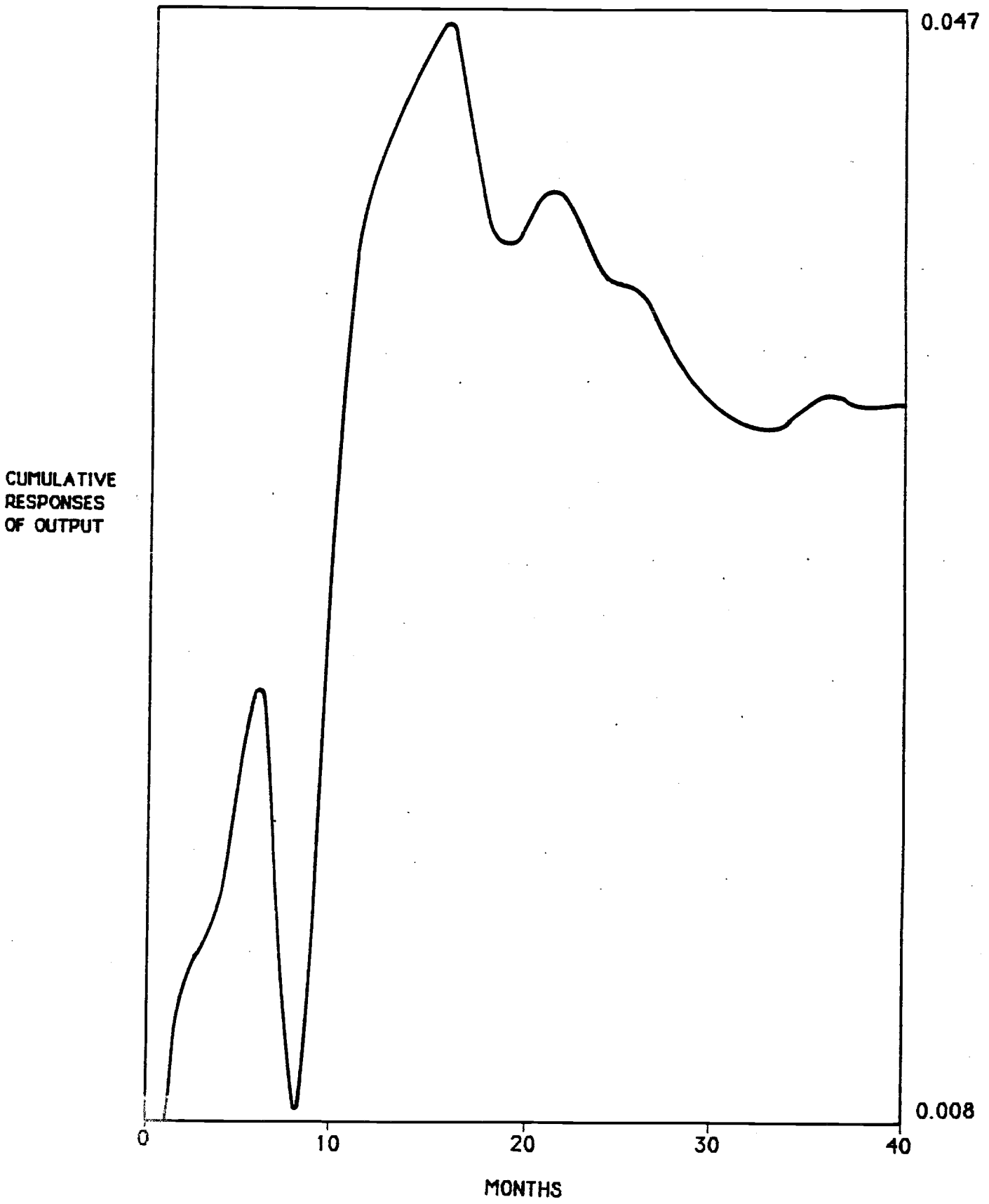

TABLE 3D
CUMULATIVE IMPULSE RESPONSES
OF THE LIABILITES OF FAILED BUSINESSES
TO A COMMERCIAL PAPER RATE SHOCK

