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New Deal Policies and the Persistence of the Great Depression: A General Equilibrium Analysis*

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1. Introduction

The recovery from the Great Depression was weak. Figure 1 shows real output, real consumption, and hours worked. Real GDP per adult which was 39 percent below trend at the trough of the Depression in 1933, remained 27 percent below trend in 1939. Similarly, private hours worked were 27 percent below trend in 1933, and remained 21 percent below trend in 1939. The weak recovery is puzzling, because the large negative shocks that some economists believe caused the 1929-33 downturn - including monetary shocks, productivity shocks, and banking shocks - become positive after 1933. These positive shocks should have fostered a rapid recovery with output and employment returning to trend by the late 1930s.[1]

Some economists suspect that President Franklin Roosevelt's "New Deal" cartelization policies, which limited competition in product markets and increased labor bargaining power, kept the economy depressed after 1933.[2] These policies included the National Industrial Recovery Act (NIRA), which suspended antitrust law and permitted collusion in some sectors provided that industry raised wages above market clearing levels and accepted collective bargaining with independent labor unions. Despite broad interest in the macroeconomic impact of these policies, there are no theoretical general equilibrium models tailored to study this question.

This paper develops a theoretical model of these policies, and uses it to quantitatively evaluate their macroeconomic effects. We construct a dynamic model of the intraindustry bargaining process between labor and firms that occurred under these policies, and embed this bargaining model into a multisector dynamic general equilibrium model. The model differs from existing insider-outsider models in a number of ways. One key difference is that our model allows the insiders to choose the size of the worker cartel, which lets us study the impact of the policies in a much richer way. We simulate the model during the New Deal and compare output, employment, consumption, investment, wages, and prices from the model to the data.

[1] The monetary base increases more than 100 percent between 1933 and 1939, the introduction of deposit insurance ends banking panics by 1934, and total factor productivity returns to trend by 1936. Lucas and Rapping (1972) argue that positive monetary shocks should have produced a strong recovery with employment returning to its normal level by 1936. Cole and Ohanian (1999) make similar arguement about positive productivity and banking shocks.

[2] See Friedman and Schwartz (1963), Alchian (1970), and Lucas and Rapping (1972).

Our main finding is that New Deal cartelization policies are a key factor behind the weak recovery, accounting for about 60 percent of the difference between actual output and trend output. The key depressing feature of New Deal policies is not government-sponsored collusion per se, but rather it is the policy linkage between paying high wages and being able to collude. Our model shows that high wages reduced employment directly in the cartelized sectors of the economy, and also reduced employment in the non-cartelized sectors through general equilibrium effects. We conclude that the recovery from the Depression would have been much stronger if these policies not been adopted.

The paper is organized as follows. Section 2 presents macroeconomic data for the 1930s. Section 3 discusses the New Deal policies, and compares wage and price changes from industries covered by the policies to those from industries not covered by the policies. Section 4 develops the model economy. Section 5 presents values for the model parameters. Section 6 illustrates how the model works by comparing the steady state of the cartel model to the steady state of the competitive version of the model. Section 7 compares the equilibrium paths of the cartel and competitive models between 1934 and 1939 to the actual path of the U.S. economy over this period. Section 8 presents a summary and conclusion.

2. The Weak Recovery

Table 1 shows real GNP, real consumption of nondurables and services (C), real investment (I), including consumer durables, total factor productivity, (TFP), the real manufacturing wage (W), and total private hours worked (H). All quantities are divided by the adult (16 and over) population, and all variables are measured relative to their trend-adjusted 1929 levels.[3] The key patterns are:

- GNP, consumption, investment, and hours worked are significantly below trend.
- Productivity returns to trend quickly.
- The real wage is significantly above trend

[3] Cole and Ohanian (1999) describes the data and the detrending procedure in detail. One difference in detrending between this paper and the earlier paper is that we detrend real manufacturing wages by the average growth rate in manufacturing compensation during the postwar period (1.4% per year).

There are two puzzles. Why was the recovery so weak, and why was the real wage so high?[4] The coincidence of high wages, low consumption, and low hours worked indicates some factor prevented labor market clearing during the New Deal. To see this, consider the standard first order condition in a competitive, market-clearing model that equates a household's marginal rate of substitution between consumption and leisure to the real wage. With log preferences over consumption (c) and leisure (l), the first order condition is $c_t/l_t = w_t$.

There is a large gap in this condition during the New Deal. Compared to 1929 values, the 1939 real wage is 120 percent higher than the 1939 marginal rate of substitution. Competition should have generated higher employment, higher consumption, and a lower real wage to reduce this large gap. A successful theory of the New Deal macroeconomy should account for the weak recovery, the high real wage, and the large gap between the marginal rate of substitution and the real wage.

3. New Deal Labor and Industrial Policies

Roosevelt's recipe for economic recovery was raising prices and wages. To achieve these increases, Congress passed industrial and labor policies to limit competition and raise labor bargaining power. This section summarizes Roosevelt's economic views and policies, and shows that prices and wages rose substantially after these policies were adopted.

There were two policy phases during the New Deal. The first phase was the NIRA (1933-1935). The NIRA created rents by limiting competition and allowed labor to capture some of those rents by exempting industry from antitrust prosecution if the industry immediately raised wages and accepted collective bargaining with labor unions.

The second policy phase was adopted after the Supreme Court ruled the NIRA unconstitutional in 1935. The Court's NIRA decision prevented Roosevelt from tieing collusion to paying high wages, so instead the government largely ignored the antitrust laws, and passed the National Labor Relations Act (NLRA), which strengthened several of the NIRA's labor provisions. We present data that shows very little antitrust prosecution by the Department

[4]The increase in the real wage during the recovery is not due to imperfectly flexible wages and unanticipated deflation, as has been suggested for the downturn of 1929-1933. Between 1933 and 1939, both nominal wages and the price level increased.

of Justice (DOJ) after 1935, and shows that the government openly ignored collusive arrangements in industries that paid high wages. We also present data that systematically shows wages and prices continued to rise after the Court struck down the NIRA.

A. The NIRA

Roosevelt believed that the severity of the Depression was due to excessive business competition that reduced prices and wages, which in turn lowered demand and employment. He argued that government planning was necessary for recovery:

"...A mere builder of more industrial plants, a creator of more railroad systems, an organizer of more corporations, is as likely to be a danger as a help. Our task is not...necessarily producing more goods. It is the soberer, less dramatic business of administering resources and plants already in hand." (Kennedy, p. 373)

A number of Roosevelt's economic advisors, who had worked as economic planners during World War I, argued that wartime economic planning would bring recovery. Hugh Johnson, one of Roosevelt's main economic advisors, argued that the economy expanded during World War I because the government ignored the antitrust laws. According to Johnson, this policy reduced industrial competition and conflict, facilitated cooperation between firms, and raised wages and output. (See Johnson (1935)). This wartime policy was the model for the NIRA.

The cornerstone of the NIRA was a "Code of Fair Competition" for each industry. These codes were the operating rules for all firms in an industry. Firms and workers negotiated these codes under the guidance of the National Recovery Administration (NRA). The codes required Presidential approval, which was given only if the industry raised wages and accepted collective bargaining with an independent union.[5] In return, the Act suspended antitrust law and each industry was encouraged to adopt trade practices that limited competition and raised prices. By 1934, NRA codes covered over 500 industries, which accounted for nearly 80 percent of private, non-agricultural employment.[6]

[5] In some cases, some of the labor provisions were adopted before the codes were written. This was achieved by Roosevelt's Re-employment Agreement (PRA) (see Dearing, Homan, Lorwin, and Lyon, "The ABC of the NRA", Brookings, 1934). Industries that followed the agreement paid minimum wages and consequently were permitted to sell to government agencies.

[6] The private, non-agricultural sectors exempted from the NIRA were steam railroads, non-profit organi-

All codes adopted a minimum wage for low-skilled workers, and almost all codes specified higher wages for higher-skilled workers.[7] A key element was *equal treatment* - employees performing the same job were paid the same wage. Consequently, codes generally did not permit differential wages based on seniority or other criteria. (See for example the Petroleum Code, Codes of Fair Competition, volume 1, page 151). We later show that this equal treatment provision will be critical for understanding the depressing effects of New Deal policies.

Most industry codes included trade practice arrangements that limited competition, including minimum prices, restrictions on production, investment in plant and equipment, and the workweek, resale price maintenance, basing point pricing, and open-price systems.[8] Minimum price was the most widely adopted provision, and the code authority often determined minimum price in many industries. Several codes permitted the code authority to set industry-wide or regional minimum prices. In some codes, the authority determined the minimum price directly, either as the authority's assessment of a "fair market price", or the authority's assessment of the "minimum cost of production". In other codes, such as the iron and steel codes and the pulp and paper codes, the authority indirectly set the minimum price by rejecting any price that was so low it would "promote unfair competition."

The trade practice arrangements had explicit provisions for profits. For example, some minimum price calculations included explicit payments to capital, such as depreciation rent, royalties, director's fees, research and development expenses, amortization, patents, maintenance and repairs, and bad debts and profit margins as a percent of cost.[9]

B. Cartelization Continues after the NIRA

On May 27, 1935 the Supreme Court ruled that the NIRA was an unconstitutional delegation of legislative power, primarily due to the NIRA's suspension of the antitrust laws. Roosevelt opposed the Court's decision: "The fundamental purposes and principles of the

zations, domestic services, and professional services.

[7] See Lyon et al

[8] Open price systems required that any firm planning to reduce its price must pre-announce the action to the code authority, who in turn would notify all other firms. Following this notification, the announcing firm was required to wait a specific period before changing its price. The purpose of this waiting period was for the code authority and other industry members to persuade the announcing firm to cancel its price cut.

[9] For example, the stone industry included a 10 percent profit margin; the concrete floor industry called for a profit margin that was a "reasonable percentage" over cost. (See Lyon et al, pp. 589-599).

