The Great Depression in the United States

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Abstract: This chapter describes and explains the course of aggregate real activity and inflation in America from 1929 through 1937-38 within the theoretical framework of "new Keynesian" models with "financial market frictions." Those models point to plausible causes for the initial downturn, the depth of the subsequent decline in real activity, and the path of inflation and real wages over 1929-33. One key factor was Federal Reserve interest-rate policy as constrained by the "zero bound" on nominal interest rates and adherence to the international gold standard. Another was the development of a massive financial crisis in which the Federal Reserve system failed to act as lender of last resort, mainly because Fed policymakers did not believe a lender of last resort was needed. The course of the economy after 1933 presents some open questions, especially about the extremely high inflation rates observed over 1934-37 and causes of the second downturn in 1937-38.

In the United States, most people use the term "Great Depression" to refer to a long stretch of depressed real activity that began in late 1929 and did not end until after the outbreak of the Second World War. Figure 1 plots estimates of real GDP and unemployment over 1928-1939 (annual) along with the Federal Reserve Board's index of industrial production (monthly). Vertical lines mark business-cycle turning points (NBER chronology). The Depression began with a downturn from a cyclical peak in August 1929 to a trough in March 1933. A brisk expansion followed but before employment and output had recovered to their pre-1929 trends there was another downturn, from a peak in May 1937 to a trough in June 1938. These were two distinct business cycles and appeared as such to contemporaries. They referred to the first as "the Depression" and to the second as "the Recession." But in American historical memory the two cycles together constitute one big slump. In the historical memory of economists, such as it is, the American Great Depression is a case study in bad monetary and fiscal policy. Economists of our day often blame the Depression mainly on decisions of policymakers in the Federal Reserve system. In 2002, Ben Bernanke, then a Federal Reserve Board Governor, half-jokingly took responsibility for the Great Depression on the part of the Federal Reserve system: "we did it. We're very sorry...but we won't do it again" (Bernanke 2002).

[FIGURE 1 HERE]

In this chapter I review economic literature on the Great Depression to explain the course of aggregate real activity and inflation in the United States from 1929 through the beginning of the 1937-38 recession. There are many excellent short overviews of the Great Depression in the United States (e.g. Romer 1993, Temin 2000). This one is different in that it is specifically directed at graduate students in economics who are new to economic history but well-acquainted with current macroeconomic theory, especially “new Keynesian” models with financial-market "imperfections" or "frictions.” In those models, the channel from monetary policy and financial-market conditions to real activity runs through the economy's default-free real interest and/or the spread between that interest rate and the cost of borrowing to "credit-constrained" (or "liquidity-contrained") agents. I argue that it

is easy to explain the 1929-33 Depression in terms of such models. They point to plausible reasons for the beginning of the downturn and the depth of the subsequent decline in real activity. One key factor was Federal Reserve interest-rate policy, as constrained by the "zero bound" on nominal interest rates and America's adherence to the international gold standard. Another was the development of a massive financial crisis in which the Federal Reserve system failed to act as lender of last resort. New Keynesian models also account for the course of wage inflation, price inflation and real wages over 1929-33. About the 1933-36 recovery and the 1937-38 recession, the models define some puzzles and open questions.

There have been attempts to account for the Depression using “real business cycle” (RBC) models, as the result of an exogenous negative shock to production technology, or unusual institutional developments over 1929-33 that widened the "wedge" between the marginal disutility of labor and the cost of labor to firms. I ignore these because economic historians have found no evidence for either phenomenon.[1] With more misgiving, I also ignore monetarist explanations of the Great Depression, though monetarism frames many of the best studies of the Depression starting with Friedman and Schwartz (1963). In monetarist theory, fluctuations in aggregate demand affect real activity and inflation much as in Keynesian theory. But the key variable determining aggregate demand is not interest rates and borrowing costs as in Keynesian models. It is rather the "money supply": the quantity

[1]Cole and Ohanian (2007) observe that conventionally-measured aggregate total factor productivity fell a lot from 1929 to 1933. They argue this may represent an exogenous shock and can account for over half of the 1929-1933 decline in real GDP. Ohanian (2001, p. 37) speculates this TFP decline was due to "a decrease in organizational capital, the knowledge and know-how firms use to organize production...There are a number of reasons why this large stock of capital could have fallen, including breakdowns in relationships with suppliers that lead to changes in production plans, and breakdowns in customer relationships that lead to changes in marketing, distribution, and inventory plans." Studies that account for variations in labor and capital utilization find little or no decline in productivity over 1929-33 (Inklaar, De Jong and Gouma 2011, Watanabe 2016). Across the entire 1929-39 decade average productivity growth was remarkably rapid for reasons clearly related to the introduction and diffusion of new technologies (Field, 2011). On the labor wedge, Ohanian (2009) argues that Hoover administration policies prevented large industrial employers from cutting nominal wages after 1929. Thus price deflation, due to a drop in nominal aggregate demand, raised real manufacturing wages in a practically exogenous and historically unique way. In fact, as I will argue below, there was nothing at all unusual about the behavior of nominal wages over 1929-33; manufacturing wages fell just as one would predict from the usual "Phillips curve" relationship. Rose (2010) looks for evidence that Hoover's policies affected the timing or magnitude of wage cuts. He finds none.

of currency held by the public *plus* checkable deposits *plus* any other similarly liquid assets. Monetary policy and financial-market conditions affect aggregate demand through changes in this money supply (Woodford 2010, p. 22-23). Keynesian economists complain that monetarists generally, and Friedman and Schwartz (1963) particularly, never laid out exactly what they had in mind as the transmission mechanism from the money supply to aggregate demand (Bordo and Schwartz 2004; Romer and Romer 2013).[2]

In the first section of this chapter I review key elements of new Keynesian macroeconomic models, and also models that describe the nitty-gritty mechanics of interest-rate control by a central bank ("monetary policy implementation"). The latter are probably unfamiliar to the reader but they are needed to understand the nature of the zero bound constraint in the Depression. In the second section I describe peculiar institutional features of the American financial system in the 1920s, necessary background for understanding the Depression. In the third section I describe, narrate and explain the 1929-33 Depression. In the fourth I cover the 1933-36 recovery. In the final section I briefly discuss the 1937-38 recession.

1. Theoretical background

1.1 New Keynesian macroeconomic models

Consider a closed-economy "New Keynesian IS/LM" model of the simplest kind (e.g. King 2000) in which price adjustment is subject to a Rotemberg (1982) or Calvo (1983) constraint and all agents can borrow and lend at the same default-free interest rate per period. Let x^e denote today's

[2]Some authors (e.g. Bordo, Erceg and Evans 2000, Christiano, Eichenbaum and Evans, 2005) attempt to represent monetarist views within a new Keynesian model. In these models the interest rate that governs aggregate demand is indirectly determined by the quantity of a variable called "money" that is directly controlled by a central bank. The interest rate is related to "money" because "money" pays no interest and the ratio of money to the price level is an argument of the representative agent's utility function. Bringing the model to data, the authors match the model's "money" to monetary aggregate statistics such as M1, which correspond (at least roughly) to the monetarist notion of the money supply. That does not do justice to the data: most assets within M1 pay interest at market-determined rates. It does not do justice to monetarists: they never argued that the money supply affected aggregate demand only (or even primarily) through interest rates on financial assets (Bordo and Schwartz 2004). And it gives a misleading notion of the way a central bank controls interest rates.

expected value for a future variable *x*. The new Keynesian IS and AS ("new Keynesian Phillips curve") equations are:

(1.1) $$y_t = y^e_{t+1} - \alpha r_t + \epsilon_{1t}$$

(1.2) $$\pi_t = \delta \pi^e_{t+1} + \gamma y_t \quad where \quad 0 < \delta < 1$$

where *y* is the "output gap," here defined as the difference between aggregate output and "flex-price equilibrium" output in the long-run steady state. ϵ_1 describes effects of temporary disturbances to preference parameters or government purchases of output. *r* is the spread between the short-term (one-period) real interest rate and the long-run "natural rate of interest" (the rate at which $y = y^e_{+1} = 0$ when $\epsilon_1 = 0$).

The model is closed with a mechanism representing the monetary regime that determines *r* subject to a lower bound on the nominal interest rate usually assumed to be zero - hence the "zero bound." The mechanism (usually an interest rate rule, or a loss function minimized by a central bank as in Clarida, Gali and Gertler [1999]) must ensure the existence of a unique long-run steady state with $\pi^e = 0$. Generally:

(1.3) $$y_t = \sum_{\tau=0}^{\infty} \left[-\alpha r^e_{t+\tau} + \epsilon^e_{1t+\tau} \right]$$

The output gap depends on the path of expected values of the short-term real interest rate from the present through the distant future. Meanwhile inflation depends on expected values of the output gap over the same horizon:

(1.4) $$\pi_t = \gamma \sum_{\tau=0}^{\infty} \delta^\tau y^e_{t+\tau}$$

In standard models expectations are fully rational but a weaker condition, the "law of iterated expectations," is actually sufficient for (1.3) and (1.4) (Adam and Padula 2011).

Many studies find that, in reality, expected values of future output (e.g. real GDP) generated by the most sophisticated forecasting methods are usually quite close to simple autoregressive forecasts (literature surveyed by Chauvet and Potter 2013). Thus, it is realistic to assume that the public's expected values for future output are close to AR(1) forecasts except under special circumstances. Describe the public's the expected value of the output gap in a future period $t+\tau$ as:

(1.5) $$y^{e}{}_{t+\tau} = \rho^{\tau} y_t + z^{e}{}_{t+\tau}$$

where ρ is the serial correlation coefficient from an AR(1) estimate. $z^{e}_{t+\tau}$ summarizes effects of unusual events that cause the public's forecast for $y^{e}_{t+\tau}$ to differ from the AR(1) forecast. Most of the time $z^{e}_{t+\tau}$ must be small relative to fluctuations in *y* - otherwise AR forecasts would not work as well as they do. Together with (1.5), (1.3) and (1.4) give:

(1.6) $$y_t = -\frac{\alpha}{1-\rho} r_t + \epsilon_{2t} \quad where \quad \epsilon_{2t} = \frac{1}{1-\rho}\left[\epsilon_{1t} + z^{e}_{t+1}\right]$$

(1.7) $$\pi_t = \gamma \frac{1}{1-\delta\rho} y_t + \gamma \sum_{\tau=1}^{\infty} \delta^{\tau} z^{e}_{t+\tau}$$

Exogenous increases in the real interest rate should be associated with decreases in real activity. Decreases in real activity should be associated with declines in inflation. Unusual events that cause expectations of future real activity to deviate from their usual relationship with current real activity, that is nonzero values of z^{e}, cause output to deviate from its usual relationship with the current real interest rate and also cause inflation to deviate from its usual relationship with real activity.