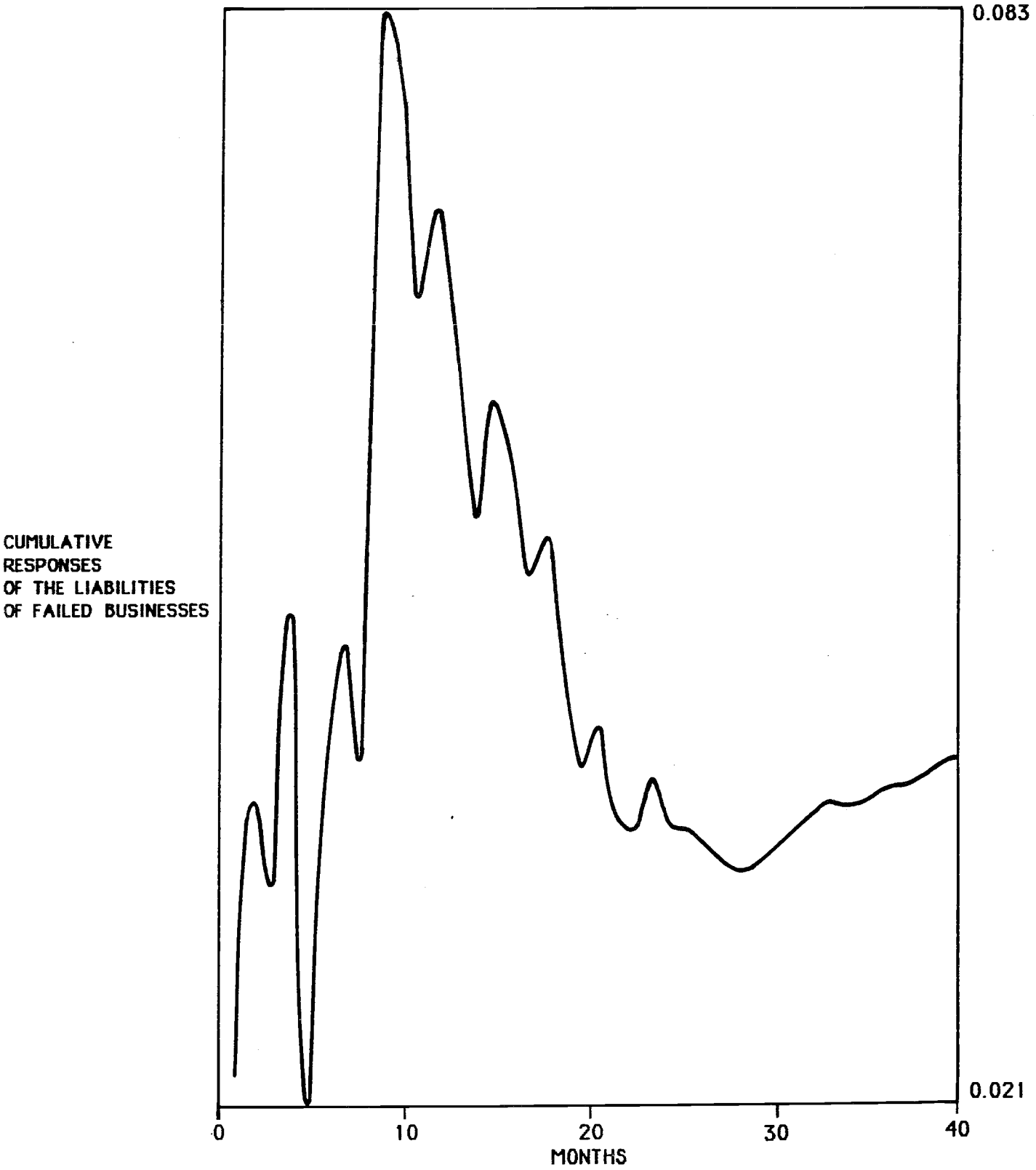

TABLE 3E
CUMULATIVE IMPULSE RESPONSES
OF OUTPUT TO A COMMERCIAL PAPER RATE SHOCK