NIRA are sound. To abandon them is unthinkable. It would spell the return to industrial and labor chaos." (Hawley, page 124.) This section shows that the government continued anti-competitive policies through new labor legislation and by ignoring the antitrust laws.

The primary post-NIRA labor policy was the National Labor Relations (NLRA) Act, which was passed on July 27, 1935. The NLRA gave even more bargaining power to workers than the NIRA. The NLRA gave workers the right to organize and bargain collectively through representation that had been elected by the majority of the workers. It prohibited management from declining to engage in collective bargaining, discriminating among employees based upon their union affiliation, or forcing their employees to join a company union. The Act also established the National Labor Relations Board (NLRB) to enforce the rules of the NLRA and enforce wage agreements. The NLRB had the authority to directly issue cease-and-desist orders.

The NLRA allowed labor to form independent unions with significant bargaining power (see Taft 1964, Mills and Brown 1950 or Kennedy (1999) p. 290-91). Union membership and strike activity rose considerably under the NLRA, particularly after The Supreme Court upheld its constitutionality in 1937. Union membership rose from about 13 percent of employment in 1935 to about 29 percent of employment in 1939, and strike activity doubled from 14 million strike days in 1936 to about 28 million in 1937.

Strikes during the New Deal were very effective because the NLRA allowed workers to take unprecedented actions against firms. One such action was the "sit-down strike", in which strikers forcibly occupied factories and halted production. The sit-down strike was used with considerable success against auto and steel producers.[10] The NLRA contrasts sharply with pre-New Deal government strike policy, in which government injunctions and/or police action were frequently used to break strikes.

The "equal pay" feature of NIRA labor policies continued in post-NIRA union contracts. Taft and Reynolds (1964) and Ross (1948) document how unions established uniform and standardized wage schedules that narrowed wage differentials: "to the extent that unionism has had any net effect on occupational differentials, this has almost certainly been in the direction of narrowing them" (Taft and Reynolds p. 185). This indicates that the NIRAs

[10] See Kennedy (1999), pp. 310-317.

equal treatment wage principle continued during post-NIRA new deal. (Cole and Ohanian 2001 discuss this issue in greater detail).

The strengthening of NIRA labor provisions was accompanied by an NIRA-type industrial policy that promoted collusion. Even though the government could not suspend antitrust law after the NIRA, the government permitted collusion, particularly in industries that paid high wages. Hawley (p. 166) cites FTC studies from the 1930s that report price-fixing and production limits in a number of industries following the Court's NIRA decision.

Some of the post-NIRA collusion was facilitated by trade practices formed during the NIRA. Hawley reports that basing-point pricing, which was adopted during the NIRA, allowed steel producers to collude after the NIRA. Interior Secretary Harold Ickes complained to Roosevelt that he received identical bids from steel firms on 257 different occasions (Hawley, p. 360-64) between June 1935 and May 1936. The Interior Department received bids that were not only identical but 50 percent higher than foreign steel prices (Ickes, p. 466). This price difference was large enough under government rules to permit Ickes to order the steel from German suppliers. Roosevelt cancelled the German contract, however, after coming under pressure from both the steel trade association and the steel labor union.

Despite this collusion, the U.S. Attorney General announced that steel producers would not be prosecuted for restraint of trade (Hawley p. 364). Hawley documents that the steel case was just one example of a lax pattern of post-NIRA antitrust prosecution. Of the few cases that were prosecuted by the DOJ between 1935 and 1937, several were for alleged racketeering charges.[11] The number of antitrust case brought by the Department of Justice (DOJ) fell from an average of 12.5 new cases per year during the 1920s, to an average of 6.5 cases per year during the period from 1935-38 (Posner 1970).

C. The End of the New Deal

Roosevelt's views changed in the late 1930s and his policies also changed. He argued that cartelization was an important contributing factor to the persistence of the Depression

[11]New legislation enacted during the mid-1930s is also viewed by some as limiting price competition, including The Robinson-Patman Act (1936), which was desinged to prevent firms from selling goods at different prices to different customers, and The Miller-Tydings Act (1937), which exempted resale price maintenance contracts from antitrust laws.

and appointed Thurman Arnold, a vigorous anti-truster, to reorganize and direct the Antitrust Division of the DOJ. The number of new cases brought by the DOJ rose from just 57 between 1935-39 to 223 between 1940-44. Posner (1970) reports that about 80 percent of these cases were won by the government.

Labor policy also changed significantly. The Supreme Court ruled in 1939 that the sitdown strike was unconstitutional, which weakened labor's bargaining power considerably (See Kennedy). Bargaining power was further weakened during World War II because wage increases had to be approved by the National War Labor Board (NWLB), and this board almost uniformly rejected wage agreements that exceeded cost of living increases. Moreover, strikes by Coal miners during the war pushed public and congressional opinion against unions and the NLRA. In 1947, the NLRA was amended by the Taft-Hartley Act. This Act weakened labor's bargaining power by restricting labor's actions, and by reducing the original limitations placed on firms in the original NLRA. The Act outlawed the closed shop and gave states the right to outlaw unions shops. Given this policy shift, we will focus our analysis on the 1933-39 period.

D. The Impact of the Policy on Wages and Prices

We now present evidence that New Deal policies significantly increased wages and prices. We compare wage and price statistics in industries covered by the policies to those in industries not covered by the policies. Data limitations complicate the analysis somewhat. One complication is that wage and price data are limited for the 1930s. A second complication is that it is difficult to form a non-cartelized comparison group, because the policies were intended to cover most of the private economy. Nevertheless, we have compiled wage and price statistics that show real wages and relative prices in sectors covered by the policies rose significantly after the NIRA was adopted and remained high throughout the New Deal. We also show that wages and prices in sectors not covered by these policies did not rise during the New Deal.

We first describe the available wage and price data, and we then turn to classifying these data between the cartelized and non-cartelized sectors. We have wage data for the overall manufacturing sector and for some industries within manufacturing. We also have

wages for some energy industries and for agriculture. We divide nominal wages by the GNP deflator to see if there were differences in real wage changes across the two categories.

Regarding prices, We have price indexes for the major NIPA categories, wholesale price indexes for manufacturing industries, and for some energy industries. We divide the nominal price indexes by the price index for consumer services. We choose the price of consumer services as the numeraire because it is the aggregate price index likely to be least affected by the policies, as some consumer services were not covered by the policies and because collusion failed in some services that were covered.[12]. This procedure of forming relative prices lets us determine whether cartelized prices rose relative to non-cartelized prices (services). To the extent possible, we report prices and wages for the same industries/sectors. We describe how we divide these sectors between the cartelized and non-cartelized groups below.

Table 2 shows annual data for wages in 3 sectors covered by the policies - manufacturing, bituminous coal, and petroleum products, and 2 sectors not covered - anthracite coal and all farm products. The farm sector was not covered by the NIRA, by the NLRA, or by other policies that would have raised farm wages. Anthracite coal is a particularly interesting de facto uncovered sector, because it was supposed to have been covered by the NIRA, but the industry and the coal miners failed to negotiate a code of fair competition.

We find that real wages in the three covered sectors rise after the NIRA is adopted and remain high through the rest of the decade. Compared to their 1929 levels, manufacturing, bituminous coal, and petroleum wages are between 24 to 33 percent above trend in 1939. In contrast, the farm wage is 31 percent below trend, and anthracite coal is 6 percent below trend. Focusing on the two coal wages, we find that bituminous coal miners - who successfully negotiated under the NIRA - were able to raise their real wage substantially, while anthracite coal miners - who did not successfully negotiate under the NIRA - were not able to raise their real wage.

Since the manufacturing wage is an aggregate of many manufacturing industry wages, it is natural to ask whether this increase is due to increases across all or most manufacturing industries, or whether it is due to very large increases in just a few industries. Using monthly

[12]For example, physican services were not covered by the policies. Other services, such as dry cleaning, were covered, but were found to be very competitive by the NIRA review board (1934).

industry-level wage data within manufacturing from the Conference Board, (Beney, 1936), we find that these industry wages systematically and significantly rose. We report real wages in 11 manufacturing industries for which we also have price data. Table 3 shows significant increases in all 11 industries occurring after the NIRA is passed. Here, we index the real wage to 100 in February 1933 (which is a few months prior to the NIRA) to focus on the effect of the adoption of the policies on real wages. All of these industry wages are significantly higher at the end of 1933, which is six months after the Act is passed. The smallest increase is seven percent (farm implements), and the largest increase is 46 percent (boots and shoes). These wages also remain high through the end of the NIRA (May 1935), and also after the NIRA. The average real wage increase across these 11 categories in June 1936 relative to February 1933 is 25.4 percent.[13]

We now turn to analyzing the relative price data. We continue to treat the manufacturing sector and the energy industries described above as the cartelized sectors. We omit the farm sector from this price analysis. We do not include farm goods in the uncovered category for prices, as we had done for wages, because the government adopted other policies to raise farm prices. However, these price support policies differed significantly from the NIRA as they did not include provisions to raise wages.

Regarding the manufacturing sector, we would like to match up a price index for the overall manufacturing sector with the overall manufacturing wage index reported in Table 2. Unfortunately, there is no such price index. We therefore report relative prices of industries within manufacturing that we can match up with the manufacturing industry wage data reported in Table 3, and we also report relative prices of investment goods, which are a major

[13]These wage premia are high relative to traditional estimates of union wage premia. There are two important reasons why union/non-union wage premia estimates are not the right statistics for evaluating New Deal wage increases. The first reason is that the NIRA raised wages of union *and* non-union workers. Very few workers were even in unions in 1933, and the NIRA took this into account by forcing firms to raise wages of all workers to get cartelization benefits. For example, Lewis (1963) analyzes bituminous coal wages in regions with different unionization rates, and finds that wages rose substantially for all states, irregardless of the fraction unionized, with the highest percentage increases occuring in non-union regions. He also reports a union wage-differential of 10-18 percent in rubber tire manufacturing in 1935. But this statistic does not take into account the fact that overall rubber manufacturing wages rose 35 percent increase between 1933 and 1935.