In more complicated new Keynesian models there are mechanisms that create *lags* in effects of interest-rate shocks and *persistence* in disturbances to real activity, such as "habit formation" in consumption and costs of changing the rate of investment in capital (e.g. Christiano, Eichenbaum and Evans 2005, Smets and Wouters 2007). The labor market is imperfectly competitive and nominal wage

adjustment is subject to the same kinds of frictions that apply to prices (following Erceg, Henderson and Levin 2000). Wage and price inflation can be affected by "wage markup shocks," that is fluctuations in the spread that the wagesetting process effectively seeks to maintain between wages and workers' opportunity cost of employment (Gali, Smets and Wouters 2011). In open economy models (Galie and Monacelli 2005), real activity is affected by foreign demand for domestic output. There can be a variable corresponding to the unemployment rate which is negatively related to output, and has long-run steady state value corresponding to the "natural rate of unemployment" (e.g. Gali 2011). Many new Keynesian models include mechanisms to create persistence in inflation (e.g. "indexing") but those are not needed to understand the Depression as I will explain below.

New Keynesian models can include financial-market "imperfections" or "frictions." The real interest rate within *r* above is the return to default-free assets. With realistic constraints on contracting and "asymmetries" in information, some agents cannot borrow at that rate. If these "credit-constrained" agents can borrow at all, it is through contractual relationships with pledges of collateral to particular lenders who incur costs to collect private information about the borrower and enforce the contracts. In models the spread between the default-free rate within *r* and the cost of funds to a credit-constrained borrower depends on the borrower's net worth or "wealth." A"financial intermediary" is an agent that lends to credit-constrained borrowers with funds the intermediary borrows himself at the default-free rate or through yet another set of contractual lending relationships. In the latter case the cost of funds to a credit-constrained borrower depends not only on that borrower's own wealth but also on the net worth or "capital" of financial intermediaries (which affects the spread between the default-free interest rate and the rate *intermediaries* must pay for funds). Several models place financial market imperfections within a new Keynesian macroeconomic setting (e.g. Bernanke, Gertler and Gilchrist 1999; Gertler and Karadi 2011; Curdia and Woodford 2016). In these models, financial market imperfections magnify effects of changes in *r* on real activity - the "financial accelerator" - and create

several additional factors that can affect real activity including current taxes ("Ricardian equivalence" fails), wealth of households or net worth of firms producing output, and financial intermediaries' capital.

Generally, more complicated new Keynesian models imply:

$$y_t = -\sum_{\tau=0}^{i} \beta_{yr\tau} r_{t-\tau} + \sum_{\tau=1}^{j} \beta_{yy\tau} y_{t-\tau} + \epsilon_{yt} \tag{1.8}$$

$$\pi^P{}_t = \beta_{\pi py} y_t + \epsilon_{\pi pt} \tag{1.9}$$

$$\pi^W{}_t = \beta_{\pi wy} y_t + \epsilon_{\pi wt} \tag{1.10}$$

π^P and π^W are respectively price and wage inflation. ϵ_y still reflects fluctuations in preference parameters or government purchases of output and unusual unusual expectations of future real activity. But it can have many additional components: exogenous factors affecting demand for exports, taxes and government transfer payments, wealth of households and firms producing output, capital of financial intermediaries or anything that causes a withdrawal of lending to financial intermediaries (Woodford 2010). $\epsilon_{\pi P}$ and $\epsilon_{\pi W}$ can be affected by wage mark-up shocks (Gali 2011). (1.8) - (1.10) can alternatively be written in terms of the "unemployment gap," the difference between the unemployment rate and the natural rate of unemployment.

New Keynesian models have no necessary implication for the relative magnitude of $\beta_{\pi wy}$ versus $\beta_{\pi py}$, that is for the cyclical behavior of *real wages* (the ratio of the wage level to the price level). Real wages may be procyclical ($\beta_{\pi wy} > \beta_{\pi py}$), countercyclical ($\beta_{\pi wy} < \beta_{\pi py}$) or acyclical ($\beta_{\pi wy} \approx \beta_{\pi py}$) depending on the relative degree of nominal rigidity in wages *versus* prices, among other things (Gali 2013).

1.2 Runs on financial intermediaries

A financial intermediary that borrows short-term to lend longer-term can be vulnerable to "runs." In a run, short-term lenders *to* an intermediary withdraw their loans *en masse* (or lend less to the intermediary on a given amount of collateral). To repay its creditors the intermediary must sell off assets including the loans it has made. As assets, however, most loans made by intermediaries are "illiquid" - hard to sell quickly at the highest possible price. A buyer needs private information to assess the probability of default on the loans - that is why the borrowers had to take out loans in the first place rather than borrow at the safe interest rate. If an intermediary suffering a run is unable to find informed buyers quickly it may have to accept low prices from uninformed buyers (in a financial "fire sale") and be left unable to pay off all its creditors even if it would have been solvent absent the run (Shleifer and Vishny 2011). The intermediary must then go out of business or at least "suspend payments." In a suspension of payments, a run-on intermediary refuses to pay off its short-term borrowings as originally pledged, but promises to pay later in hope that the run will stop or it will be able to find informed buyers for its assets in the meantime. Either way, the intermediary stops lending at least for a while. A wave of runs on many intermediaries at once is a "financial crisis." Gertler, Kiyotaki and Prestipino (2017) present a new Keynesian macroeconomic model with financial intermediaries subject to runs, in which a financial crisis depresses real activity.

In models runs are set off by conditions that would arise in a business cycle downturn (e.g. Allen and Gale, 1998, Gertler, Kiyotaki and Prestipino, 2017). Thus runs may be another mechanism amplifying the effect of an increase in *r* (increasing β_{ry} and $\beta_{lag\,y}$). The relationship between economic conditions and runs is abruptly discontinuous because an individual lender to an intermediary has greater incentive to withdraw his loan if other lenders withdraw ("strategic complementarity") (e.g. Morris and Shin 2000; Goldstein and Pauzner 2005). In some models runs can be triggered by events not obviously related to macroeconomic conditions (e.g. Chari and Jagannathan 1988), or even occur

randomly (“caused” by “sunspots”) as in the well-known model of Diamond and Dybvig (1983). That implies runs can be a source of exogenous shocks to output (more components to ϵ_y in 1.8).

Generally, models of runs imply they can be prevented by an insurance system that pays off lenders to an intermediary if the intermediary defaults. Runs can also be prevented or mitigated by a “lender of last resort.” A lender of last resort provides funds to an intermediary in exchange for its illiquid assets, valuing the illiquid assets at the relatively high prices they would fetch eventually from informed buyers. A lender of last resort can provide funds either by buying the illiquid assets outright or by taking illiquid assets as collateral for loans. Because a lender of last resort needs either stupendous wealth or the ability to create funds at will, the most obvious real-world institution that can act as a lender of last resort is a central bank.

1.3 Mechanics of monetary policy implementation

Macroeconomic models skim over *minutiae*. New Keynesian macroeconomic models ignore, or describe in wildly unrealistic ways, the mechanism by which the value for a short-term interest rate desired by central bank policymakers becomes the market rate. This mechanism is, however, described in realistic models of monetary policy implementation. Most central banks today use variants of the same basic set-up (described by Ennis and Keister 2008). Firms and households make payments to each other by transferring ownership of short-term loans - “deposits” - to certain financial intermediaries - “banks.” Banks make payments to each other mainly by transferring balances in “reserve accounts” at a central bank. "High-powered money" is the total of these reserve balances and currency. The central bank pays a “reserve interest rate” on reserve-account balances and charges a higher “penalty rate” for short-term loans to banks. The market overnight rate cannot fall below the reserve interest rate (the return to lending overnight funds to the central bank) and cannot rise above the penalty rate (the cost of borrowing overnight funds from the central bank).

A bank that suffers a shortfall in its reserve account is required to borrow at the penalty rate to cover the shortfall. A shortfall might be an overdraft or a failure to meet a regulatory minimum "reserve requirement." A bank's "excess reserve" is its reserve balance less its reserve requirement. A bank's "free reserve" is its excess reserve *not* including funds borrowed from the central bank at the penalty rate. The total supply of free reserves is equal to the high-powered money less currency less bank's required minimum balances less their penalty-rate borrowing. The central bank adds to (subtracts from) free reserve supply when it buys (sells) assets on the open market.

There is a cost to a bank of holding free reserves: it loses the spread between the reserve interest rate and the market overnight rate. But there is also a benefit. It is hard to predict exactly when some reserve-account payment orders will go through. A bank that aims to keep a free reserve of zero may actually suffer a reserve shortfall and have to borrow at the high penalty rate. As a bank trades off the cost of holding free reserves against the benefit, aggregate demand for free reserves is a downward-sloping function of the market overnight rate, between the upper bound of the penalty rate and the lower bound of the reserve interest rate. This reserve-demand curve is shifted up (down) by an increase (decrease) in the penalty rate and/or the reserve interest rate. The market overnight rate equates the demand for free reserves to the supply.

A central bank can control the market overnight rate because it controls the supply of free reserves, the penalty rate and the reserve interest rate. A central bank can reduce the market overnight rate by adding to free reserve supply, or by lowering the penalty rate and/or reserve interest rate. A sufficiently large free reserve supply can drive the market rate all the way down to the reserve interest rate. At this point banks will be indifferent to holding even more funds in their reserve accounts so further increases in reserve supply will have no effect on market short-term rates. Also there will be no borrowing at the penalty rate to cover reserve-account shortfalls, because each bank holds a large enough free reserve to entirely eliminate the danger of a shortfall.

The ultimate lower bound on short-term nominal rates is the lowest possible value the central bank can pay for reserve balances. This might be the nominal interest rate on currency, which is zero. Hence the “zero lower bound.” When the market overnight rate has been pushed to the ultimate lower bound the economy is in a “liquidity trap.”

2. Historical background: the American economy in the 1920s

2.1 America’s banks

On the eve of the Great Depression the American financial system was more vulnerable to crises than other countries with sophisticated financial markets such as Britain, Australia and Canada. By the late nineteenth century each of those countries had a few large banks with nationwide branch networks which lent to businesses and households all over the country. Defaults by borrowers in a particular region did not threaten such a bank’s solvency. Bank assets included illiquid loans, long-term bonds and two types of liquid short-term assets: “call money” loans, and “acceptances.” Acceptances were bills (transferrable short-term debts) which had been guaranteed - “accepted” - by a firm of well-known solvency - the "acceptor." Some acceptances financed purchases of securities. Others - “real bills” - financed purchases of materials, inventories or goods for shipment. An accepted bill was usually liquid, easy to sell on secondary markets, because its default risk depended on the perceived solvency of its acceptor not the original issuer. Call money loans were overnight loans collateralized by stocks, bonds or acceptances. They were taken out mainly by speculators and dealers in cities with big financial markets. Banks made call money loans through their branches in those cities.

In the world’s largest financial market, London, the Bank of England had taken on the functions of a central bank and lender of last resort. The Bank could lend to practically anyone on almost any kind of collateral, and did so in crises (Bagehot 1873, p. 51, 196). However, the Bank could do a great deal to stabilize financial markets without lending directly to anyone in particular. In a crisis

acceptances could become illiquid as doubts arose about acceptors' solvency. The Bank helped to maintain bills' liquidity, hence intermediaries' ability to pay off their creditors on short notice, by making a standing offer to purchase ("rediscount") acceptances at a standard rate (Bagehot, 1873; Clapham, 1970; Bignon, Flandreau and Ugolini, 2012).