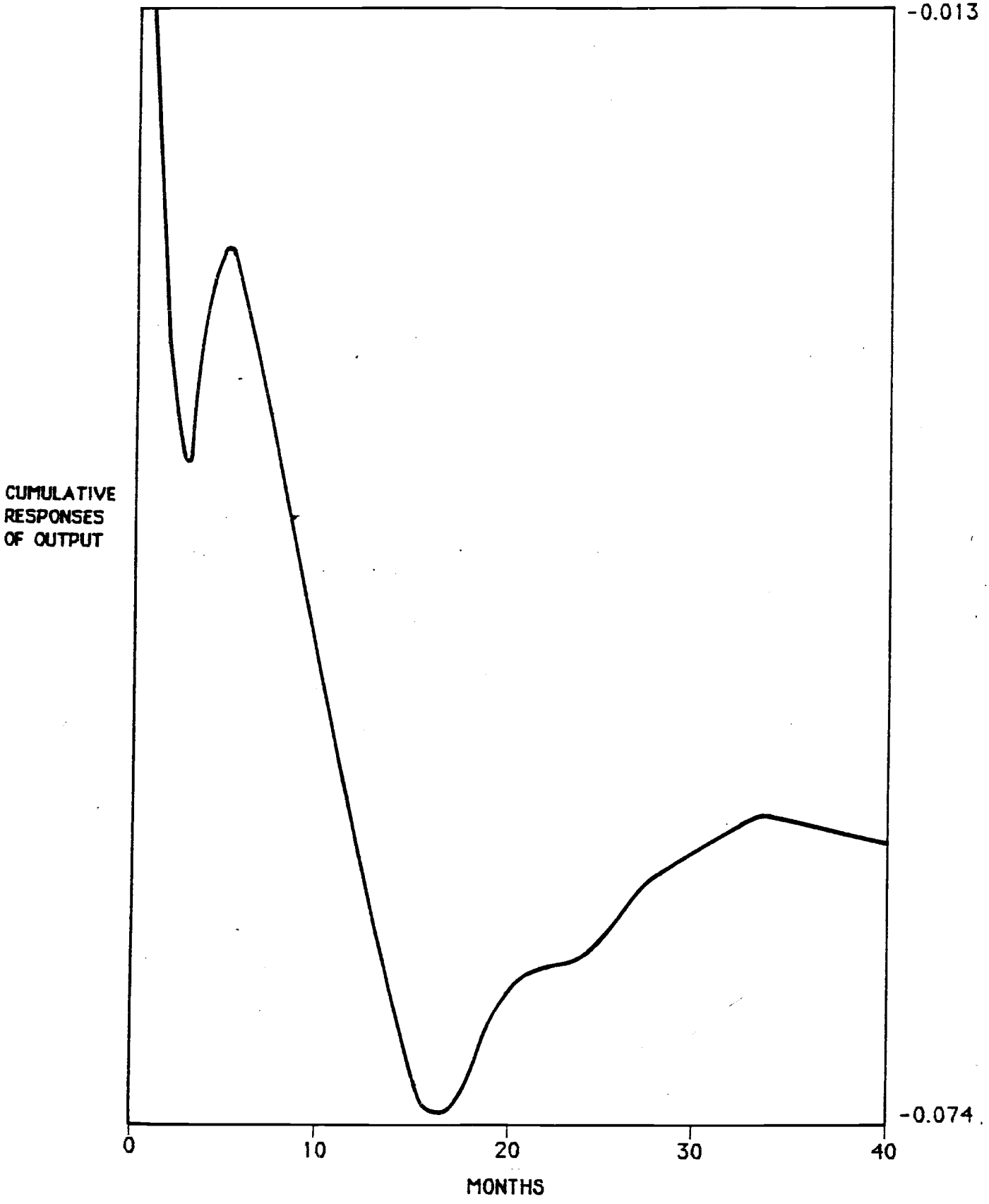

TABLE 3F
CUMULATIVE IMPULSE RESPONSES
OF REAL LOANS TO AN INTEREST DIFFERENTIAL SHOCK