A second reason is that most estimates of union wage premia are from post-World War II data. These data are not good estimates of the impact of these policies on union bargaining, because postwar union bargaining power was lower than worker baragining power during the New Deal.

manufactured good. Table 4 shows relative prices of new fixed investment goods and durable equipment goods. These relative prices rise about 8-10 percent between 1934 and 1933, and are about 11-12 percent above their 1929 levels in 1939. These increases are particularly noteworthy because they occur during an economic recovery. Typically, the relative price of investment goods fall during recoveries (see Greenwood et al, 2000).

We now turn to the other price data. Table 5 shows the manufacturing and energy goods prices before and after New Deal policies. We use the same format as in Table 3 for manufacturing industry wages by choosing the same reporting dates and the same date for the normalization. The timing and magnitude of the price increases are very similar to the other wage and price changes we observe. Prices for almost all the categories covered by the policies rise substantially by the end of 1933, and remain high through the end of the 1930s. It is again interesting to compare the price of bituminous coal - an industry that negotiated a code of fair competition under the NIRA - to the price of anthracite coal - an industry that did not negotiate a code of fair competition. The relative price of bituminous coal rises after the NIRA is passed, and remains high through 1939. In contrast, the relative price of anthracite coal is unchanged after the NIRA is passed, and then declines moderately over the rest of the 1930s.

In summary, we have compiled wage data from manufacturing, energy, mining, and agriculture, and price data from these same sectors less agriculture. This evidence indicates that New Deal policies raised relative prices and real wages in those industries covered by these policies: manufacturing and some energy industries. Relative prices and real wages in these sectors increased significantly after these policies were adopted and remained high throughout the 1930s, whereas prices and wages in uncovered sectors did not rise.

There is additional evidence supporting our conclusions about the effects of these policies. One source of evidence is the National Recovery Review Board (NRRB), which evaluated whether the NIRA was creating monopoly. This board was created because of widespread complaints by consumers, businesses, and government purchasing agencies about price fixing and collusion, and the board was in place even before all the codes of fair competition had been negotiated (Hawley, 1966). The NRRB wrote three different reports over the course of the NIRA, analyzing industries covering about 50% of NIRA employment. 16

of the 26 codes that were studied by the NRRB covered industries that we have classified as cartelized. The NRRB concluded on the basis of trade practices and conduct that there was significant monopoly in all 16 of these industries. Moreover, the NRRB concluded that the one consumer service they studied - cleaning and dyeing - was very competitive. This latter conclusion supports our view that consumer services were less affected by these policies. The Board drew very strong conclusions about the cartelized industries:

> "Our investigations have shown that in the instances mentioned the codes do not only permit but foster monopolistic practices and nothing has been done to remove or even to restrain them. If monopolistic business combinations in this country could have anything ordered to their wish, they could not order anything better than to have the antitrust laws suspended" (3rd report, pages 34-37)

There are other sources of evidence supporting our conclusions. One source is a series of FTC analyses studies of manufacturing industries, which concluded there was collusion during and after the NIRA. The FTC concluded that there was little competition in many concentrated industries, including autos, chemicals, aluminum, and glass.[14] A second source of evidence is stock market data. The Dow Jones 30 Industrials and the Standard and Poor's Industrials, rose 74 percent and 100 percent, respectively, between March 1933, which was before the policy was announced, and July 1933, which was the first month after the policy was adopted.[15] These indexes remained around their July 1933 levels over the next year as the policy was implemented. (Source of data: Board of Governors of the Federal Reserve System (1943), and Pierce (1982)). Stock returns are also consistent with our view that cartelization continued after the NIRA was declared unconstitutional in June, 1935. These stock indexes rose about 10 percent between May, 1935 and July, 1935. Even Roosevelt finally acknowledged the impact of cartelization on the economy by the late 1930s: "the American economy has become a concealed cartel system."... The disappearance of price competition is one of the primary causes of present difficulties" (Hawley, 1966).

[14] See Hawley (1966) for a summary of post-NIRA FTC studies that found significant evidence of monopoly in manufacturing.

[15] 28 of the 30 Dow Jones Industrial companies were either in manfuacturing or energy production, which we classify as cartelized.

The evidence indicates New Deal policies created cartelization, high wages, and high prices in at least manufacturing and some energy and mining industries. Hereafter, we will treat these industries as cartelized and we will treat the remainder of the economy as competitive. We will then use the relative sizes of these two categories to parameterize the cartelized and competitive sectors of our model. We therefore assume that all the other sectors in the economy for which we do not have price and wage data were unaffected by the policies. This is a conservative estimate of the fraction of the economy that was cartelized, because there is evidence that the policies affected other sectors. (For example, the NRRB found evidence of monopoly in wholesale and retail trade). We will later show that our conservative assessment of the size of the cartelized sector will understate the effects of these policies on employment and output.

4. A Dynamic General Equilibrium Model with New Deal Policies

Our model of New Deal policy specifies that in a subset of industries, workers and firms bargain over the wage, and that the firms can collude over pricing and production if they reach a labor agreement. The analysis requires developing a new theoretical model, because several necessary elements do not jointly appear in existing models. Four key elements are (i) repeated bargaining in some sectors, with collusion contingent on the labor agreement, (ii) optimal choice for the number of cartel workers by the insiders, (iii) job search, and (iv) voluntary participation by firms. The first element captures the essence of the NIRA. The second and third elements let us assess the model's predictions for employment, unemployment, output, and other macroeconomic variables during the New Deal. The fourth element captures the fact that industry was an early supporter of the NIRA. These features - particularly the optimal determination of the number of insiders - lets us analyze the impact of the policies in a much richer way than had we used existing insider-outsider models.[16]

[16] In addition to the optimal choice of the size of the insiders, the participation decision of the firms is also a novel feature of our model relative to other insider-outsider models, such as Blanchard and Summers (1986), Lindbeck and Snower (1988), Gali (1995) and Alvarez and Veracierto (1999). The number of insiders is a parameter in Blanchard and Summers and Snower and Lindbeck. Gali's model is one in which the entire economy is monopolized, and thus can't be used to study a partially cartelized economy that is the focus of our paper, including cross-sector wage differentials or the size of the cartel sector. The most closely related model is that of Alvarez and Veracierto (2001). However, policies have larger negative effects in our model than in Alvarez-Veracierto because the insiders control the size of their cartel.

With these elements, our model is consistent with key objectives of labor unions during the 1930s, including raising wages and eliminating wage differentials across similar workers (see Ross (1948) and Taft and Reynolds (1964)). Our model also is reminiscent of the classic Harris-Todaro (1969) model in which unemployment serves as a lottery for high wage jobs.

A. Environment

Time is discrete and denoted by $t = 0, 1, 2, ...\infty$. There is no uncertainty. There is a representative household whose members supply labor and capital services, and consume the final good. There are two distinct types of goods: *Final goods* can be consumed or invested. These final goods are produced using a variety of *intermediate goods.* These intermediate goods are produced using identical technologies with capital and labor. There is a unit mass of intermediate goods indexed by $i \in [0, 1]$. Each i denotes a specific industry. We partition the unit interval of industries into different sectors. There are S sectors, and the set of industries in sector s is given by $[\varphi_{s-1}, \varphi_s]$, where $\varphi_s \in [0, 1]$, $\varphi_{s-1} < \varphi_s$, $\varphi_0 = 0$ and $\varphi_S = 1$.

Our model includes both industry output and sectoral output because the policies operated at the industry level, and because we will specify a substitution elasticity across goods at the industry level that differs from that at the sectoral level. Some of these sectors will be cartelized, and some will be competitive.

We denote the output of industry i by $y(i)$. All industries in all sectors share identical constant returns to scale (CRS) Cobb-Douglas technologies for producing output from capital and labor. Labor is completely mobile across industries and sectors. Capital is sector specific. The level of the capital stock in sector s in period t is denoted by K_{st}.

Output for a representative intermediate producer in industry i at date t who rents k_t units of capital and n_t units of labor is:

$$y_t(i) = (z_t n_t(i))^{\gamma} k_t(i)^{1-\gamma}$$

where z_t denotes the date t level of labor-augmenting technology. The sequence $\{z_t\}_{t=0}^{\infty}$ is known with certainty.

Sectoral output in sector s, Y_{st} is a CRS constant elasticity of substitution (CES)

aggregate of industry outputs in that sector with curvature parameter θ,

$$(1) \qquad Y_{st} = \left(\int_{\varphi_{s-1}}^{\varphi_s} y_t(i)^\theta di \right)^{1/\theta}.$$

The final good, Y_t, is produced from sectoral outputs using a CES production technology,

$$(2) \qquad Y_t = \left[\sum_{s=1}^{S} Y_{st}^\phi \right]^{1/\phi}.$$

This specification permits the substitution elasticity between industry outputs in the same sector $(1-\theta)^{-1}$ to differ from the substitution elasticity between the aggregated outputs across sectors $(1-\phi)^{-1}$. This distinction is important, because the policies operated among disaggregated industries where substitution elasticities are likely to be much higher than at aggregated sectoral levels.

In the fraction χ of the intermediate goods sectors, workers and firms in an industry in that sector bargain over the wage and the number of workers to be hired, and that firms can collude over production given an agreement with their workers. These are the *cartelized industries*. The remaining intermediate goods industries and the final goods producers are perfectly competitive. Thus, χ is a policy parameter that governs the scope of the cartelization policy.