The United States was different. Prior to 1914 it had no central bank. American regulations prevented a bank from operating offices in more than one state (or even, in some states, more than one city). Most banks lent mainly to businesses and households within a small region. A merely regional downturn could threaten nanks' solvency. Fewer types of liquid assets were available to banks. Accepted bills did not exist, partly due to regulations (national banks were not allowed to guarantee bills).[3] An American bank could make call money loans but there was little demand for such loans outside New York city, the country's main securities market. Most banks outside New York made few if any call money loans. Their main liquid asset was interest-paying "interbank" demand deposits in New York banks which on-lent the funds to the New York call money market (James 1978). The prevalence of interbank deposits added an extra source of potential instability to the American financial system. Just as depositors in the hinterland might run on their banks, hinterland banks might run on New York banks (Chari 1989). In the decades before 1914 America suffered several national financial crises in which depositors started to withdraw deposits *en masse* from hinterland banks, hinterland banks started to withdraw their deposits *en masse* from New York banks, New York banks suspended payment, and banks throughout America suspended payment because their main liquid asset had become illiquid (Wicker 2000).

[3] The closest thing to accepted bills in American financial markets was a type of bill called "commercial paper." Commercial paper was less liquid than accepted bills, with no active secondary market, because it had no guarantor (James 1978). Its value depended on the perceived solvency of its original issuer - typically a firm that was relatively large but not as widely known as firms that accepted bills in Europe.

These crises occurred in the wake of cyclical downturns and stock-market crashes, which caused fears of defaults on bank assets (Calomiris and Gorton 1991). The cyclical downturns were in turn caused by hikes in American interest rates due to foreign financial crises or domestic monetary factors (Hanes and Rhode 2013). A national financial crisis accelerated a downturn, not just because it restricted the supply of loans from financial intermediaries as in new Keynesian models, but also because widespread suspension of bank payments made it harder to hire labor and sell things. Factories closed because they could not get cash for weekly payrolls. Trade declined because it was harder to make payments between cities. James, McAndrews and Weiman (2013) describe these effects. They show that widespread suspensions of bank payment were coincident with sharp drops in real activity. Real activity stabilized or turned up when banks resumed payment.

At the beginning of the Great Depression American banks were still prohibited from setting up branches in more than one state. Several state governments had attempted to set up systems of deposit insurance that could prevent bank runs by paying off depositors of a failed bank. But all these schemes had failed (Federal Deposit Insurance Corporation 1998).

2.2 The Federal Reserve system

The Federal Reserve system - the “Fed” - started operation in 1914. It was a confederation of twelve “Reserve banks” placed in major banking cities. One was in New York. Each Reserve bank had a geographically defined “district.” The whole system was overseen by a central Board (later known as the Board of Governors) that met in Washington. It was not clear exactly which potential actions of a Reserve bank required Board approval.

A bank could become a "member" of the Federal Reserve system. A member bank was required to hold a reserve balance in its district Reserve bank subject to a required minimum balance called a "reserve requirement." A member bank could use its reserve balance for payments to and from other banks and the federal government. Some banks (those chartered by the federal government,

called “national” banks) *had* to become members. Other banks (chartered by state governments) could choose whether or not to join. Many chose not to because members were subject to costly extra regulations and the Fed did not pay interest on reserve balances (Wingfield, 1941).

The designers of the Fed hoped that it would be eventually be able to operate as the Bank of England did, interacting with banks primarily through a market for acceptances. To that end American regulations were changed to encourage creation of acceptances, called “banker's acceptances" in America. Each Reserve bank set an “acceptance rate” at which it bought acceptances. By 1929 a market in acceptances had begun to develop but banks outside New York still did not hold many of them (Ferderer 2003).

The Federal Reserve's ability to lend to financial intermediaries was strictly limited by the law setting up the Fed, the "Federal Reserve Act," and later amendments to that law. A Federal Reserve bank could ordinarily lend only to a member bank. To lend to a nonmember bank a Reserve bank needed special permission from the Board in Washington. A Reserve bank could buy, or take as collateral for a loan, *only* banker's acceptances, federal debt, or certain types of bank loans - "eligible paper." To be "eligible" a bank loan had to be short-term (original maturity ninety days or less) and "for producing, purchasing, carrying or marketing goods in one or more of the steps of the process of production, manufacture or distribution." A loan was *not* eligible if it had been used to finance purchases of stocks or bonds, or "for permanent or fixed investments of any kind, such as land, buildings or machinery" (Steiner 1926). The rates at which Reserve banks bought (“rediscounted”) or lent against eligible paper could vary across Reserve banks. They became known as Federal Reserve “discount rates.” A bank that acquired funds this way was “borrowing through the discount window."

Discounting of eligible paper and purchases of banker’s acceptances occurred at the initiative of member banks. At its own initiative, a Federal Reserve bank could buy and sell federal government debt in “open market operations.” By the late 1920s most Reserve banks’ open market operations were

managed through a system-wide committee (later called the Federal Open Market Committee [FOMC]). Federal Reserve banks also made a standing offer to buy and sell gold at a fixed price. This put the U.S. "on the gold standard" as described further below.

By the late 1920s a market had developed in uncollateralized overnight loans of Federal reserve funds - "federal funds" (Meltzer 2003, p. 164), which operated alongside the long-established market for overnight call money. The level of market overnight rates for fed funds and call money was influenced by two factors under the control of the Federal Reserve system: Reserve bank discount rates, and the supply of free reserves. The mechanism (described by Hanes 2006) corresponded to the models described in section 1.4) except that the reserve interest rate was always zero. The "penalty rate" facing a member bank was its Reserve bank's discount rate (lacking acceptances, a bank short of funds usually had to borrow through the discount window). Free reserve supply was total reserve balances in excess of reserve requirements less funds supplied through the discount window. Fed purchases (sales) of gold, or of federal debt in open-market operations, added to (reduced) free reserve supply. A sufficiently large free reserve supply could push the market return to overnight lending down to the zero rate paid on reserve balances. At this point the economy would be in a liquidity trap.

Fed policymakers knew that their operations influenced short-term rates. But they had a different theory of the mechanism. Today their theory is called the "Burgess-Riefler doctrine" after two Fed staffers who developed it (Wheelock 1990, Meltzer 2003, p.141,161). This theory assumed banks wanted to hold a certain total quantity of reserve balances. If the Fed supplied less than this quantity through gold purchases and open market operations, banks had to borrow the difference through the discount window. But banks were "reluctant to borrow." A bank that had borrowed through the discount window would curtail lending to pay its debt to the Fed. An increase in free reserve supply reduced discount borrowing, hence made banks more willing to lend and reduced

market short-term interest rates. A decrease in discount rates had the same effect because it made banks more willing to remain in debt to the Fed.

The Burgess-Riefler doctrine implied that there was a limit to the Fed's influence on interest rates similar to the liquidity trap. Once free reserve supply was great enough to entirely eliminate discount-window borrowing, further increases in reserve supply could have no effect on financial market conditions.

2.3 The gold standard and the Fed's monetary policy strategy

In the late 1920s the U.S. and most of its international trading partners were in an international gold standard system. Each country had a monetary authority, usually a central bank, that exchanged currency and central bank reserve balances for gold at a fixed price. This held foreign exchange rates close to the values implied by the countries' relative gold prices ("gold parities"). The authority of a country running a balance-of-payments deficit could cover it by selling reserves of foreign assets, but once those were gone it had to sell gold. A country's long-run equilibrium price level was determined by its gold price and world prices, in gold, of tradable goods. The world gold price level was in turn determined by the balance of world gold supply against gold standard countries'demand for gold reserves. Overall the gold standard monetary regime appears to have kept inflation rates close to zero in the very long run (Taylor, 1999). Thus it satisfied the precondition for new Keynesian models that the long-run expected inflation rate be close to zero.

For an individual country, the gold standard was in most respects simply a commitment to fixed exchange rates. This placed a constraint on monetary policy. If international capital mobility had been "perfect" (so that "uncovered interest-rate parity" held) the constraint would have been very tight for all countries all the time: each country's nominal interest rates would have to equal foreign rates. In fact international mobility was "imperfect" (as in textbook models e.g. Romer 2006, pp. 236-41; Mankiw 2010, p. 153-161). A country's interest rates need not equal foreign rates, but its net inflow of

international investment, hence its balance of payments, decreased if foreign interest rates rose relative to the country's domestic interest rates. Thus the gold standard constraint on monetary policy was "asymmetric," tight on a country running a balance of payments deficit, loose on a country running a surplus (Temin 2000). Authorities of a surplus country did not have to eliminate the surplus. They could just keep buying up gold (or foreign assets); to prevent the high-powered money supply from increasing and reducing domestic interest rates, they could "sterilize" gold purchases by simultaneously selling bonds in open-market operations. Authorities of a deficit country, on the other hand, had to eliminate the deficit because they must run out of gold sooner or later. To eliminate the deficit they had to raise domestic interest rates. In the short run that did the trick by drawing in international investment. In the long run it depressed real activity, lowered the domestic inflation rate, lowered the country's nominal wage and price level and hence depreciated its real exchange rate. The gold standard's "rules of the game" called for a surplus country to allow its purchases of gold (or foreign assets) to boost its high-powered money supply and lower its interest rates. That would help other countries get back into balance. But there was nothing to *force* this policy on a surplus country.

Over most of the 1920s the United States ran a balance-of-payments surplus. Federal Reserve banks usually held no foreign-asset reserves, just gold. The most influential person in the Federal Reserve system was Benjamin Strong, head of the New York Reserve bank. Sometimes Strong called for decreases in U.S. interest rates to help deficit countries remain on the gold standard. More often he wanted to sterilize gold purchases and use the Fed's influence on financial-market conditions to stabilize the American price level. Strong and his staff monitored indicators of inflation and real activity. When there were signs of inflation or too-rapid growth Strong pushed for increases in discount rates, and/or open-market sales of securities to reduce free reserve supply. When there were

signs of deflation or slow growth Strong pushed for the opposite.[4] Strong usually managed to get support for his preferred policies (Meltzer 2003, pp. 169, 177, 209,230). Thus, over the 1920s the Fed followed something close to a Taylor rule with a zero inflation target (Orphanides 2003).

But Strong's monetary policy strategy was not universally accepted among Federal Reserve policymakers. Many Reserve bank heads and most members of the Board in Washington were adherents of the "real bills doctrine." According to this doctrine a central bank should not, and probably could not, use free reserve supply and discount rates to stabilize the price level.[5] Its discount rates should follow market rates, not control them. The important thing was to discourage "speculation" by hindering the supply of loans to finance purchases of securities. Thus, a European central bank should accept only real bills for rediscount. The Federal Reserve system should accept as collateral at the discount window only bank loans analogous to real bills. That was the idea behind the definition of eligible paper in the Federal Reserve Act.

Benjamin Strong died in 1928. His successor as head of the New York Reserve bank, George Harrison, shared Strong's views on strategy but lacked Strong's influence in the system (Eichengreen, 2016).