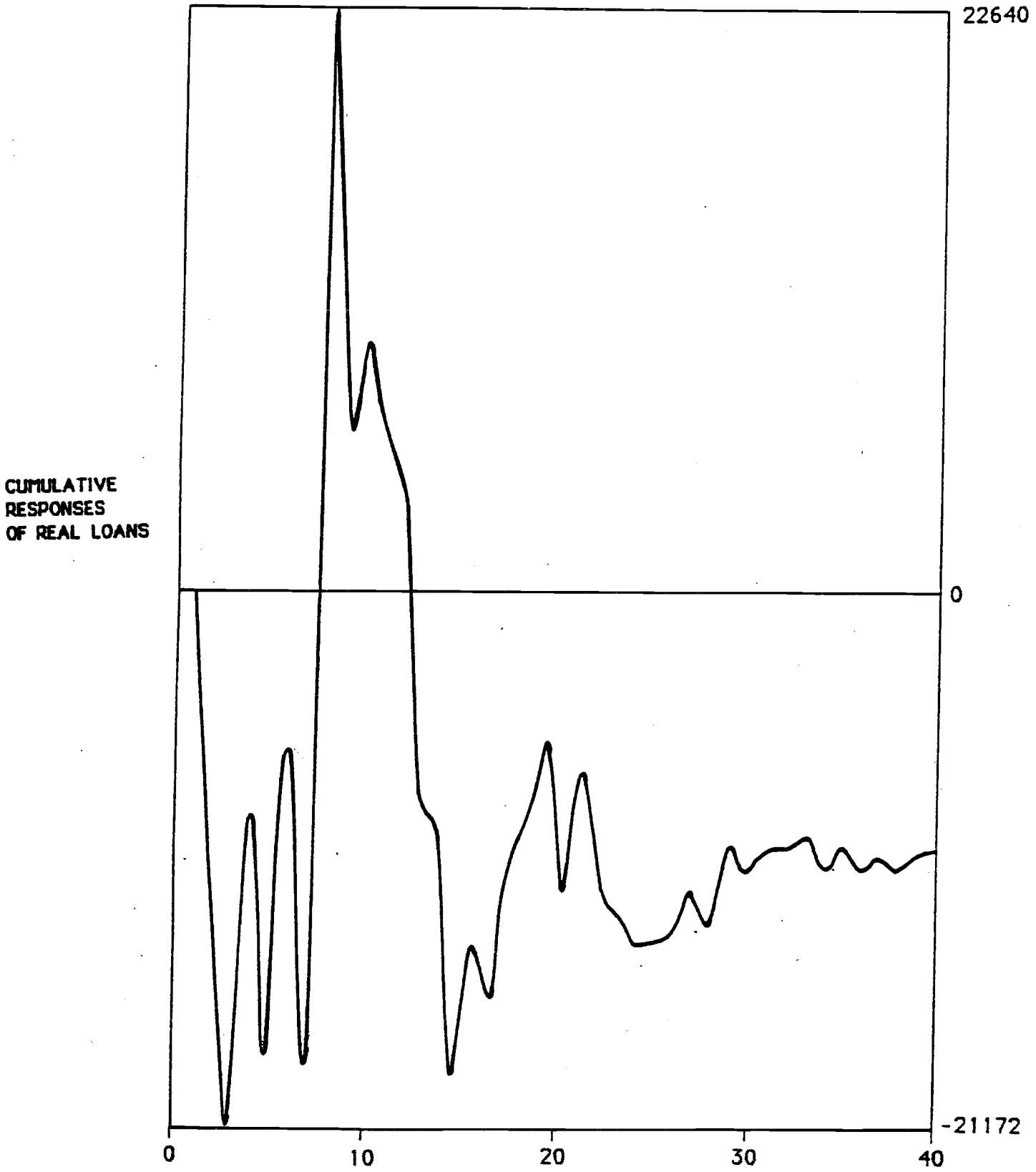

TABLE 36
CUMULATIVE IMPULSE RESPONSES
OF OUTPUT TO AN INFLATION SHOCK

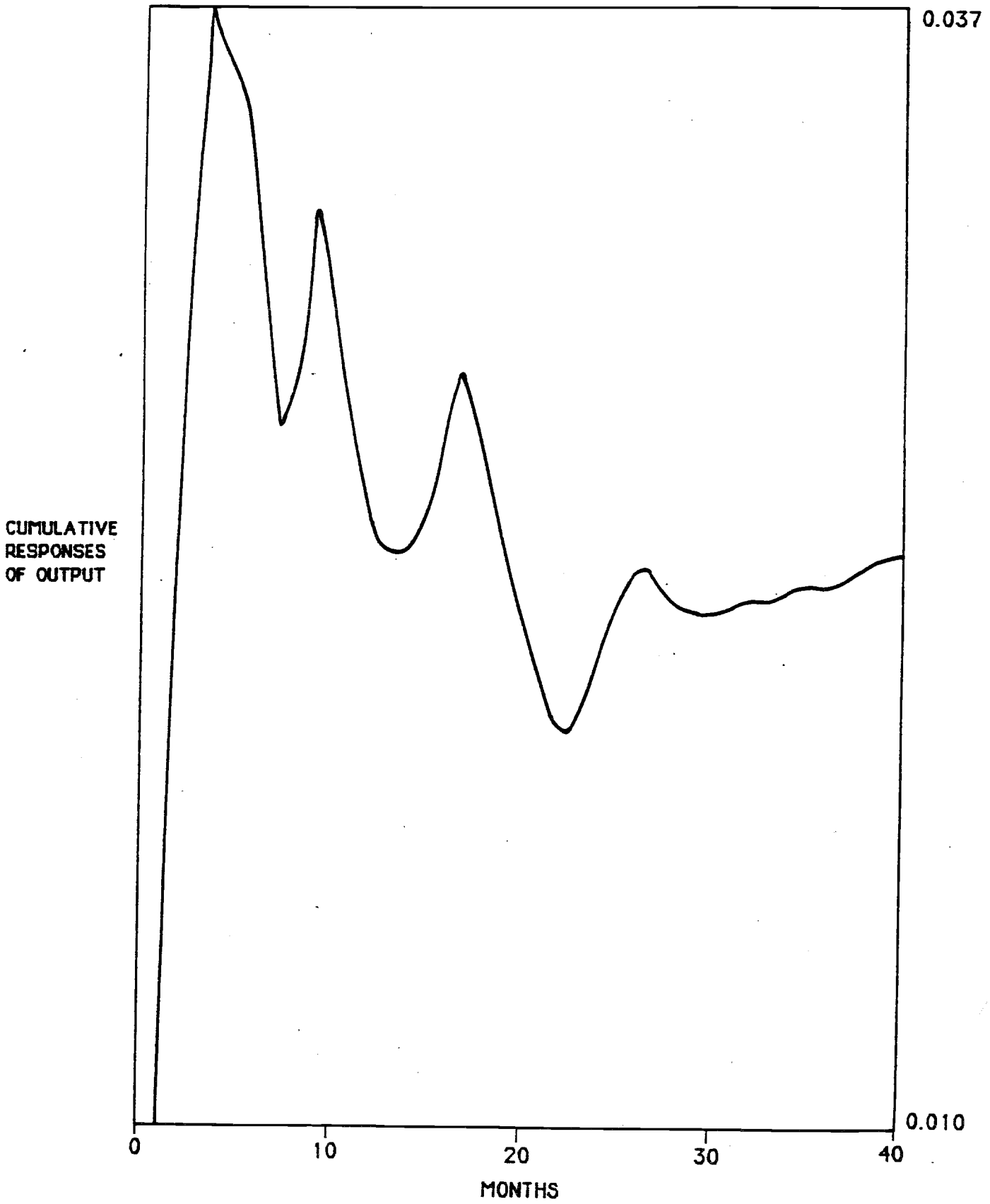

EXHIBIT 1
Credit Rationing During the Panic of 1907

TABLE No. 29.—LOAN AND DISCOUNT RATES IN THE NEW YORK MARKET, WEEKLY, 1890–1909—Continued.