Symmetry implies the cartelized sectors and the competitive sectors can be aggregated. This lets us work with a two sector model with a cartel sector of size χ and a competitive sector of size $1-\chi$. We will use "m" to refer to cartel sector and we use "f" to refer to the competitive sector. The output of the cartel sector is:

$$Y_{mt} \equiv \left[\int_0^\chi y_t^\theta(i) di \right]^{1/\theta}.$$

The output of the competitive sector is:

$$Y_{ft} \equiv \left[\int_\chi^1 y_t^\theta(i) di \right]^{1/\theta}.$$

Final output is the numeraire. We denote the output and its price in a representative cartelized industry by y_{mt} and p_{mt}, and similarly denote the output and price in a representative competitive industry by y_{ft} and p_{ft}. We also denote the wage rates and capital rental rates in representative industries in the two sectors as w_{mt} and r_{mt} and w_{ft} and r_{mt}.[17]

[17] Symmetry implies that wage rates in all cartelized industries are the same.

A household member either works in the competitive sector, (n_{ft}), works in the cartel sector (n_{mt}) (if the household member already has a cartel job), searches for a job in the cartel sector (n_{ut}), or takes leisure. Since the cartel wage will be higher than the competitive wage, household members compete for these rents by searching for cartel jobs. Searching consists of waiting for a vacant cartel job, and search incurs the same utility cost as working full time. If a cartel job vacancy arises, the job is awarded randomly at the start of the period to an individual who searched the previous period. We denote the probability of obtaining a cartel job through search in period t as υ_t.[18]

To build in job turnover arising from life-cycle events such as retirement or disability, we assume that cartel workers face an exogenous probability of losing their jobs at each date. The probability that a worker retains their cartel job is π.[19]

B. Household Problem

The representative family's problem is:

$$\max_{\{n_{mt},n_{ut},n_{ft}\}} \sum_{t=0}^{\infty} \beta^t \left[\log(c_t) + \phi \log(1 - n_t)\right]$$

subject to

$$(3) \qquad \sum_{t=0}^{\infty} Q_t \left[w_{ft} n_{ft} + w_{mt} n_{mt} - c_t + \sum_{S} (r_{st} K_{st} - x_{st}) \right] + \Pi_0 = 0,$$

$$(4) \qquad k_{st+1} = x_{st} + (1 - \delta) k_{st}$$

$$(5) \qquad n_{mt} \leq \pi n_{mt-1} + \upsilon_{t-1} n_{ut-1},$$

$$n_t = n_{ft} + n_{mt} + n_{ut},$$

where $\pi n_{m,-1}$ denotes the initial number of insiders in the first period. The household's income consists of flows of labor income from the competitive and noncompetitive sectors, rental income from supplying capital, and date-zero profits (Π_0). Equation (5) is the law of motion for the number of household members with cartel jobs (n_{mt}). This is equal to the

[18] Employment in competitive industries confers no rents, hence search activity in these sectors is zero.

[19] With $\pi < 1$, there is a unique balanced growth for the model. If $\pi = 1$, then the balanced growth path depends on initial conditions.

number of household members who retain their cartel jobs from last period (πn_{mt-1}), plus the number of household members that obtain vacant cartel jobs from searching the previous period ($v_{t-1}n_{ut-1}$). The term Q_t is the date-t Arrow-Debreu price of final goods. All the first order conditions for this problem are standard, with the exception of the first order condition for searching for a cartel job. This condition is

$$(6) \qquad v_{t-1}\sum_{\tau=0}^{\infty} Q_{t+\tau}\pi^{\tau}(w_{mt+\tau} - w_{ft+\tau}) = Q_{t-1}w_{t-1}.$$

This equation shows that the marginal benefit of searching, which is the expected present value of the cartel wage premia, is equal to opportunity cost of searching, which is the value of the previous period's wage.

C. Competitive Goods Producers

A representative final goods producer, taking prices of its inputs as given, $\{p_t(i)\}$, has the following profit maximization problem:

$$\max_{y_t(i)} Y_t - \left(\int_0^{\chi} p_t(i)y_t(i)di + \int_{\chi}^{1} p_t(i)y_t(i)di\right).$$

A representative intermediate goods producer in a competitive industry maximizes profits given (p_f, w_{ft}, r_{f_t}) :

$$(7) \qquad \max_{n_{ft},k_{ft}} p_{ft}(z_t n_{ft})^{\gamma} {k_{ft}}^{1-\gamma} - w_{ft}n_{ft} - r_{ft}k_{ft},$$

D. The Cartel

We now describe the maximization problem of cartel workers and cartel firms. The *insiders* are the workers who were employed in the industry last period and who did not suffer attrition. The insiders bargain each period with the firms in the industry over the wage and the employment level.

The bargaining game between the insiders and the firms is a two-stage negotiation game which is played at the beginning of period. In stage one the insiders make a wage and employment proposal: $(\bar{w}_t, \bar{n}_t)$. (In equilibrium, it will be the case that $\bar{w}_t = w_{mt}$ and $\bar{n}_t = n_{mt}$). In stage two, the firms either accept or reject this proposal. If the firms accept, they collude and operate as a monopolist, subject to the constraint that they hire $\bar{n}_t$ units of labor at the wage $\bar{w}_t$, hiring first from the stock of insiders. If the firms reject, they hire

labor from the spot market at the competitive spot market wage, w_{ft}. In this case, however, firms can collude and operate as a monopolist only with probability ω. With probability $1-\omega$, firms must behave competitively. Thus, this parameter governs the probability that the government enforces antitrust law when firms do not pay high wages.[20]

To characterize the equilibrium, we will first conjecture that the firms play a reservation profits strategy in the bargaining game. We then derive the insiders' best response to this strategy by setting up their dynamic programming problem. We will then verify that the conjectured strategy for the firms is a best response to the strategy that solves the insiders' maximization problem.

We first define the firm's profit function. For any arbitrary wage w and exogenous variables Y_t, Y_{mt}, z_t, and r_{mt}, profits are given by

$$\Pi_t(w) = \max_{n,k} \left\{ \begin{array}{c} Y_t^{1-\phi} Y_{mt}^{\phi-\theta} \left((z_t n)^{\gamma} k^{1-\gamma} \right)^{\theta} \\ -r_{mt} k - wn \end{array} \right\}, \tag{8}$$

where we have used the inverse demand function of the final goods producers to construct the revenue function for the industry. The associated optimal employment function is given by $N_t(w) = n$. We will use $\Pi_t(w, n)$ as the solution to the monopolist's maximization problem when he rents the optimal quantity of capital, taking wages and employment as given. We will later use these functions when we construct the solution to the bargaining game.

The Insiders' Problem

The existing stock of insiders in an industry is given by n. They make a sequence of wage/employment offers to the firms in the industry to maximize the expected present value of the per-insider wage premium. If the insiders' offer of $(\bar{w}, \bar{n})$ is accepted, everyone hired in the cartelized industry receives the same wage, $\bar{w}$, and the hiring rule within the cartel is as follows. If $\bar{n} > n$, then all of the insiders get jobs, and $\bar{n} - n$ workers are hired randomly from the cartel job searchers.[21] If $\bar{n} < n$, then $n - \bar{n}$ of the insiders are randomly chosen to leave the industry, while those remaining get jobs.

[20] We assume that there is no entry in the cartelized industries. There were two factors present in the 1930s that impeded entry. Tariffs were high, which increased the cost of importing substitutes for the cartelized goods. Wages were also high, which Williamson (1968) argues is an effective barrier to entry.

[21] If all the job searchers are hired, then any additional workers are hired randomly from the pool of non-searchers.

Note that with an accepted agreement, insiders control entry into their group and exit (net of attrition) from their group. Moreover, insiders add new members only if it increases the insiders' payoffs, as insiders do not care about the welfare of new members. Once new members are added, however, they become insiders the following period.

Since insiders are perfectly insured within the family and because they can always work at the competitive wage, they maximize the expected present value of the premium between the cartel wage and the competitive wage. Moreover, given perfect family insurance, it is optimal that insiders who are terminated or who suffer exogenous attrition receive no insurance payments.[22]

The value of being an insider is the expected present value of the cartel wage premia. We assume that the firms will accept any wage and employment offer $(\bar{w}_t, \bar{n}_t)$ that promises the firms at least their reservation profits P_t. Given this reservation profit constraint, an individual insider's value of being in the cartel with an initial stock of n insiders is given by the following Bellman equation:

$$(9) \qquad \begin{aligned} V_t(n) &= \max_{(\bar{w},\bar{n})} \left\{ \left(\min \left[1, \frac{\bar{n}}{n} \right] \right) \left[\bar{w}_t - w_{ft} + \pi(Q_{t+1}/Q_t) V_{t+1}(\pi \bar{n}) \right] \right\} \\ &\quad \text{subject to } \Pi_t(\bar{w}, \bar{n}) \geq P_t. \end{aligned}$$

The probability that an insider is terminated is given by $\min[1, \bar{n}/n]$. Insiders discount future wage premia $(\bar{w}_t - w_{ft})$ using the market discount factor scaled by the probability of remaining in the cartel: $\pi(Q_{t+1}/Q_t)$. The insider's proposal of $(\bar{w}, \bar{n})$ must yield the reservation profit level of P_t, which we characterize later. (The appendix shows the derivation of 9). $V_t(n)$ is decreasing in n, and is strictly decreasing if $n > \bar{n}$ and $\bar{w}_t > w_{ft}$. The opportunity cost to the insiders of adding cartel workers (i.e. when $\bar{n}_t > n_t$) consists of two pieces: the current wage premium, $\bar{w} - w_{ft}$, as all workers are paid the same wage, and $\pi(Q_{t+1}/Q_t)V'(\pi\bar{n})$, reflecting the opportunity cost of having more insiders tomorrow.