3) The 1929-33 Depression

[4] Strong explained the transmission mechanism from monetary policy to the price level this way: "when we have very cheap money, corporations and individuals borrow money in order to extend their business. That results in plant construction; plant construction employs more labor, brings in to use more materials for plant construction, and gives more employment. It may cause some elevation of wages. It creates more spending power; and with that start it will permeate through into the trades and the general price level" (quoted in Hetzel 1985, p. 7).

[5] Adolph Miller, the "dominant personality at the Board" (Meltzer p. 138), argued that arguments for price-level targeting relied on faulty assumptions: "One of those assumptions is that changes in the level of prices are caused by changes in the volume of credit and currency; the other is that changes in the volume of credit and currency are caused by Federal reserve policy. Neither one of those assumptions is true...undertaking to regulate the flow of Federal reserve credit by the price index is a great deal like trying to regulate the weather by the barometer. The barometer does not make the weather; it indicates what is in process" (quoted in Hetzel 1985, p. 10). Miller further argued that there was nothing the Fed could do to stop a recession: "you can not stop the recession by the lowering of the discount rate, the cheapening of the cost of credit, or making credit more abundant" (p. 12). The head of the Philadelphia Reserve bank said he did not believe the Fed should attempt to resist changes in the price level: "When the movement of prices is underway, it seems to me that it is always a doubtful and generally a dangerous thing for any outside agency to interfere with and attempt to alter the current" (p. 12).

3.1) 1928: the Federal Reserve hikes short-term interest rates

In 1928 there were no signs of inflation. Real activity was sluggish, if anything. But there was a developing boom in the stock market which Federal Reserve policymakers wanted to stop. They began to raise discount and acceptance rate and sold bonds to reduce free reserve supply. The idea was to raise short-term rates and choke back bank lending, in order to hinder the supply of loans to finance stock purchases (Meltzer 2003, pp. 224-25, 228, 235). Some Fed policymakers warned that this could have an undesirable side-effect: it could cause a recession and unwanted deflation (p. 225, 230, 239). Hoping to stop bank lending to finance stock purchases *specifically*, the Board directed reserve banks to apply "direct pressure" against such lending. This meant "restricting the [discount] borrowings from the federal reserve banks by those member banks which were increasingly disposed to lend funds for speculative purposes" (Miller 1935, p. 454), and requiring “interviews between Federal Reserve Bank officials and member banks whose [discount-window] borrowing appeared to be excessive or too continuous” (Burgess 1930, p. 16). In effect, Federal Reserve banks were to *ration* discount-window credit to banks that appeared to be lending on stock collateral.

[FIGURE 2 HERE]

The immediate result was a big increase in overnight rates. From December 1927 to May 1929 the call money rate rose by more than four percent. The overnight fed funds rate rose by about two percent (Willis 1957, p. 10). Both call money and fed funds rates rose well above the New York reserve bank’s discount rate, which had previously set a ceiling on market overnight rates, perhaps because “direct pressure” rationing raised the effective cost of discount borrowing above the posted discount rate (Beckhart and Smith 1932, p. 46; Wheelock 1990). A relatively clear indicator of the return to overnight lending (or at least the return to overnight lending expected to prevail within the next few weeks) is the rate on very short-term Treasury debt. This is plotted in Figure 2 on a monthly

frequency, along with the yield on long-term Treasury bonds.

3.2) The initial downturn 1929-30

On October 24th 1929 ("Black Thursday") the stock market crashed. Real activity had turned down before that. The NBER cyclical peak is August 1929. The obvious explanation of the downturn is the preceding hike in interest rates. This was plausibly an exogenous shock to real activity because it was not a response to inflation or rapid growth. From December 1927 to May 1929 short-term Treasury rates rose about two percent (Figure 2). This compares with increases in short-term Treasury rates in postwar (after the Second World War) policy tightenings engineered by the Fed. Romer and Romer (1989) identify six instances in which the Fed hiked short-term interest rates for reasons unrelated to current or forecast inflation. Around some of these tightenings, across a six or twelve-month window around the date of the policy change, three-month Treasury rates rose more than two percent. Across many of them three-month Treasury rates rose *less* than two percent. *All* of the tightenings were followed by cyclical downturns.

After August 1929, however, the decline in real activity was extraordinarily sharp. On current estimates by the U.S. Bureau of Economic Analysis (BEA), from 1929 to 1930 real GDP fell by about eight and a half percent. After the end of the Second World War real GDP never fell that much in one year, even in the most severe recessions. The decline in real GDP at the beginning of the "Great Recession," from 2008 to 2009, was less than three percent. What can explain the violence of the 1929 downturn? Was there something about the economy in 1929 that magnified the effect of an increase in interest rates? Were there other exogenous shocks that contributed to the downturn?

New Keynesian models imply that the immediate decline in real activity associated with a hike in interest rates is unusually large if people expect the current recession to be unusually bad, so that expected future real activity deviates from its usual relationship to current real activity (negative values

of z^e in (1.5)). That cannot explain 1929-30. There is no evidence expectations were unusually pessimistic at the beginning of the Great Depression. It appears people believed they were facing a normal cyclical downturn (Mathy and Stekler 2017). Business managers forecast a slowdown in real activity less severe than the one that actually occurred (Klug, Landon-Lane and White 2005). There was nothing unusual about that. At the start of deep recessions in the postwar era, forecasts of real activity have been similarly overoptimistic (Mankiw 2010, p. 449).

The stock market crash may have worsened the downturn. It was a big hit to households' net worth (Mishkin 1978). In New Keynesian models with financial market frictions, a reduction in wealth reduces real activity. To the degree the crash reflected a decline in rational expectations of future corporate earnings, this was part of the financial accelerator. If the crash was the bursting of an irrational bubble - a debatable point (White 1990) - it was an additional cause.

Had the American economy built up some type of "financial fragility" that supercharged the financial accelerator? In models of financial frictions, the decline in real activity resulting from a negative shock is greater if households have previously taken on lots of debt in a "credit boom," so that their net worth is already low at the time the shock hits (Gertler and Gilchrist 2017). Perhaps such a credit boom had taken place in the 1920s (Eichengreen and Michener 2004). New forms of debt had been created to finance purchases of new "consumer durables" such as automobiles and radios. Much of this debt was on the "installment plan," which gave borrowers strong incentive to cut back on other spending in response to a decline in current income. This may have caused household spending to decline more after 1929 (Olney 1999). Also, around 1925 there had been a nationwide boom in residential real estate: an increase in house construction, rising house prices and an unprecedented increase in mortgage debt. The boom ended before 1929: over 1925-27 prices fell off a bit, construction fell off a lot. But the boom may have left something behind, such as more mortgage debt,

that affected spending after 1929. Over 1929-33 the cities that had seen the biggest booms around 1925 suffered the biggest declines in house prices and the highest mortgage foreclosure rates (Brocker and Hanes 2014).

3.3) Continued decline 1930-33

Real activity continued to decline through 1933 - four years in a row. This is what made the Great Depression great. In most postwar recessions, real GDP fell for just one year. There were just two postwar recessions in which real GDP fell for as long as two years (1973-75, 2008-2010).

[FIGURE 3 HERE]

One factor that probably did *not* contribute to continued decline was fiscal policy. The response of the federal government led by the Hoover administration was to boost spending while raising tax rates as needed to maintain a balanced budget (Fishback 2010, p. 402-3). Figure 3 plots real purchases of goods and services by all levels of government (federal, state and local). Government purchases rose from 1929 to 1931 and fell only modestly from 1931 to 1933. Figure 4 plots taxes, government transfer payments to households, and the ratio of taxes net of transfers to national income. New Keynesian models with financial frictions imply that an increase in this ratio might reduce spending of liquidity-constrained agents. The ratio did increase after 1931 but not much. Marginal personal income tax rates were lower over 1930-33 than they had been in 1929 (Meltzer 2003, p. 563).

[FIGURE 4 HERE]

A factor that did contribute to decline but only in a small way was a dropoff in demand for American exports. Real exports, plotted in Figure 3, fell steadily from 1929 through 1932. This was largely blowback from the American interest-rate hike of 1928-29. Along with the stock-market boom, the hike in American interest rates drew in international investment, increased the American balance-of-payments surplus and drained gold from foreign monetary authorities. To save their gold reserves they raised domestic interest rates. That, and a series of financial crises in Europe, put foreign

economies into recession and decreased their demand for American goods (Eichengreen 1992 p. 246). But exports were a small portion of American GDP. Thus this (and the "Smoot-Hawley" tariff increase of 1930) cannot have made much difference (Temin 2000, p. 305).

So what explains the persistence and depth of the decline in real activity after 1930? One obvious cause was a perverse hike in short-term interest rates engineered by the Fed in the midst of the downturn. Another was an increase in bank failures that started in late 1930 and ended in 1933 in a massive financial crisis. New Keynesian models imply both of these factors could prolong and deepen the Depression.

3.4) Federal Reserve interest rate policy

On the heels of the October 1929 stock market crash policymakers at the Federal Reserve Bank of New York bought bonds in open market operations, hoping to help stabilize financial markets. They did not ask the Board in Washington for permission which annoyed members of the Board. At the beginning of November the Board allowed the New York Reserve bank to cut its discount rate but only on condition that it suspend open-market purchases (Meltzer 2003, p. 243-44).

By January 1930 it became apparent that a recession had begun (Meltzer 2003, 291). As the recession deepened Fed policymakers became aware of its severity (p. 315). Fed policymakers did not agree on what their response should be. Some, including George Harrison of the New York Reserve bank, wanted to lower market interest rates and spur bank lending to fight the recession (consistent with Benjamin Strong's strategy). Others, adherents of the real bills doctrine, opposed any such actions (Meltzer 2003, p. 290). Harrison's side mostly prevailed. From 1930 through the middle of 1931 they pushed through several cuts in discount and acceptance rates. Free reserve supply grew rapidly as the system purchased bonds in open market operations and refrained from sterilizing gold inflows. Overall, Fed interest-rate policy in the first year of the Depression was similar to policy in postwar downturns including the post-2008 Great Recession. In the Great Recession the Fed began to cut its

target fed funds rate in July 2008; over the following year the market fed funds rate and three month Treasuries both fell about 3 and a quarter percent. From October 1929 to October 1930, fed funds rates fell by about 4 and a quarter percent (Willis 1957, p. 10); short-term Treasuries fell about 2 and three quarters percent (Figure 2).

In late 1931 all the Fed's information indicated that real activity was still falling. But the Fed took steps to raise short-term rates. As shown in Figure 2, short-term Treasury rates rose almost 2 1/2 percent from August to December 1931. The increase in short-term rates was accompanied by an unusually large increase in long-term rates.

Why did the Fed act in this perverse way? To maintain the gold standard. Over 1930-31 many foreign central banks had raised domestic interest rates to prevent gold outflows. In summer 1931 German authorities stopped outflows of international investment and gold with regulations (exchange controls). In September 1931 authorities in Britain and most dominions of the British Empire stopped paying out gold for domestic currency, effectively floating their currencies (Temin 2000 p. 312; Meltzer 2003, p. 342). International investors feared the U.S. would follow suit. They sold American assets and bought gold. The Federal Reserve's gold reserve was draining out. To show commitment to the gold standard and stop the drain the Federal Reserve system acted to raise American short-term interest rates, mainly by hiking discount rates (Eichengreen 1992, p. 293-4).