1907.

Week ending—	Premium on currency (range).	Call loans at— Stock Exchange. Range.	Stock Exchange. Average.	Banks and trust companies (minimum).	Range of time loans. 30 days.	60 days.	90 days.	4 months.	5 months.	6 months.	7 months.	Commercial paper. Double names, choice 60 to 90 days.	Single names. Prime 4 to 6 months.	Good 4 to 6 months.
Jan. 4		2 – 15	15	5	7	7	6½– 7	6 –7	6 –6½	6 –6½		6 –6½	6 –6½	6½–7
11		2 – 15	6	3		6	6	6	6	6		6 –6½	6 –6½	6½–7
18		2½– 5	4	2½		5½	5½	6	6	6		6 –6½	6 –6½	6½–7
25		2 – 4	2½	2½		4½– 5	4½– 5	5½	5½	5½		5½–6½	5½–6½	6½
Feb. 1		1¾– 4	3	2	5½– 5½	5½– 5½	5½	5½	5½–5¾	5½–5¾		5½–6½	5½–6½	6½
8		2 – 6	2½	2½		4½	5	5½–5½	5½–5½	5½–5½		5½–6½	5½–6½	6½
15		2½– 6	4½	3	5 – 5½	5½– 5½	5½ 5½	5½	5½			5½–6½	5½–6½	6½
22		2 – 5½	5	4		5½	5½– 5½	5½	5½	5½		5½–6	5½–6	6½
Mar. 1		4 – 7	5	4		5½	5½	5½–5½	5½–5½	5½–5½		5½–6	5½–6	6½
8		3 – 6½	5½	4	6	6	5½– 6	5½	5½–5½	5½–5½		6 –6½	6 –6½	6½–7
15		3½– 25	10	6	5	7 – 7½	6½– 7	6½	6	6		6 –6½	6 –6½	6½–7
22		2 – 6	4	3	6½	6½	6 – 6½	6	6	6		6 –6½	6 –6½	6½–7
29		2½– 14	6	3		6½	6	6	6	6		6 –6½	6 –6½	6½–7
Apr. 5		1 – 4½	3	2		4½– 5	5	5½	5½	5½		6 –6½	6 –6½	6½–7
12		1½– 2½	2	2	4½– 4½	4½– 4½	4½– 4½	4½–4½	5	5		6	6	6½
19		1¾– 3	2½	2	3½– 4	3½– 4	4 – 4½	4 – 4½	5	5		5½–6	5½–6	6 –6½
26		1¾– 2½	2½	1½		3½	4 – 4½	4½–4½	4½–5	4½–5	5½	5½–6	5½–6	6½
May 3		1 – 4	2½	1½		3½	3½	4	4½	4½		5½–6	5½–6	6
10		2 – 3	2½	2½		3½	4	4½	4½	4½		5½	5½	5½–6
17		2 – 3	2½	2		3½– 4	4	4½–4½	4½–4½	4½–4½		5½	5½	5½–6
24		1½– 2½	2½	2	3 – 3½	3½– 4	4 – 4½	4½	4½–4½	4½–4½		5½	5½	5½–6
31		1½– 2½	1½	1½	2½– 3	3½	3½– 4	4	4½	4½	5½–5½	5 –5½	5 –5½	5½
June 7		1½– 2½	2	[d] 1½	3 – 3½	3 – 3½	4½	4½–5	4½–5	4½–5	5½	5	5 –5½	6
14		1½– 3½	2½	2	3½	3½– 4	4 – 4½	4½	4½	5½–5½	5½–5½	5½–6	5½–6	6½
21		2½– 3½	3	2½	4	4½	4½	4½–5	5½	5½	5½–6	5½	5½–6	6 –6½
28		2 – 12	5	2½		4½– 4½	4½– 4½	5	5½–5½	5½–5½	5½–6	5½	5½–6	6 –6½
July 5		3½– 15	8	3½		4½– 4½	4½– 4½	5	5½–5½	5½		5½	5½–6	6 –6½
12		2½– 8	6	2½		5	5½– 5½	5½–5½	5½–5½	6		5½–6	6	6 –6½