We now describe some properties of the solution to the insiders' problem. First, we

[22] We assume that families are large enough to insure members against employment risk, but small enough such that family members work only in a small fraction of the catelized industries. This assumption implies that the family does not internalize the aggregate consequences of their actions since the likelihood of a family member obtaining a cartel job is independent of the actions of the industries in which family members work.

denote the pair (w_t^*, n_t^*) as the maximum possible wage and the associated level of employment that satisfies the minimum profit constraint. We then have $w_t^* = \Pi_t^{-1}(P_t)$ and $n_t^* = N_t(w_t^*)$. Since $\Pi_t' < 0$, $\lim_{w\to\infty} \Pi_t(w) = 0$, and $P_t \leq \Pi_t(w_{ft})$, w_t^* is well defined, and the value of $V_t(n)$ defined in (9) is bounded above by $\sum_{\tau=t}^{\infty} \pi^{\tau-t} Q_\tau (w_\tau^* - w_{f\tau})/Q_t$. We now provide a characterization of the solution to the insiders' problem.

PROPOSITION 1. *In problem (9), the optimal policy is such that*

(i) $\Pi_t(\bar{w}, \bar{n}) = P_t$

(ii) if $n \leq n_t^*$, *then* $\bar{n} \geq n$.

(iii) if $n_t^* < n \leq N_t(w_{ft})$ *then* $\bar{n}_t = n$.

(iv) if $n > N_t(w_{ft})$, *then* $\bar{n} \leq n$.

Proof. See the Appendix.

Proposition 1(i) implies that insiders always set their offer so that firms earn their reservation profits. Proposition 1 (ii-iv) are about changes in the number of cartel workers. This change depends on the initial stock of insiders, n. There are three regions. Region 1 is where the initial stock is less than the optimal size ($n < n^*$), region 2 is where the initial stock is above the optimal size, but below the employment level of pure monopoly at the competitive wage: $n_t^* < n \leq N_t(w_{ft})$, and region 3 is where the initial stock exceeds the employment level of pure monopoly at the competitive wage: $n > N_t(w_{ft})$. We will now see that the impact of the policy depends on the initial stock of the insiders.

The number of cartel workers is weakly increasing in region 1. Insiders add new members only if it raises the present value of the insiders' surplus. Since they are below their optimal size ($n < n^*$), the insiders raise their current payoff by adding new workers because the fixed cost of paying P_t can be spread among more members. In this region, this cost reduction more than offsets the fall in the marginal revenue product of adding new workers in this region.

Region 2 is a zone of inactivity with no employment change, despite the fact that the number of insiders exceeds the optimal number. The reason that the insiders choose not to shrink is because this action would reduce the insiders' current expected per-member surplus. This is because shrinking their size would reduce the total surplus available to the insiders,

because total rents are maximized at $N_t(w_{ft})$. Thus, the insiders keep employment constant because any change would reduce their expected payoff.

Employment is weakly decreasing in region 3, because in this region the group is sufficiently large that it earns no current surplus above the competitive wage. Thus, insiders may choose to shrink their membership. The employment level at which insiders choose to shed workers depends on the attrition probability parameter and the discount factor. With attrition, new workers will ultimately be added. This means that keeping employment constant, rather than shrinking employment, may be optimal because it postpones the date at which new members would be admitted and thus lets current members receive the future surplus that would otherwise be paid to the new hires.

The Firm's Best Response

Here we verify our conjecture that given the insiders' strategy, the firms' optimal strategy is to accept any offer $(\bar{w}_t, \bar{n}_t)$ that yields profits of at least $\omega\Pi_t(w_{ft})$. To do so, conjecture that the continuation payoff to the firms from period $t+1$ onwards is given by

$$W_{t+1} = \sum_{\tau=t+1}^{\infty} \left(\frac{Q_\tau}{Q_{t+1}} \omega \Pi_\tau(w_{f\tau}) \right). \tag{10}$$

Note that this payoff is independent of the number of workers in the industry at the beginning of period $t+1$. Next, consider what happens if firms reject the workers' offer in period t. With probability ω they behave as a monopolist hiring labor at the competitive wage w_{ft} and earn monopoly profits of $\Pi_t(w_{ft})$, and with probability $1-\omega$ they behave competitively and therefore earn no profits. Thus, their expected payoff in period t is $\omega\Pi_t(w_{ft})$, and the present value of rejecting the offer is $\omega\Pi_t(w_{ft}) + (Q_{t+1}/Q_t)W_{t+1}$.

Since the firms' payoff from accepting the offer is $\Pi_t(\bar{w}_t, \bar{n}_t) + (Q_{t+1}/Q_t)W_{t+1}$, the firms' optimal strategy is to accept an offer of $(\bar{w}_t, \bar{n}_t)$ if $\Pi_t(\bar{w}_t, \bar{n}_t) \geq \omega\Pi_t(w_{ft})$ and otherwise reject. Since the workers' optimal strategy is to offer firms their reservation profit level, then in equilibrium $W_t = \omega\Pi_t(w_{ft}) + (Q_{t+1}/Q_t)W_{t+1}$, which is the date t version of (10). This verifies our conjecture for both the firms' continuation payoff and their optimal strategy, and indicates that their reservation profit level is given by

$$P_t \equiv \omega\Pi_t(w_{ft}). \tag{11}$$

Note that the firm's reservation profit level is independent of any industry state variables and only depends upon aggregate variables. Finally, note that bargaining is efficient in this model; there are no contracts that can make both the firm and the workers better off than the $(\bar{w}, \bar{n})$ contract, given that all workers receive the same wage. (See Cole and Ohanian (2001) for a further discussion of bargaining efficiency).

Equilibrium

An equilibrium in this model is a sequence of quantities $\{n_{jt}, k_{jt}, x_{jt}\}_{j=m,f}$ and $\{n_{ut}, c_t\}$, and prices $\{p_{jt}, r_{jt}, w_{jt}\}_{j=m,f}$ and $\{Q_t\}$, and a sequence of value functions for the cartelized workers and firms $\{V_t, W_t\}$.

The following proposition shows that under the following conditions the insiders can obtain the maximum wage w_t^* each period.

PROPOSITION 2. *If $N_t(w_t^*) \geq \pi n_{t-1}^*$ for $t \geq 0$, then for all t*

$$\bar{w}_t = w_t^* = \Pi_t^{-1}(P_t), \text{ where } P_t = \omega \Pi_t(w_{ft}), \tag{12}$$

and the employment level is given by

$$\bar{n}_t = N_t(w_t^*). \tag{13}$$

Proof. See the Appendix.

The number of cartel workers is constant along the balanced growth path. Thus the conditions of proposition 2 are satisfied, and the wage rate in the cartelized industries is given by (12) and the employment level by (13). These conditions are satisfied in our transition path analyses, because the initial stock of insiders in 1933 will be below their balanced growth path level.

Moreover, as long as the conditions of proposition 2 are satisfied, then the workers only need to specify the wage in their contract with the firms. This is because specifying a wage of w_t^* leads the firms to choose n_t^* and yields the reservation profit level.[23]

[23] This result is consistent with the fact that between 1933-1939 both the NIRA codes and union contracts often specified only the wage and not the employment level. When the initial level of employment is high enough that the workers want to set $\bar{n}_t > n_t^*$, then the workers need to specify both the wage and the

The Impact of Relative Bargaining Power

The impact of the cartelization policy depends on the relative bargaining power of the insiders and firms, which is determined by the parameter ω. In the appendix we characterize the balanced growth of the model. Here, we summarize these results. When $\omega = 1$, firms have all the bargaining power. In this case, P_t is equal to monopoly profits, and the cartel chooses the employment level equal to that chosen by a monopolist hiring labor from the spot market. For values of $\omega < 1$, the workers have some bargaining power, and the cartel arrangement depresses employment relative to the monopoly case. As $\omega \to 0$, workers have all the bargaining power. In this case, employment converge to zero.

To understand these results, note that there are two opposing forces affecting the number of insiders. First, the per-worker profits that must be paid to the firm (P_t/n_{mt}) increases as n_{mt} falls. This fixed cost tends to increase employment. On the other hand, revenue per worker is maximized by setting employment to zero, and this effect tends to reduce employment. Since the importance of P_t/n_{mt} declines as P_t falls, the second effect dominates the first effect which implies that employment and output in this industry tend to zero as $P_t \to 0$.

This model of New Deal policy sets up a dynamic insider-outsider friction in our model. The quantitative importance of the insider-outsider friction depends on ω, the bargaining game parameter and χ, the fraction of sectors being cartelized. We now turn to choosing parameter values for the model.

5. Parameter Values

A number of the parameters appear in other business cycle models, and for these parameters we choose values similar to those in the literature. These parameters are γ, β, g, A, δ. We choose values for the first three so that in the competitive version of the model, steady state labor share of income is 70%, the annual real return to capital is 5%, and the average growth rate of per-capita output is 1.9% per year. We set the leisure parameter A so that households work about 1/3 of their time in the steady state. We set $\delta = 0.07$, which yields a

employment level to force the firms to their reservation profit level. This implication of our model is consistent with the observation that in declining industries employment is typically part of the factors being bargained over.

steady-state ratio of capital to output of about 2.

The parameters θ and ϕ govern industry and sector substitution elasticities. The parameter θ governs the substitution elasticity between goods across industries within a sector. This substitution parameter also appears in business cycle models in which there is imperfect competition. In these models, this parameter governs the mark-up over marginal cost as well as the elasticity of substitution. We choose a substitution elasticity of 10, which is the standard value used in the imperfect competition- business cycle literature.

The parameter ϕ governs the substitution elasticity between goods across the aggregated cartelized and non-cartelized sectors. Since we are treating manufacturing as a cartelized sector, we use long-run manufacturing data to determine a range of values for this parameter. The relative price and expenditure share of manufactured goods have declined in the postwar period. These two trends are consistent with a substitution elasticity between manufactured goods and other goods that is less than one. Thus, we consider a unit substitution elasticity ($\phi = 0$) as an upper bound on this parameter, and we also consider substitution elasticities between 1/4 and 1. We found that the results were insensitive to these different values. We therefore chose a value of $\phi = -1$, which implies a substitution elasticity of 1/2.