The interest-rate hikes did what they were supposed to do. Gold outflow stopped in November and reversed in December (Meltzer 2003, p. 354). Relieved, Fed policymakers began to discuss steps to lower interest rates. But they were stymied by a provision of the Federal Reserve Act which required each Reserve bank to hold a minimum gold reserve (valued at the official price) equal to 35 percent of the balances held in that Reserve bank plus 40 percent of the Federal Reserve notes (a type of currency) issued by that Reserve bank. Some Reserve banks were up against these minimums. Without "free gold" they could not cover the increases in reserve balances that would result from open-market

bond purchases or increased discount-window lending to banks (Meltzer 2003, 354, 357).

In February 1932 Congress passed a revision to the Federal Reserve Act that loosened the free gold constraint. The Federal Reserve began to buy bonds in open market operations. The New York reserve bank cut its discount rate and cut it again in June. By late spring 1932 Federal funds rates were at the lowest level ever observed in the 1920s-1930s (1/8 of one percent) and there was almost no discount borrowing (Willis 1957, p. 10). Three-month Treasuries were down to 1/4 percent (Figure 2).

In July 1932 the Fed stopped buying bonds. Why? Eichengreen (1992, p. 315-16) argues that Fed policymakers feared further bond purchases might raise doubts about American authorities' commitment to the gold standard and trigger outflows of international investment and gold like those seen in 1931. Epstein and Ferguson (1984) argue that Fed policymakers feared that low short-term interest rates would depress bank profits. According to Hsieh and Romer (2006, p. 169), "the Federal Reserve decided to slow the monetary expansion in mid-June in part because its model of monetary policy led it to believe that monetary conditions were already loose and that further purchases would be of little use." They refer to the Burgess-Riefler doctrine which implied that open-market purchases and discount-rate cuts lost their stimulative power once free reserve supply was so great that banks had no debt to the discount window. Hsieh and Romer call the Burgess-Riefler doctrine "a flawed model of the economy" (p. 172).

The Burgess-Riefler doctrine was indeed a flawed model but new Keynesian models imply that Federal Reserve policymakers were right about one thing: further increases in reserve supply or discount-rate cuts were useless. Short-term rates were at the zero bound. As shown in Figure 2, by the end of 1932 three-month Treasuries were less than a tenth of a percent. This is about the same as the three-month Treasury rate that prevailed in 2010, when the Federal Reserve's overnight-rate target was practically zero. The absence of discount borrowing in 1932 confirms that the economy was indeed in a liquidity trap. Recall that in the correct model of overnight-rate determination described in 1.3), when

the return to overnight lending is equal to the reserve interest rate (zero in this case), banks stop borrowing at the penalty rate to cover reserve-account shortfalls.

Unfortunately, the Fed was unable to leave interest rates on the floor for long. The gold standard took one more bite. In February 1933 international investors again began to fear that American authorities would devalue the dollar. The balance of international investment again turned against the U.S. The New York Reserve bank, which sold most gold for export, was running out of gold. In accordance with gold standard orthodoxy, Fed policymakers allowed market interest rates to rise as gold sales reduced free reserve supply by refraining from sterilization and hiking discount rates (Meltzer 2003, p. 379). But this time the increase in short-term rates did not stop the gold drain (Friedman and Schwartz 1963, p.326; Wigmore 1987, p. 748; Meltzer 2003, p. 387). On March 6th 1933 the incoming president, Franklin Roosevelt, solved the problem by suspending Federal Reserve banks' obligation to exchange gold for dollars (Friedman and Schwartz 1963, p. 328).

3.5) Bank failures and the financial crisis of 1933

From late 1930 through 1932 there were waves of bank failures. Their timing is indicated by Figure 5, which plots total deposits in banks that suspended payment and reopened later or went permanently out of business in a given month, as a fraction of deposits in American banks. The first wave hit in October 1930. Another peaked in October 1931 while the Fed was raising short-term rates in the wake of Britain's devaluation. Until late 1932 failures remained confined to a few cities or regions and the fraction of deposits in failed banks was very small. These failures may nonetheless have significantly disrupted financial intermediation. Total deposits, also plotted in Figure 5, began to fall at the time of the first wave of failures and plummeted at the time of the second wave. At the same points in time currency held by the public increased (Friedman and Schwartz 1963, pp. 311, 313). It looks like regional bank failures caused nationwide withdrawal of funding from banks.

[FIGURE 5 HERE]

At the end of 1932 things got worse. A wave of failures that began in the far west spread to the midwest and the then-important city of Detroit. In February 1933 New York banks began to see mass withdrawal of interbank deposits (Friedman and Schwartz 1963, p.324-326). In March 1933 there was a crisis worse than any of the pre-1914 era. Pre-1914 crises had been resolved by suspensions of payments organized by private bank associations (clearing houses) during which banks stopped handing out currency but still provided many other services. The 1933 crisis was resolved by government-ordered shutdowns of all banks, cheerfully called "bank holidays," that stopped nearly all bank services. By the beginning of March 1933 nearly all states' governors had declared holidays. On March 6, incoming president Franklin Roosevelt declared a national bank holiday that shut down all banks in the country. At that time households and businesses in much of the country had already been without bank services for weeks.

Bank failures may have been an amplification mechanism more than an independent cause of the Depression. Up to 1933, at least, banks that failed appear to have been relatively close to insolvency *before* depositors began withdrawing *en masse* because of interactions between their prior investment policies and the Depression's effects on loan defaults and prices of relatively risky bonds (Calomiris and Mason 1997, 2003b). In any case bank failures and withdrawal of funding from banks must have deepened the Depression. In models of financial frictions, hindrances to the operation of financial intermediaries depress real activity by raising the cost of funds to liquidity-constrained borrowers. Bernanke (1983) argues that this mechanism was at work over 1930-33. Christiano, Motto and Rostagno (2003) present a new Keynesian model with financial intermediation by banks, specifically meant to describe the Depression era. In the model, withdrawal of deposits and increased demand for currency reduces aggregate output.[6] Recall that in pre-1914 financial crises, suspensions of

[6]In their model the shift from deposits to currency occurs because of a shock to preferences, not a response to bank failures. They also assume that the supply of high-powered money would not respond to the consequences of the shock, which is not

payments appear to have depressed real activity by making it harder to produce and trade. There is abundant evidence that held over 1930-33 (Rockoff 1993; Kennedy 1973, p. 161-164). Over 1929-33, across time and across geographic regions, bank failures were strongly associated with lower real activity (Bernanke 1983, Calomiris and Mason 2003b).

3.6) Where was the lender of last resort?

Some banks that failed over 1930-32 were merely "illiquid" rather than "insolvent" (Richardson 2007). They closed only because their depositors had withdrawn *en masse* creating a financial fire-sale problem. Certainly, it was a liquidity crisis, not a wave of ordinary insolvency, that hit in 1933. In a liquidity crisis a lender of last resort can prevent closure of financial intermediaries by purchasing their illiquid assets or taking them as collateral for loans. A central bank is supposed to act as a lender of last resort. What was the Federal Reserve system doing all this time?

Provisions of the Federal Reserve Act hindered the ability of the Federal Reserve system to act as a lender of last resort. In the regional crises of 1930-32 many banks that needed to borrow were not member banks. Some member banks that needed to borrow did not hold enough assets the Fed would accept as collateral for a loan - Federal debt, banker's acceptances, eligible paper (Carlson and Wheelock 2016). The Fed was not allowed to lend against many types of bank assets that were illiquid or became so in a crisis, such as long-term corporate bonds.

To act effectively as a lender of last resort, a Reserve bank had to "improvise and test the limits of the Federal Reserve Act" (Bordo and Wheelock 2013, p. 88). Some Reserve banks, most prominently the Federal Reserve Bank of Atlanta, did push the limits. Other Reserve banks, such as the Federal Reserve Bank of St. Louis, did not. Richardson and Troost (2009) examined a crisis in late 1930 that affected banks in a region that straddled the line between the Atlanta and St. Louis districts.

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realistic. But the model does illustrate how deposit withdrawal can affect real activity within an otherwise-conventional new Keynesian model.

They found banks were less likely to fail, and business activity remained stronger, within the Atlanta district. "If other Federal Reserve banks had pursued similar strategies [to Atlanta's], fewer banks would have failed, and the depression may have followed a different course" (p. 1034). Unfortunately, most Reserve banks were like St. Louis.

In the absence of Federal Reserve action President Hoover and Congress set up other institutions that could lend to more types of financial intermediary and on more types of collateral. The most important was the Reconstruction Finance Corporation (RFC) established in January 1932. Unfortunately, the RFC's effectiveness was crippled by a law passed in July 1932 that "was interpreted as requiring the publication of the names of banks to which the RFC had made loans...The inclusion of a bank's name on the list was correctly interpreted as a sign of weakness, and hence frequently led to runs on the bank" (Friedman and Schwartz 1963, p. 325).

Why did Federal Reserve policymakers not try harder to act as lender of last resort? Because most of them did not think that was their job. Even the head of the New York Reserve bank, George Harrison, opposed proposals to let Reserve banks lend on more types of assets or lend indirectly through less-constrained agencies (Meltzer 2003, p. 347). In February 1932 the same legislation that loosened the Fed's free gold constraint (the Glass-Steagall Act of February 1932) made it possible for Reserve banks to lend on any kind of collateral, under certain conditions (only to relatively small member banks and on approval of Board members [Carlson and Wheelock 2016]). Incredibly, Reserve banks failed to take advantage of this (Meltzer 2003, p. 358). The head of the Fed's Board from 1930 through early 1933, Eugene Meyer, supported the creation of the RFC and even served concurrently as chairman of the RFC's board. He did not appear to believe there was any overlap between the functions of the RFC and the Fed.

When the Fed was founded in 1914, its supporters argued that it would prevent the kinds of financial crises that had plagued the U.S. But they did not expect it to do so by acting as a lender of last resort. They believed the U.S. had suffered financial crises before 1914 mainly because its supply of high-powered money did not adjust to seasonal fluctuations in money demand; by following the real bills doctrine the Federal Reserve system would automatically adjust money supply and create an "elastic currency" so that "such a thing as a currency and credit panic can not exist under the Federal Reserve system" (Miller, quoted in Hetzel 1985, p. 12).