19		2½– 4	3½	2½	4½	4½– 4½	5	5½–5½	5½	5½		5½–6	6	6½
26		2 – 3	2½	[b] 2–2½	4	4½– 4½	5	5½–5½	5½–5½	6		5½–6	6	6½
Aug. 2		2 – 3½	3	2½		5	5½	5½	6 –6½	6 –6½		6	6 –6½	6½+
9		2 – 6	4	2½	5	5 – 6	6	6½	6½–7	6½–7		6	6 –6½	6½+
16		2½– 8	3	2½		6 – 6½	6½	6½–6½	6½–7	6½–7		6 –6½	6 –6½	6½+
23		1½– 3	2½	[c] 2	6	6½	6½– 7	7	6½–7	7		6 –6½	6 –6½	6½+
30		2½– 4	3	2½	5	5½	6 – 6½	6 –6½	6½–7	6½–7		6½	6½	6½–7
Sept. 6		2½– 4	3	2½		5½	5½– 6	6	6	6	6	6½–7	6½–7	7 –7½
13		2 – 6½	5	2½	5	5½	5½	6	6	6		6½–7	6½–7	7 –7½
20		2 – 5	4	2½	5	5½	5½	6	6	6		6½–7	6½–7	7 +
27		1 – 6	4	2½		5½	5½– 6	6	6	6		7	7	7 +
Oct. 4		3 – 10	5	3		5½– 6	6 – 6½	6 –6½	6 –6½	6 –6½		7	7	
11		2½– 6	5	3		6 – 6½	6½– 7	6½	6	6		[c] 7	[c] 7	[c] 7–7½
18		2½– 10	5	3		6	6½	6	6	6	6	[c] 7	[c] 7–7½	[c] 7½+
25		5 –125	40	6		[d] 6½– 7	[d] 6½– 7	[d] 6½–7	[c] 6	[c] 6	[c] 6	[c] 7–7½	[c] 7–7½	
Nov. 1	1 –3	3 – 75	50	[e]		12 –16	12 –16	No business.				No business.		
8	1 –4	4 – 25	22	[e]			12 –15	No business.				[c] 7–7½	[c] 7–7½	
15	2½–4	5 – 15	10	[e]		12 –15	12 –15	No business.				[c] 7–7½	[c] 7–7½	
22	1½–3½	3½– 15	10	[e]		12 –15	12 –15	No business.				No business.		
29	¼–1½	3 – 12	7	[e]			12 –15	No business.				8	8	
Dec. 6	½–2	3 – 13	6	[e]	No regular rates; all business subject to special agreement.									
13	½–1½	2 – 25	15	[e]		8 –10	8 –10	8	7 –8			[c] 8	[c] 8	
20	½–1½	6 – 17	12	[e]	15 –18	12	10	8	6 –7			[c] 8	[c] 8	
27	½–1½	6 – 25	20	[e]		12	10 –12		7½–8			[c] 8	[c] 8	
31 [f]	[g] ½– ½	5 – 20	17	[e]	12	10	10	8				8	8	

[a] Trust companies not in the market, rates being too low.
[b] Lower rate at banks only; trust companies put out no money at that figure.
[c] Quotations entirely nominal; no business.
[d] Nominal rates; no offerings.
[e] Banks and trust companies out of the market.
[f] Covers business for last two days of year.
[g] The premium on currency practically disappeared with the last day of the year.

Source: National Monetary Commission, Statistics of the United States, 1867-1909, January 1932.