There are three parameters that are specific to our cartel model: π, χ, and ω. The first parameter is the probability that a current cartel worker remains in the cartel the following period. The second parameter is the fraction of industries in the model economy that are cartelized. The third parameter is the probability that a firm in a cartelized industry can act as a monopolist but pay the non-cartel (competitive) wage.

The parameter π is the cartel worker attrition rate. We choose $\pi = 0.95$, which corresponds to an expected job tenure for a cartel worker of 20 years. We experimented by analyzing two different values that correspond to expected job durations of 10 years and 40 years, respectively. The results were not sensitive to these variations.

6. Evaluating the Steady State

Before choosing values for χ and ω, we explore how variations in these values affect the steady state. We consider two values for the parameter χ: 0.25 and 0.50. These values correspond to a 25% share of industries, and a 50% share of industries, respectively, that are

cartelized. As we will describe later, 0.25 is a reasonable lower bound on the fraction of the economy that was effectively cartelized.

The parameter ω is the probability that an industry fails to reach an agreement with labor but still behaves as a monopolist. We conduct the steady state analysis for a range of values for this probability: $.05, .50, 1$. Recall that $\omega = 1$ is a model in which labor has no bargaining power, and the industries in fraction χ of the sectors behave as monopolists. We call this version the *monopoly model*. This version of the model is useful because it shows the quantitative importance of the high wage element of the policy relative to the pure monopoly element of the policy.

Table 6 shows aggregate output (y), aggregate employment (n), the cartel (insider) wage (w_n), and employment (n_m) in the cartel sector divided by their respective competitive steady state values. The table also shows the fraction of workers searching for a cartel job (s).

The cartel policy significantly depresses output and employment provided that ω is low. For example, with $\chi = 0.25$ and $\omega = 0.05$, output falls 14 percent relative to competition, and for $\chi = 0.50$ and $\omega = 0.05$, output falls about 25 percent relative to pure competition. Lower output and employment are associated with significant increases in the wage in the cartelized sector. For $\chi = 0.25$ and $\omega = 0.05$, the cartelized wage is about 36 percent above its value in the competitive economy, and for $\chi = 0.50$ and $\omega = .05$, the cartelized wage is about 16 percent.

The key depressing element of the policy is not monopoly per se, but rather the link between wage bargaining and monopoly. To see this, note that the cartelized wage in the monopoly version of the model in which labor has no bargaining power ($\omega = 1$) is about the same as the wage in the competitive model. In this case, aggregate output is not much lower than its level in the competitive model. However, fixing the size of the cartelized sector (χ), we see that reducing ω (raising labor's bargaining power) raises the wage and consequently reduces employment.

The link between wage bargaining and monopoly is key because raising the wage above its competitive level in our model requires imperfect competition. In the absence of rents, constant returns to scale and the competitive rental price of capital implies that the wage

rate cannot exceed the marginal product of labor. The fact that labor unions aggressively campaigned against antitrust prosecution of firms when New Deal policies began to shift in the late 1930s empirically supports this mechanism in our model (see Hawley, 1966).

The impact of the policy also depends on the fraction of the economy covered by the policies (χ). Fixing the value of ω and increasing χ reduces output and employment because more of the economy is cartelized.

Note that the policy depresses employment and output in both the cartelized and competitive sectors. This is because the policy has general equilibrium effects that impact on the competitive sector. One such effect is that the policy lowers the competitive wage. This is because lower cartelized output reduces the marginal product of competitive output in the production of final goods. This reduces the value of the marginal product of competitive labor, which in turn reduces employment in the competitive sector.[24] Another general equilibrium effect is that the high cartel wage induces some household members to search for high paying cartel jobs. For example, for $\chi = 0.25$, $\omega = 0.05$ about 5 percent of individuals involved in market activity search for a cartel job. For $\chi = 0.5$, $\omega = 0.05$, about 11 percent of workers search for a cartel job. This means that the policy depresses employment more than it depresses labor force participation.

In summary, the steady state general equilibrium works as follows. The policy raises the wage in the cartel sector, which reduces output in the cartel sector. This decrease in cartel output affects the competitive wage through its impact on the value of the marginal product of labor in the competitive sector. The low competitive wage and the wage gap between the two sectors reduce employment in the competitive sector, as some individuals choose to search for a cartel job, and some choose to take leisure rather than work for the low competitive wage. The gap between the steady state cartelized wage and the competitive wage is determined solely by the policy parameters (χ and ω), the cartel attrition probability (π), and the interest rate. Thus, search activity has no affect on the cartelized wage because the cartel workers control the size of their group.

These results show that a small value of ω will be required to understand the impact of New Deal policies, because wages were substantially above normal in the cartelized sectors.

[24] This occurs as long as the two intermediate goods are not perfect substitutes.

We now turn to choosing values for ω and χ to compute the transition path of the model economy.

7. Comparing the Model to the Data: 1934-1939

We compute the transition path for the purely competitive version and the cartel version of our model from initial conditions in 1934 to their respective steady states. We then compare the predicted variables from the two models to the data between 1934 and 1939. We choose 1934-39 because 1934 is the first full year of the policy, and because the policies began to change significantly after 1939.

We first choose parameter values for χ and ω. We choose a conservative value for χ, which is 0.32. This is the fraction of the economy covered just by those industries we previously classified as cartelized on the basis of wages, prices, and government reviews**:** manufacturing, bituminous coal, and petroleum.[25]

We choose $\omega = 0.10$, which yields a cartelized wage that is 20 percent above its competitive steady state value. We chose this number because the average manufacturing wage is about 20 percent above trend during the late 1930s, and we assume that the wage would have been near its normal level in the absence of these policies. Given χ, this value of ω produces a steady state cartel wage that is 20 percent above the steady state wage in the perfectly competitive version of the model. (For the competitive model, $\chi = 0$.)

We also need an initial condition for the capital stock in the model. We find that the overall capital stock in 1934 is about 15 percent below trend, which reflects the low level of investment during the Depression. We therefore specify the initial capital stock in each of the two sectors to be 15 percent below the steady state.

Cole and Ohanian (1999), report that measured TFP is significantly below trend in 1933, and recovers back to trend by 1936. We therefore feed in the observed sequence of TFP values relative to trend between 1934-1936 followed by the steady state TFP value thereafter

[25]Manufacturing accounts for 28 percent of output, and the remaining sectors account for about 4 percent of output in 1929. Another reason this is a conservative choice for χ is because we abstract from other New Deal policies that likely affected other sectors. These policies include the Davis-Bacon Act, which required federally-funded contractors to pay union scale wages and benefits, and the Fair Labor Standards Act, which established a minimum wage, overtime pay, and restricted employment of workers under 18 years of age. It is also worth noting that this value for χ is consistent with the share of unionized employment in 1939.

to the competitive model. For the cartel model, we have to modify this procedure because with imperfect competition, measured TFP and the true technology level differ. We therefore feed in a sequence of TFP values such that measured TFP in the cartel model is the same as that in the data. We then compute the perfect foresight transition path for the two versions of our model.

Figure 2 compares the recovery in output in the models to actual output during the New Deal. The figure shows that the recovery in the cartel model is much closer to the actual recovery. Tables 7 and 8 present details for the two models.

Table 7 presents the results for the competitive model. The predicted recovery from this model differs significantly from the actual 1934-39 recovery. Predicted economic activity is too high, and the predicted wage is much lower than the wage in manufacturing. In particular, predicted output returns nearly to trend by 1936, while actual output remains about 25 percent below trend. Predicted labor rises above trend by 1936. In contrast, actual labor input remains about 25 percent below trend through the period. Predicted consumption recovers nearly to trend by the end of the decade. Actual consumption remains about 25 percent below trend. There is an even larger disparity between predicted and actual investment. Predicted investment rises 18 percent above trend by 1936, due to the low initial capital stock and the rapid recovery of productivity. In contrast, actual investment recovers only to 50% of its trend level. The predicted wage is initially low, and then rises nearly to trend as TFP rises and the capital stock grows. In contrast, the manufacturing wage is considerably above trend over the 1934-1939 period. The predicted equilibrium path from the competitive model differs considerably from the actual path of the U.S. economy.

It is natural to suspect that slowing down the convergence of the competitive model would let it match the actual recovery much better. Cole and Ohanian (1999) showed that this was not the case. We found that plausibly parameterized "slow converging" versions of the competitive model have the same problem as the standard model by predicting that the economy should have been near trend by 1939, and that the wage should have been below normal during the recovery.

We now turn to the cartel model. To compute the equilibrium path of this model, we need a value for one additional state variable, which is number of insiders. We choose this

number by dividing trend-adjusted 1933 manufacturing employment by its 1929 value, which yields .58. Table 8 shows output, consumption, investment, employment, searchers divided by the sum of workers and searchers (s), employment in the cartel sector (n_m), employment in the competitive sector (n_f), the wage in the cartel sector (w_m) and the wage in the competitive sector (w_f).

The table shows the equilibrium path of the cartel model is similar to the actual path of the economy, and sheds light on a number of the puzzles about the weak recovery. Two key puzzles in the data are the low levels of output and labor input. These variables rise from their trough levels between 1934-1936, and are flat afterwards in the data, remaining about 20-25 percent below trend. The cartel model predicts very similar patterns for these variables. They rise between 1934 and 1936, and are flat afterwards. The cartel model economy remains significantly depressed in 1939, though the severity of the depression is less than in the data. Output in the model is 13 percent below its competitive steady state level, and employment is 11 percent below its steady state level. The model also captures the pattern of consumption. Actual consumption is flat throughout the recovery, remaining about 25 percent below trend. The pattern of consumption in the cartel model is also flat, rising from 16 percent below its competitive steady state level in 1934 to 14 percent below in 1939. The cartel model predicts a much stronger investment recovery - an increase from about 60 percent below its competitive steady state level in 1934 to 13 percent below in 1939. While this deviation between theory and data is significant, it is much smaller than the deviation between investment in the competitive model and the data. Investment in the competitive model is 18 percent *above* its competitive steady state level in 1936. This stands in contrast to investment in the cartel model, which is 12 percent below the competitive steady state level.