Some influential people in the Federal Reserve system believed that a lender of last resort actually did more harm than good. Henry Parker Willis was Secretary of the Federal Reserve board 1914-18 and research director at the board 1918-22. In a book published in the wake of the 1933 crisis, he wrote (Willis 1936):

The commonest and least precise idea of central banking is that which regards it as a form of "emergency relief" or "panic insurance." According to this viewpoint, ordinary banks are likely from time to time to get into "trouble"..due to the acquisition of "frozen" [that is illiquid] assets...lack of confidence in which depositors or other creditors, believing they cannot at will convert their claims into cash, may bring about a "run," thereby forcing a bank into an embarassed condition, or even forcing it to suspend...it may be possible to afford "relief"...through rediscounting or buying paper held in the embarassed institution which it could not otherwise dispose of (pp. 5,6)

the view of central banking which considers it a means of helping out hard-pressed banks that have become "frozen" is not only theoretically unsound but is actually found in most cases to be injurious...When a central bank does so it merely tends to make a bad matter worse (p. 15)

Willis believed that the constraints on Fed lending imposed by the definition of eligible collateral was a good thing *because it made it harder for the Fed to act as lender of last resort*:

The fact that throughout the whole history of Federal Reserve banking, there has been continuous resistance to the observance of eligibility rules shows conclusively the need of them, and illustrates the danger involved in making the central bank merely a medium of emergency relief, to be availed of in times of stress..As long as this conception of central banking prevails, there will, of course, be continuous danger (p. 138)

Meltzer (2003, p. 731) concluded that Fed policymakers were influenced by a "firm belief" that

the system "could, or should, do nothing to prevent bank failures...Failures, they believed, were the inevitable consequence of bad decisions and speculative excesses that had to be purged before stability could return."

3.6) Aggregate supply in the 1929-33 downturn: wage inflation, price inflation, real wages

While real activity declined over 1929-33, what happened to inflation? Pretty much what one would expect based on new Keynesian models and experience in other cyclical downturns.

In simple new Keynesian models inflation rises and falls with the output gap (expressions (1.9), (1.10)). One of the conditions generating that relationship is that the public's expected value for the inflation rate that will prevail in the long-run future is zero. That condition seems to have held at the outset of the Great Depression. Inflation had been close to zero for several years. Judging from contemporary literature, most people believed the gold standard would assure a roughly stable price level in the long-run future. Experts assumed the dollar's gold value would remain fixed and forecast a stable or slightly decreasing price level based on the balance of world gold supply and demand (Nelson, 1991: 6-7). Thus, new Keynesian theory implies that wage and price inflation should have fallen along with real activity over 1929-33. That is what happened. Figure 6 plots inflation (percent change from the same month or quarter of the previous year) in a monthly index of average hourly earnings in manufacturing (the only high-frequency indicator of wage inflation from the 1930s that can be compared with series from other historical eras) and two price indices: a monthly CPI, and a quarterly GNP deflator. Inflation started to fall almost immediately after the cyclical peak and fell more as the depression deepened. Because inflation was about zero at the start this meant deflation.

[FIGURE 6 HERE]

There have been other historical eras in which expected long-run inflation was probably close to zero. Before 1914 the international gold standard could reasonably be believed to ensure a stable price level in the long run. From the 1950s through the mid-1960s and again after the 1980s, expected

future long-run inflation appears to have been "anchored" at a low value by public confidence in monetary policy. Data from all of those eras are consistent with (1.9) and (1.10): wage and price inflation are positively (negatively) correlated with estimates of the output (unemployment) gap (Gordon 1990; Alogoskoufis and Smith 1991; Allen 1992; Gali, 2011; Ball and Mazumder 2015; Blanchard 2016).[7]

[FIGURE 7 HERE]

The magnitude of deflation over 1929-33 was about what one would expect from patterns in those other eras. Figure 7 is a scatterplot of annual data on wage inflation and unemployment rates from 1924-1939 and 1891-1914 and 1954-1965. I chose these particular sets of years to compare with the Great Depression because they are covered by comparable series on wage inflation and unemployment rates, and they were unaffected by wage and price controls.[8] The observations for 1930-32 are in line with those from 1891-1914 and 1954-65.[9] Observations from 1933-1938 are different: those years' annual wage inflation is anomalously high. I will return to this point later.

Returning to Figure 6, note that over 1930-31 the two measures of price inflation fell faster than wage inflation: real wages were countercyclical. That may seem odd. Most studies of postwar data find real wages to be procyclical or acyclical. But it was the usual pattern in recessions prior to the Second World War. It was not anything special about the Great Depression. Whenever one can compare similarly-constructed wage and price series across historical eras, real wages appear less procyclical, more countercyclical in eras prior to the Second World War (Hanes 1996). Huang, Liu and

[7]In some postwar years, from the later 1960s through the 1980s, real activity was correlated with the *change* in inflation - that is, inflation was strongly "persistent." Inflation persistence can be generated in new Keynesian models by "indexing" wages and prices to lagged inflation (e.g. Christiano, Eichenbaum and Evans 2005). It can also be generated in models where the expected long-run future inflation rate varies over time. The latter possibility is tricky; see Ascari (2004), Kozicky and Tinsley (2005), Cogley and Sbordone (2008).

[8]The Korean War controls were lifted in February 1953(Rockoff 1984).

[9] It is sometimes claimed that nominal wages were unusually rigid in the 1929-33 downturn (e.g. O'Brien 1989; Ohanian 2009). Obviously not true.

Phaneuf (2004) show that this historical development is consistent with new Keynesian models that allow for multiple stages of production, so that sticky-priced output is used partly as an input to production of more sticky-priced output. In these models real wages are more countercyclical if there are fewer number of stages or rounds of production before final sale. In the U.S. both consumer goods and aggregate final output (GDP) were less finished, in this sense, in the 1930s than in postwar decades (Hanes 1999).

4) The recovery 1933-1937

The recovery from the March 1933 cyclical trough was spectacular. On current BEA estimates, in *every* year from 1934 through 1936, annual real GDP grew faster than in *any* year after the Second World War. Three factors undoubtedly contributed to recovery. First, fiscal policy was mildly stimulative. Second, short-term nominal interest rates were as low as they could go: monetary policy pushed them back down to the floor and, this time, kept them there. Third, financial intermediaries were reactivated. Banks reopened and were reformed in a way that created confidence they would not fail in the future. Deposits flowed back in. That is, funding for loans to credit-constrained borrowers flowed back into financial intermediaries. Yet another factor may have contributed to recovery, but its existence is hard to prove. Monetary and exchange-rate policies adopted by the incoming Roosevelt administration may have created expectations of future inflation. In new Keynesian models, that would give an immediate boost to current real activity.

4.1) Fiscal policy

Real gvernment purchases of goods and services rose from 1933 through 1936 (Figure 3), while the ratio of taxes-net-of-transfers to national income fell (Figure 4). Thus fiscal policy contributed to recovery. But most analysis has concluded that the contribution was modest at best (e.g. Brown 1956). In 1936 the federal government made a one-time "bonus" transfer payment (apparent in Figure 4) to veterans of the First World War. Hausman (2016) argues that the bonus allowed credit-

constrained recipients to borrow against expected future income growth and boosted 1936 GDP growth by as much as 1.6 percent. But that was not much relative to total real GDP growth in 1936, which was almost 13 percent.

4.2) Revival of the banking system

Most banks were back in business less than two weeks after Roosevelt's proclamation of the national bank holiday on March 4th 1933 (Friedman and Schwartz 1963, p. 421-8; Awalt 1969; Kennedy 1973, 179-202; Meltzer 2003, p. 421-435). Within that short time legislation had been passed that allowed the RFC to lend on security of low-quality assets and to make equity investments in banks to boost bank capital. Also, all banks had been examined by agents of existing bank regulators and triaged. Those that were clearly solvent and liquid were reopened over March 13-15. Deeply insolvent banks were sent into liquidation; owners lost their investment, depositors and other creditors received a fraction of what was owed them. (The process usually involved a loan from the RFC, so that illiquid assets could be sold off slowly and get a better price.). Marginally solvent banks were reorganized and reopened gradually (often with a capital contribution from the RFC). In January 1934 a new deposit insurance scheme started operation, backed by the federal government (Federal Deposit Insurance Corporation 1998, pp. 27-31).

Deposits began to flow back into banks quickly starting in January 1934 (Figure 5). Of course, that does not mean the spread between safe interest rates and the cost of funds to credit-constrained borrowers snapped right back to pre-1929 levels. There is evidence loan supply remained impaired after 1933. Many banks still had less capital than before the depression and they appear to have required higher expected returns on risky assets such as loans relative to safe assets such as government bonds (Friedman and Schwartz 1963, 449-462; Calomiris and Wilson 2004).

4.3) The path of short-term interest rates

In January 1934 the Roosevelt administration put the United States back on the gold standard,

in the sense that American monetary authorities resumed exchange of dollars for gold a fixed price. It was a new, higher price, however, which devalued the dollar against currencies of the many countries which continued to fix or at least tightly manage their gold exchange rates. Under new institutional arrangements the Treasury rather than the Fed exchanged gold for dollars (buying gold from anyone, selling gold only to foreign monetary authorities). But just as before gold purchases added to high-powered money (Meltzer, 2003: 458). Also as before the U.S. usually ran a balance of payments surplus. The Federal Reserve did not sterilize the effect of Treasury gold purchases, so high-powered money and free reserves grew rapidly. Overnight rates fell. In early 1934 the fed funds rate was back on the floor. Discount borrowing to cover reserve shortfalls was nil (Hanes 2006). This situation prevailed through the beginning of 1937, as indicated by the low Treasury bill rate in Figure 2.

4.4) Expected future inflation

Many economists have argued that Roosevelt's suspension of gold payments in March 1933 and devaluation of the dollar against gold in January 1934 created expectations of future inflation (Temin and Wigmore 1990, Jalil and Rua 2016). That would certainly have been true if expectations were sufficiently rational. Generally, exchange-rate devaluation raises import prices and the domestic price level (Eichengreen 2004). A commitment to a devalued exchange rate is effectively a promise on the part of the authorities that a higher domestic price level is coming sooner or later (Svensson 2003). Over 1933-34, Roosevelt not only depreciated the dollar but pledged to "reflate" prices back to pre-Depression levels. Romer (1992) argues that realized increases in high-powered money supply from 1934 on also raised expected future inflation.

In standard new Keynesian models, when short-term nominal rates are stuck at the zero bound news that inflation is coming in the future boosts real activity immediately. Recall that current real activity depends not only on the current short-term real interest rate, but on the path of expected short-term real rates from now into the distant future (expression 1.3 above). Given the path of expected

future nominal rates, a belief that inflation most come *sometime* lowers expected real rates for at least some future periods. Krugman (1998, p. 161) and Svensson (2004, p. 90) argue that Roosevelt's policy moves of 1933-34 may have spurred real activity in this way. Eggertsson (2008) presents a new Keynesian model of the 1930s economy in which a mechanism of this type accounts for most growth in output over 1933-37.

Unfortunately, there is no simple way to confirm that Roosevelt's policies and pronouncements really did affect beliefs of households and business managers in this way. There were no surveys of inflation expectations in the 1930s like today's Survey of Professional Forecasters or Michigan Survey.

4.5) Aggregate supply over 1933-37: anomalous inflation

Figure 6 shows that wage and price inflation picked up as real activity recovered after March 1933, as one would expect. But the rates of inflation, especially wage inflation, that prevailed after March 1933 were anomalously high. Output, though rising, was still far below the pre-Depression trend. Unemployment, though falling, was still high. In Figure 7, annual wage inflation looks wildly high in 1934 and 1937.

One possible explanation of this anomalous inflation is the same new Keynesian expected-inflation mechanism that could have contributed to recovery of real activity. In new Keynesian models extraordinary events that raise expected future inflation at any horizon, however distant, give an immediate boost to current inflation at any given level of current real activity. In terms of (1.7), such events mean higher values of $z^e_{t+\tau}$.

Another explanation is Roosevelt administration policies that fixed minimum wages, banned wage cuts, encouraged union formation and strengthened union bargaining power (Samuelson and Solow 1960, p. 188; Weinstein 1980). There were historically unprecedented increases in the fraction of workers belonging to unions and engaging in strikes, especially over 1934-35 and 1937-38. It is

plausible that these things were causes and effects of an increase in workers' bargaining power. In new Keynesian models, increases in worker bargaining power correspond to "wage mark-up shocks" that should raise inflation at any given level of real activity (positive values of $\epsilon_{\pi P}$ and $\epsilon_{\pi W}$ in 1.9, 1.10).

5. The 1937 downturn

At the end of 1936 full recovery was in sight. If output had continued to grow as it had over 1935-36 real GDP would have been back to pre-Depression trend by the end of 1938 (Melzter 2003, p. 571). Instead there was another downturn, from a cyclical peak in May 1937 to a trough in June 1938. This recession was short; the trough was just a year later in June 1938. But it was sharp. Annual real GDP fell more than 3 1/4 percent from 1937 to 1938, more than in any postwar year. The 1937-38 downturn has been studied much less than 1929-33. Its causes are still unclear.

It must have been at least partly due to fiscal policy. From 1936 to 1937 real government purchases fell (Figure 3). Taxes net of transfers rose as a fraction of national income (Figure 4) due to three events that were all exogenous to macroeconomic conditions: the end of the veterans' bonus payment, legislation that raised personal income tax rates (the Revenue Act of June 1936), and the first collections of payroll taxes for the new Social Security system (Meltzer 2003 p. 521, 563; Velde 2009). However, it would be hard to argue that the fiscal tightening alone can account for the magnitude of the decline in real activity (Romer 1992, p. 766).

What about monetary policy? In 1936 Fed policymakers had come to fear that the increasing supply of high-powered money must create uncontrollable inflation at some point in the future, because it getting to be too large to drain with sales of Fed assets. According to the Burgess-Riefler doctrine, there would soon be no way to tighten policy because it would be impossible to reduce free reserves enough to force banks into the discount window. To head off this problem, the Federal Reserve Board reduced free reserves by hiking reserve requirements. In July 1936 the Fed announced a

hike to become effective in August (Meltzer 2003, pp. 493-503). In January 1937 it announced more hikes to become effective in March and May 1937 (Meltzer 2003, p. 507-510).

Meanwhile Treasury policymakers had come to fear foreign gold inflows might reverse in the future, creating uncontrollable *deflation* (Blum, 1959: 359-60). They developed a method by which the Treasury could sterilize gold inflows and build up a gold reserve to cover a future balance-of-payments deficit. The scheme was simultaneously announced and put into effect in late December 1936, at which time high-powered money growth ceased.

Together, the hikes in reserve requirements and cessation of high-powered money growth reduced free reserve supply substantially. In March 1937 short-term rates rose above the floor (Figure 2). But they did not rise much, and the cyclical downturn came just two or three months later. The lag between an interest-rate hike and a consequent decline in real activity is usually longer than that, in postwar data at least (Christiano, Eichenbaum and Evans 2005). The first hike in reserve requirements back in 1936 was not associated with an increase in short- or long-term interest rates (Figure 2). Thus, the channel through which reserve-requirement hikes and cessation of money growth could have actually caused the recession is not obvious. Eggertsson and Pugsley (2006) argue that the channel was the new Keynesian expected-inflation mechanism: the policy changes raised doubt about policymakers' commitment to a future increase in the price level, hence raised expected future real rates.

Conclusion

Graduate students should always be on the lookout for open questions to answer. So I conclude by pointing out some open questions about the Great Depression. In 1933, did suspension of bank payment services depress real activity by making it harder to produce and trade? How much did this matter relative to other effects of bank failures such as increases in costs of funds to credit-constrained borrowers? Why was inflation so high over 1933-37? In 1937-38, how did apparently small increases in short-term interest rates and a mild tightening of fiscal policy cause such a large recession so

quickly? Some proposed answers to those questions rely on propositions about the response of the public's long-term inflation expectations to historically unique events. How can such propositions be tested?

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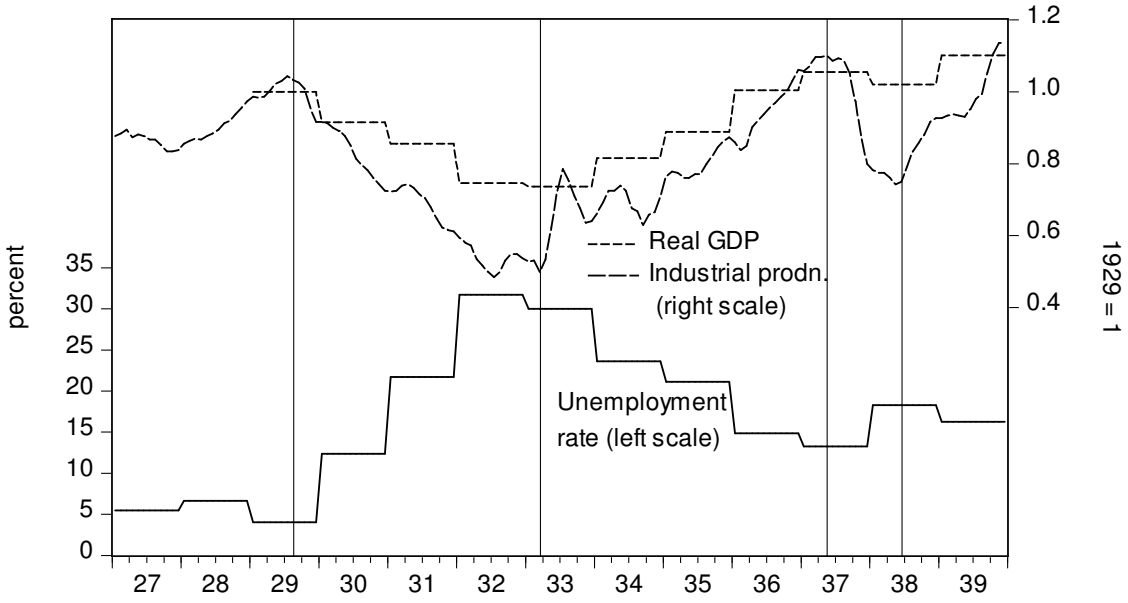

Fig. 1 Unemployment rate and industrial production index 1927-1939, real GDP 1929-1939 (Sources and notes: real GDP from United States Bureau of Economic Analysis (https://www.bea.gov/iTable/index_regional.cfm). Federal Reserve Board index of industrial production (seasonally adjusted) from Federal Reserve Bank of St. Louis (https://fred.stlouisfed.org/series/INDPRO). Private nonfarm unemployment rate from Weir 1992 Table D3. The household surveys that underly postwar unemployment rate series were not taken in the 1920-30s. Weir estimates annual employment from a variety of sources and defines the unemployment rate in ratio to an estimate of the "usual labor force" constructed from Census data. Weir excludes agriculture, government and relief workers from both the employment and labor force figures. Weir excludes agriculture because, absent survey data, there is no reliable way to estimate short-term variations in agricultural employment (since so much farm labor is family labor). By excluding government workers Weir sidesteps a debate as to whether the large numbers of Federal relief workers in the 1930s should be classified as employed or unemployed)

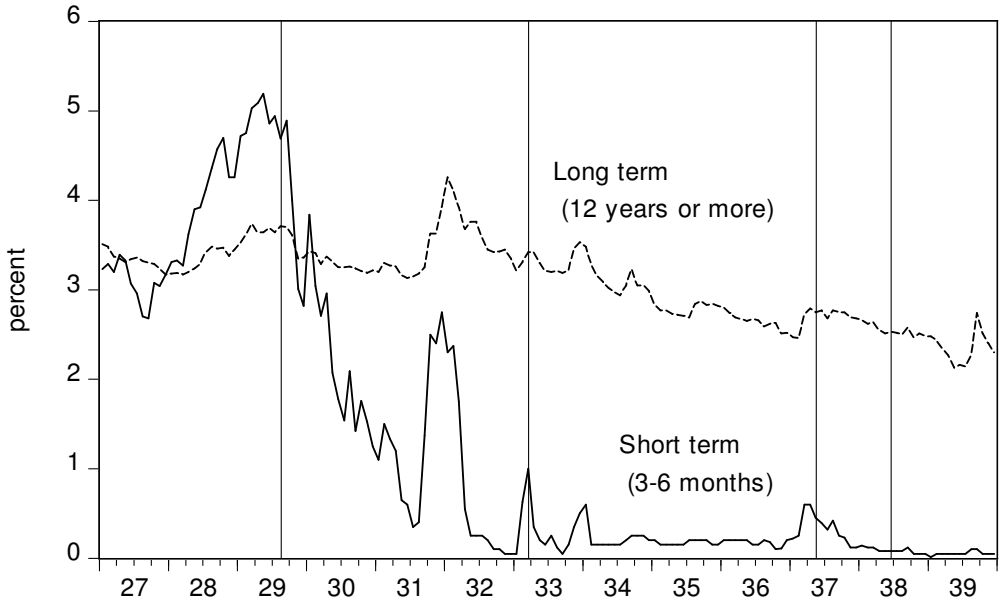

Fig. 2 Treasury interest rates 1927-1939 (Sources and notes: Short term 1927-1928 from U.S. Federal Reserve Board (1943), Table 122, 3- to 6-month Treasury notes and certificates. Short term 1929-1939 from Cecchetti (1988), Table A1, 3 Months. Long term from U.S. Federal Reserve Board (1943), Table 128, U.S. government)

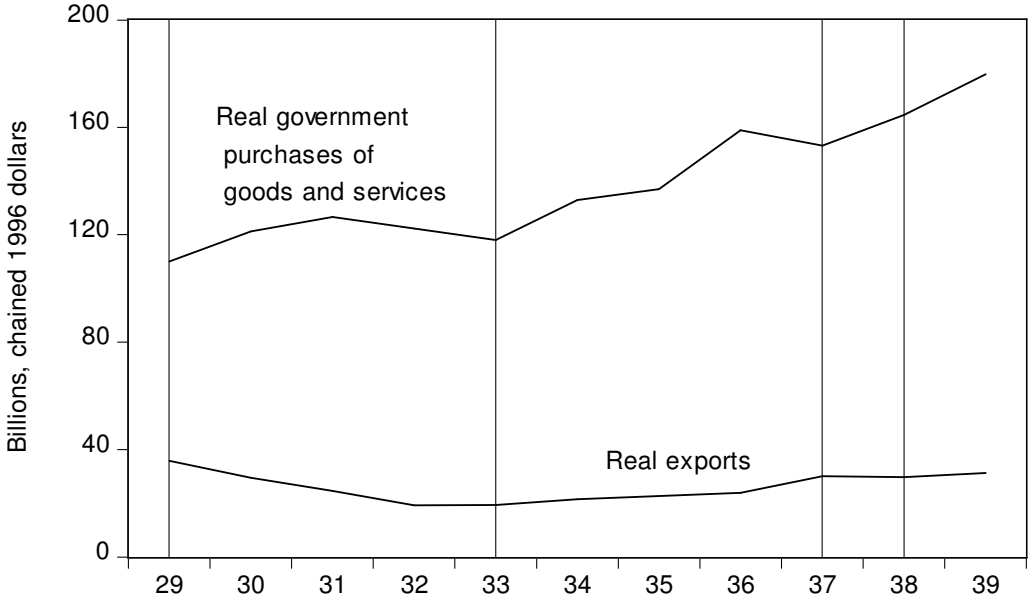

Fig. 3. Real government purchases of goods and services, real exports 1929-1939 (Sources and notes: both series from Carter et. al. (2006), government purchases series Ca89, exports series Ca87)