We now turn to discussing some other features of the data and the corresponding predictions of the model. The manufacturing wage, which take to be a cartelized wage in the data, rises from 11 percent above trend in 1934 to about 20 percent above trend at the end of the decade. The cartelized wage in the model exhibits a similar increase. It rises from about 15 percent above its competitive steady state level in 1934 to 20 percent by 1939. While the parameter ω was chosen so that the steady state wage is 20 percent above the competitive

steady state level, this choice places no restrictions on the time path of the cartelized wage as it converges to its steady state value. Thus, the model reproduces the time path in the cartel wage over the recovery period.

The wage in the competitive sectors of our cartel model is significantly below its competitive steady state level, despite normal productivity growth. It is 20 percent below its competitive steady state level in 1934, and remains 17 percent below in 1939. While there is no corresponding wage measure in the data for comparison, there is evidence that wages outside of manufacturing were below trend during the 1934-1939 period. We constructed a measure of real compensation per hour in the non-manufacturing and non-mining sectors by dividing compensation of employees in the non-manufacturing, non-mining sectors by hours worked in the non-manufacturing, non-mining sectors. This hourly compensation measure is about 18 percent below trend in the late 1930s, which is similar to the cartel model's competitive wage.

The adoption of the cartel policy in our model generates monopoly rents. It is hard to find profit measures in the data for direct comparison to these theoretical monopoly rents, but it is interesting that manufacturing accounting profits rose significantly after the NIRA was adopted, and rose faster than profits in other sectors.

Our model also predicts the fraction of individuals in the market sector who search for a job. The number of searchers in our model, divided by the number who are either working or searching, is 11 percent during the early part of the transition, and then declines to about five percent. The initial number of searchers is high because insiders add workers in the first two years, which raises the probability of obtaining a cartel job. Insiders add new workers because the initial number of insiders are low relative to the steady state, and because the time path of TFP rises over time, which in turn raises the reservation profit level of the firm. Darby (1976) reports that unemployment ranged between 9 and 16 percent between 1934 and 1939. Thus, the model is consistent with the persistently high unemployment that occurred during the New Deal.

We now turn to a discussion of the predicted patterns in output and labor input over time. Both of these variables rise initially. This may seem counterintuitive - why does the adoption of the cartel policy lead initially to some recovery? One factor is that the initial

stock of workers in the cartelized sector in the model is small relative to its steady state value because of the large employment loss during the Depression. This leads the insiders to expand their group size. Another factor is the rising time path of productivity. This increases the firm's reservation value and the marginal revenue product of labor in 1935 and 1936, which leads the cartel to add additional workers during those years as well. This increase in cartel employment raises the probability of finding a cartel job, which raises the number of cartel job searchers in 1934 and 1935. Thus, our model sheds light on the initial recovery from the Depression, as well as the lack of full recovery.

We have evaluated the robustness of our results to changes in assumptions about job search, about differences in cartelization intensity across industries, and about the lack of any monopoly prior to the policies. The results are robust to these changes. The Appendix discusses these experiments in detail.

8. Conclusion

The recovery from the Great Depression was weak, and was accompanied by significant increases in real wages and prices in several sectors of the economy. A successful theory of the recovery from the Depression should account for persistent low levels of consumption, investment, and employment, the high real wage, and reduced competition in the labor market. We developed a model with New Deal labor and industrial policies that can account for sectoral high wages, a distorted labor market, and depressed employment, consumption, and investment, despite rapid productivity growth.

Our results show that New Deal policies are important, accounting for about 60 percent of the weak recovery. The key depressing element behind New Deal policies was not monopoly per se, but rather linking collusion with paying high wages. Our model indicates that these policies reduced output, consumption, and investment about 13 percent relative to their competitive steady state levels. Thus, the model accounts for about half of the weak recovery in output and helps explain why the initial recovery stalled by the late 1930s.

New Deal labor and industrial policies did not lift the economy out of the Depression as Roosevelt had hoped. Instead, the joint policies of increasing labor's bargaining power and linking collusion with paying high wages prevented a normal recovery by creating rents and an

inefficient insider-outsider friction that raised wages significantly and restricted employment.

The adoption of these industrial and trade policies not only coincided with the persistence of depression through the late 1930s, but the subsequent abandonment of these policies coincided with the strong economic recovery of the 1940s. Further research should evaluate the contribution of this policy shift to the World War II economic boom.

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9. Appendix

This appendix presents the equilibrium conditions in the model, constructs the balanced growth path equilibrium, presents proofs of the propositions, and summarizes the computation of the equilibrium.

We begin with the equilibrium conditions. The households' first order conditions include the following equations for optimal choices of consumption, labor input in the competitive sector, investment, labor input in the cartel sector, and search for a cartel job.

$$\beta^t \frac{1}{c_t} = Q_t \lambda \tag{14}$$

$$\beta^t \frac{A}{1-n_t} = \lambda Q_t w_{ft}, \tag{15}$$

$$Q_{t+1}[r_{s,t+1} + 1 - \delta] - Q_t = 0, \tag{16}$$

$$Q_t w_{mt} \lambda - Q_t \xi_t + Q_{t+1} \pi \xi_{t+1} = \beta^t A \frac{1}{1-n_t} \tag{17}$$

$$Q_{t+1} \upsilon_t \xi_{t+1} = \beta^t A \frac{1}{1-n_t}, \tag{18}$$

where λ is the Lagrange multiplier on the budget constraint (3) and ξ_t is the Lagrangian multiplier on the market hours constraint (5).

Cartel Job Acquisition

(15) and (16) can be used to solve for the equilibrium probability of receiving a cartel job from searching. Assuming that $\lim_{\tau\to\infty} Q_{t+\tau}\pi^{\tau}\xi_{t+\tau}/Q_t = 0$, the value of being a cartel worker is

$$\xi_t = \frac{\lambda}{Q_t}\sum_{\tau=0}^{\infty} Q_{t+\tau}\pi^{\tau}(w_{mt+\tau} - wf_{t+\tau}).$$

Thus, the value to a household member of being in the cartel is the expected discounted value of the cartel wage premium. Combining this expression with the time cost of searching for a cartel job from (17) yields

$$(19) \quad \upsilon_{t-1}\sum_{\tau=0}^{\infty} Q_{t+\tau}\pi^{\tau}(w_{mt+\tau} - w_{ft+\tau}) = Q_{t-1}w_{t-1}.$$

This condition determines the equilibrium probability of finding a cartel job.

A. Deriving the Insider's Maximization Problem

We derive (9). Start by taking as given the sequence of offers $\{\bar{w}_t, \bar{n}_t\}$ and note that the present value of lifetime earnings of the insiders (workers in the cartel at the beginning of the period), assuming that they work in the competitive sector if they leave the cartel, is implicitly given by

$$\begin{aligned} n_t W_t &= \min[n_t, \bar{n}_t]\,\bar{w}_t + \max[0, n_t - \bar{n}_t]\,X_t \\ &\quad + \beta\frac{Q_{t+1}}{Q_t}\left\{\pi\min[n_t, \bar{n}_t]\,W_{t+1} + (1-\pi)\min[n_t, \bar{n}_t]\,\beta X_{t+1}\right\}, \end{aligned}$$

where W_t denotes the present value of lifetime earnings to an insider in period t and X_t denotes the present value of lifetime earnings to a worker in a competitive industry, where

$$X_t = w_{ft} + \frac{Q_{t+1}}{Q_t}X_{t+1}.$$

In the period t flow payoff, $\min[n_t, \bar{n}_t]$ is the number of insiders who continue working in the industry this period and $\max[0, n_t - \bar{n}_t]$ is the number who are laid off and work in a competitive industry. The future payoff to those who are not laid off in period t accounts for the fact that between periods the fraction $1-\pi$ of the cartel workers (insiders who work that period plus new members added to the cartel) will suffer attrition. Since $[W_t - X_t] = V_t(n_t)$, we obtain (9).

If $\bar{n}_t > n_t$, the current surplus received by cartel workers is $\bar{n}_t(\bar{w}_t - w_t)$. However only the portion $n_t(\bar{w}_t - w_t)$ is received by the period t insiders. Similarly, the present value of surplus received by insiders at the beginning of period $t+1$, $n_{t+1}(W_{t+1} - V(n_{t+1})$, includes both the present value of surplus received by the period t insiders, whose number is $\pi \min[n_t, \bar{n}_t]$ and to new hires in period t, whose number is $\pi \max[0, \bar{n}_t - n_t]$.

B. The Balanced Growth Path of the Cartel Model

We begin by characterizing the competitive variables. From the consumer's problem, Q_t is given by

$$Q_t = \left(\frac{\beta}{g}\right)^t$$

Given our preference assumption, the relationship between c and the competitive wage, w_f is given by

$$(20) \quad w_f(1-n) = Ac$$

Denoting investment in the competitive sector as $x_t = xg^t$, then the capital stock in the competitive sector is given by

$$K(x) \equiv \sum_{j=1}^{\infty} x_{ft-j}(1-\delta)^{j-1} = \sum_{j=1}^{\infty} x_f g^{-j}(1-\delta)^{j-1} = \frac{x_f/g}{1-\frac{1-\delta}{g}}.$$

Defining z to be the detrended level of z_t, the competitive intermediate goods producer's conditions are

$$(21) \quad \gamma z^{\gamma}(K(x_f)/n_f)^{1-\gamma} - w_f = 0$$

$$(22) \quad (1-\gamma)z^{\gamma}(n_f/K(x_f))^{\gamma} - r_f = 0,$$

while the capital goods producer's f.o.c. is:

$$(23) \quad \left(\frac{\beta}{g}\right)[r_f + (1-\delta)] = 1$$

We now turn to the cartel sector. We will denote the output level and the price of intermediate goods (in terms of the final good) produced in the cartel sector by Y_m and p_m, and those in the competitive sector by Y_f and p_f. The output and prices of these two types

of intermediate goods will be different, however, since the outputs are growing at the same rate g, the prices will be time invariant. From the f.o.c.'s of the final goods producer these prices are given by

$$(24) \quad p_m = Y^{1-\phi} y_m^{\phi-1}$$

$$(25) \quad p_f = Y^{1-\phi} y_f^{\phi-1}$$

The rental price of capital is determined by the identical condition to that in the competitive sectors, hence $r_m = r_f = r$.