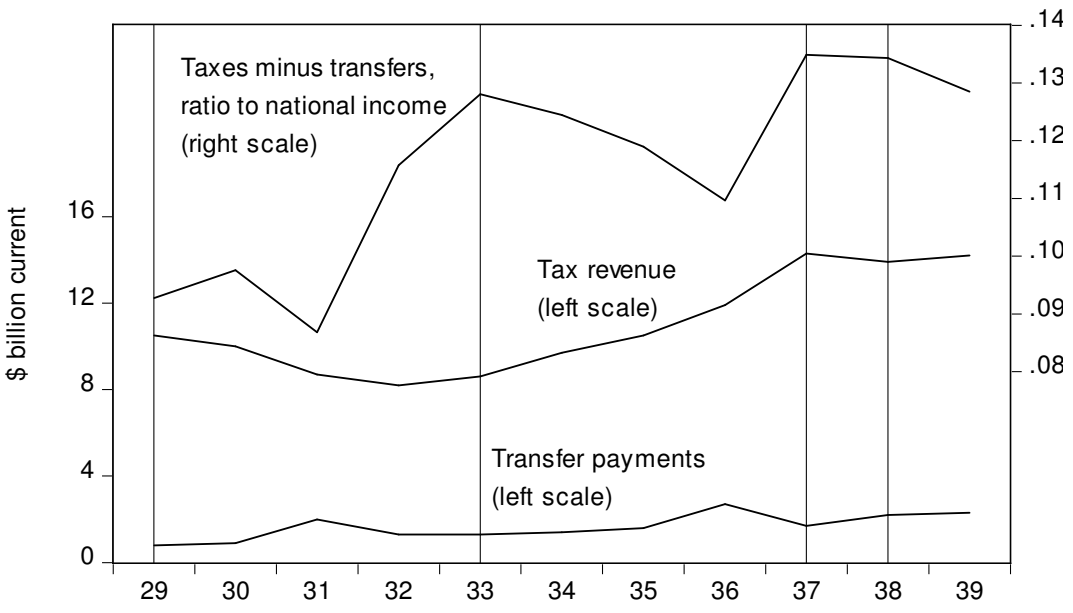

Fig. 4 Taxes, government transfer payments, ratio of taxes minus transfers to national income 1929-1939 (Sources and notes: United States Bureau of Economic Analysis (https://www.bea.gov/iTable/index_regional.cfm) Table 3.1 for taxes and transfers, Table 1.17.5 for national income. Taxes is current receipts including social insurance contributions. Transfers is government transfer payments to persons. National income is gross national income)

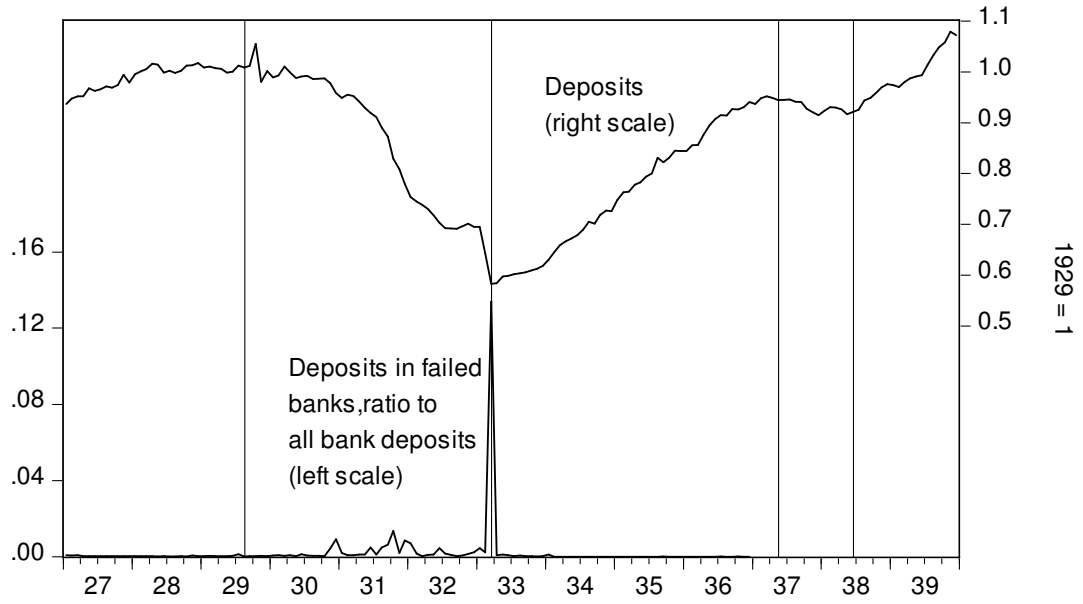

Fig. 5 Deposits in failed banks 1927-1936, deposits in all banks 1927-1939 (Sources and notes: deposits from Friedman and Schwartz (1963) Table A-1, total adjusted deposits in commercial banks. Deposits in failed banks from Federal Reserve Bulletin December 1937 p. 909. The failed bank series underestimates the intensity of failure in some months as it does not include banks that suspended or partially defaulted on deposits by "agreement" with depositors. Such agreements were common in 1931 and 1932 (Federal Reserve Bulletin December 1937, p. 1206). More importantly, it fails to to include banks temporarily shut down by bank holidays)

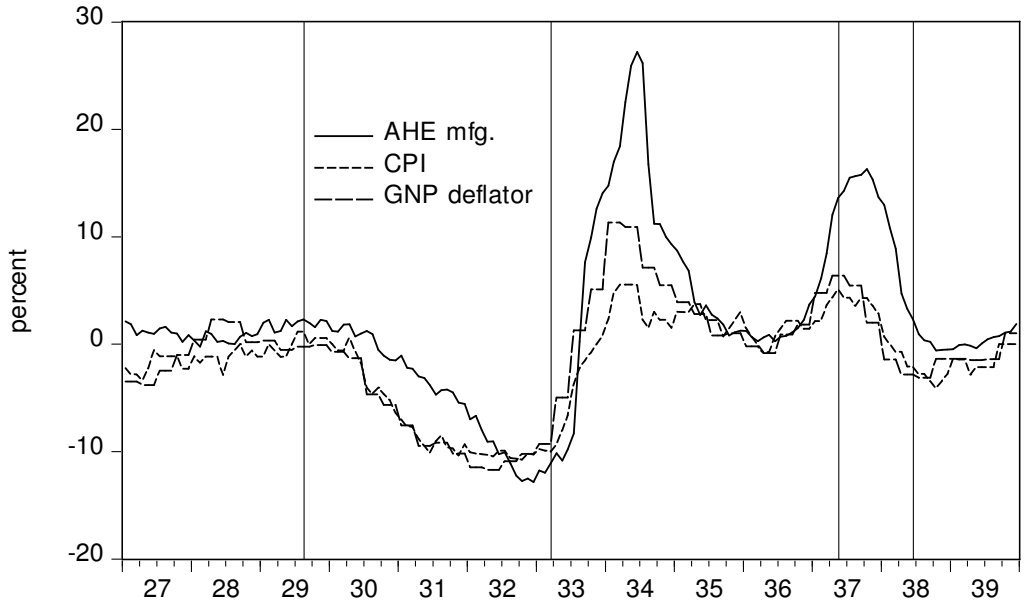

Fig. 6 Inflation in average hourly earnings, consumer prices, GNP deflator 1927-1939 (Sources and notes: average hourly earnings from Hanes (1996). Consumer price index from Federal Reserve Bank of St. Louis (https://fred.stlouisfed.org/series/CPIAUCNS). GNP deflator from Balke and Gordon (1986) Table 2. Both the CPI and GNP deflators are rougher estimates than their postwar counterparts constructed from lower-frequency estimates by interpolation on very limited data.

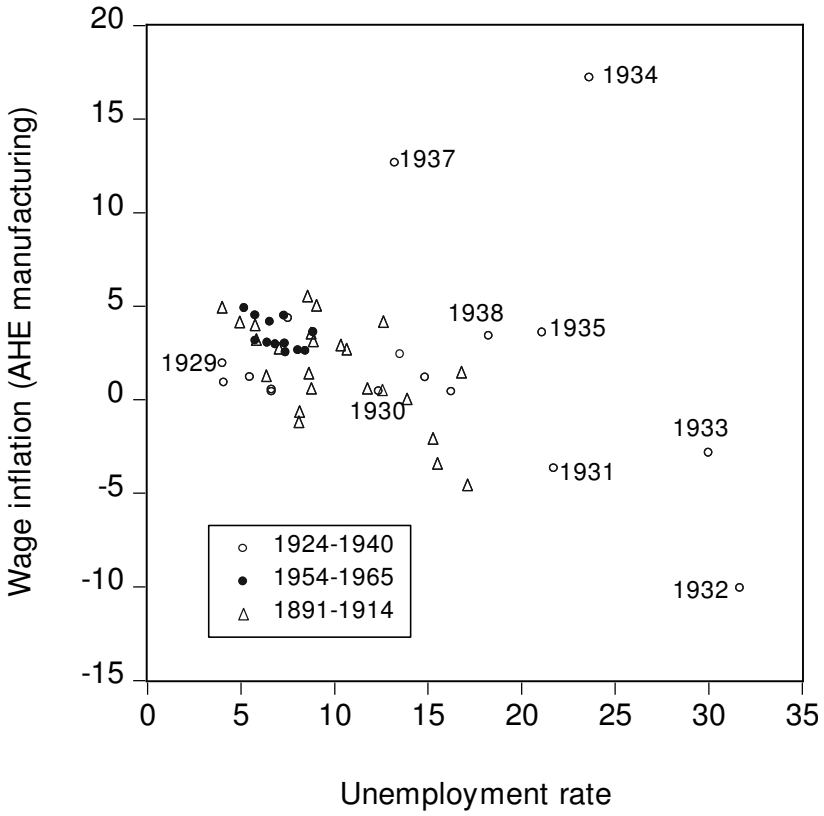

Fig. 7 Wage inflation and unemployment 1924-1940, 1954-1965, 1891-1914 (Sources and Notes: annual average hourly earnings in manufacturing 1891-1914 from Rees (1960) "nine-industry" index; 1924-40 and 1954-65 from Hanes (1996). Private nonfarm unemployment rate from Weir 1992 Table D3.)