The level of sectoral output is given by $Y_m = m y_m$ and $Y_f = (1-m) y_f$. The level of final goods output is given by

$$(26) \quad Y = \left[m \left(y_m \right)^{\phi/\theta} + (1-m) \left(y_f \right)^{\phi/\theta} \right]^{1/\phi}$$

and the resource constraint is

$$(27) \quad Y = c + m x_m + (1-m) x_f .$$

Total level of labor effort is given by

$$(28) \quad n = m n_m + (1-m) n_f + n_s$$

We now characterize the solution to the cartelized intermediate goods producers. We begin with the determination of P. One can see from (8) and from the associated f.o.c.s that when the firms are allowed to collude and chooses labor, $\tilde{n}$ and capital, $\tilde{k}$, at the competitive wage, then

$$\frac{\tilde{n}}{\tilde{k}} = \frac{r}{w_f} \frac{\gamma}{1-\gamma}.$$

This yields the following expression for $\tilde{k}$:

$$\tilde{k} = \left[\frac{r}{\theta p_m Y_m^{1-\theta} \left(z r \gamma / w_f (1-\gamma) \right)^{\gamma(\theta-1)} (1-\gamma) (z r \gamma / w_f (1-\gamma))^{\gamma}} \right]^{\frac{1}{\theta-1}}$$

The firm's static expected payoff from turning down the workers' offer is:

$$(29) \quad P = \omega \left\{ p_m Y_m^{1-\theta} \left(\tilde{k} (z r \gamma / w_f (1-\gamma)) \right)^{\gamma} \right)^{\theta} - r \tilde{k} - w_f \tilde{k} (r \gamma / w_f (1-\gamma)) \right\}.$$

Since the balanced growth path level of employment in the cartel industries is constant at n_m, and $n_m > \pi n_m$, it follows that the conditions in proposition 2 hold, and n_m satisfies

$$(30) \quad \theta p_m \gamma z^{\gamma} (k_m/n_m)^{1-\gamma} - \left(\frac{p_m (z n_m)^{\gamma} k_m^{1-\gamma} - r k_m - P}{n_m} \right) = 0.$$

Since firms are acting as a monopolist, the following condition must also hold

$$(31) \quad \theta p_m (1-\gamma)(z n_m/k_m)^{\gamma} - r = 0.$$

The cartel wage rate is given by

$$(32) \quad w_m = \frac{p_m (z n_m)^{\gamma} k_m^{1-\gamma} - r k_m - P}{n_m}$$

The probability of a searcher obtaining a cartel job, υ, along the balanced growth path is given by (19):

$$(33) \quad \frac{\beta}{1-\pi\beta}(w_m - w_f)\upsilon = w_f.$$

Therefore, the number of searchers is

$$(34) \quad n_s = (1-\pi) n_m / \upsilon.$$

Equations (20)- (34), along with the industry production functions, yield a system of equations with which to determine (c, w_i, x_i, n_i, r, y_i, p_i, n, n_s, y, P, υ) for $i = m$ or f, and thus characterize the balanced growth path of the cartel model.

When $\omega = 1$, this model is simply a two-sector model in which the fraction m of the intermediate goods producers are monopolists and the fraction $1-m$ are competitive. To see this note in this case P is simply monopoly profits, and from condition (32) $\bar{w} = w$, and hence that condition (30) is the same as the monopolist's f.o.c. with respect to labor . As $\omega \to 0$, the effective wage in the cartel sector is approaching $(p_m ((z n_m)^{\gamma} k_m^{1-\gamma}) - r k_m)/n_m = p_m \gamma (z n_m)^{\gamma} k_m^{1-\gamma}$, and hence $n_m \to 0$. Finally, note that as $\theta \to 1$, the market power of the industry disappears, and condition (30) is the same as the monopolist's f.o.c. for labor. In this case, the cartel equilibrium converges to the competitive equilibrium.

C. Proof of Proposition 1

The proof of (i) is by contradiction. If $\Pi_t(\bar{w}, \bar{n}) > P_t$, then the workers could raise $\bar{w}$, keeping $\bar{n}$ the same, and raising the value of the objective function.

The proof of (ii) is by contradiction. Assume that $\bar{n}_t < n_t$, and note that by setting $\bar{n}_t = n_t$ and keeping $\bar{n}_{t+1}$ unchanged, then the workers current return is higher and their expected future is unchanged. To see that their current payoff is higher, note that $\bar{w}_t$ is higher (given that it is set according to 1(i)) and they receive this return with probability one. To see that their expected future return is unchanged, note first that the likelihood that an initial worker in period t remained employed in period $t+1$ was $(\bar{n}_t/n_t)\pi \min(\bar{n}_{t+1}/\pi\bar{n}_t, 1)$. Under the proposed deviation, there are no layoffs in period t, but the higher layoffs in period $t+1$ just offset this and the probability of working in period $t+1$ for an initial worker in period t is unchanged by construction. Hence, their future payoff is unchanged, since the payoff per worker who is employed in period $t+1$ is unchanged. If $\bar{n}_{t+1}$ is chosen optimally given that the number of initial workers in period $t+1$ is πn_t, the future payoff could be even higher: since $V_{t+1}(\pi n_t)$ is optimal, $V_{t+1}(\pi n_t) \geq (\bar{n}_t/n_t)V_{t+1}(\pi n_t)$.

The proof of (iii) is by contradiction. As in the proof of (ii), consider deviating and setting employment to n_t and the wage according to 1(i). Since the total profits earned by the workers are $\Pi_t(0, \bar{n}_t) - P_t$ in period t, we need only show that

$$(35) \qquad \frac{\Pi_t(0, n_t) - P_t - n_t w_t}{n_t} + \frac{\pi Q_{t+1}}{Q_t}\left(\min\left[1, \frac{\bar{n}_{t+1}}{\pi n_t}\right]\right)\begin{bmatrix} \bar{w}_{t+1} - w_{t+1} + \\ \pi(Q_{t+2}/Q_{t+1})V_{t+2}(\pi\bar{n}_{t+1}) \end{bmatrix} \geq$$
$$\frac{\Pi_t(0, \bar{n}_t) - P_t - \bar{n}_t w_t}{n_t} + \frac{\bar{n}_t}{n_t}\frac{\pi Q_{t+1}}{Q_t}\left(\min\left[1, \frac{\bar{n}_{t+1}}{\pi\bar{n}_t}\right]\right)\begin{bmatrix} \bar{w}_{t+1} - w_{t+1} + \\ \pi(Q_{t+2}/Q_{t+1})V_{t+2}(\pi\bar{n}_{t+1}) \end{bmatrix}$$

Note that $\left(\min\left[1, \frac{\bar{n}_{t+1}}{\pi n_t}\right]\right) = \frac{\bar{n}_t}{n_t}\left(\min\left[1, \frac{\bar{n}_{t+1}}{\pi\bar{n}_t}\right]\right)$ and therefore the second terms are equal in the two expressions by construction. Hence we need only show that

$$(36) \qquad \frac{\Pi_t(0, n_t) - P_t - n_t w_t}{n_t} > \frac{\Pi_t(0, \bar{n}_t) - P_t - \bar{n}_t w_t}{n_t},$$

which follows trivially from the fact that $n_t \leq N_t(w_t)$, and the profit function $\Pi_t(w_t, n_t)$ is concave in n_t.

The proof of (iv) is similar to (iii). We again need to show that (35) is satisfied, and

this follows trivially from the assumption that $\bar{n}_t > N_t(w_t)$.

D. Proof of Proposition 2

The proof follows trivially from the fact that w_t^* is the maximal wage rate in period t, and that therefore the value of (9) is bounded above by $\sum_{t=0}^{\infty} \pi Q_t(w_t^* - w_t)$, and this sequence achieves that bound. The uniqueness of the sequence follows from the fact that Π is strictly decreasing in w.

E. Convergence

We have not proved that the equilibrium sequences in our model monotonically converge, but our model simulations suggest they do. Proposition 2 covers the case where employment starts at or below the balanced growth path level (n_t^*). It shows that if employment starts at or below n_0^* and the sequence n_t^* decreases at a rate less than $1 - \pi$, the maximum wage and minimum employment level are chosen in each period. Propositions 1(iii) covers the case when initial employment, $n_0 : N_0(w_{f0}) \geq n_0 > n_0^*$ and convergence is sufficiently monotonic. In this case, the employment level decays at least at the rate $1 - \pi$ down to n_t^*, where it remains thereafter.

F. Robustness Experiments

The first experiment evaluates the importance of our search friction by eliminating it. Instead, cartel jobs were simply randomly allocated among households. Without job search, steady state output fell 11 percent, compared to 13 percent with job search.

The second experiment evaluates our assumption that the average 20 percent wage premium in the manufacturing sector is due to all of these industries being identically cartelized, rather than some having higher wage premia, and some having lower wage premia. To evaluate this, we conducted an experiment in which the measured wage premium is a combination of some highly cartelized sectors, and some competitive sectors. We therefore reduced χ from its original value of .32 by 25 percent, and reduced ω from its value of .10 such that our analog to the measured manufacturing wage, $\hat{w}$, still produced the measured 20 percent premium:

$$\hat{w}(\chi, \omega) = \frac{\chi n_m(\chi, \omega) w_m(\chi, \omega) + (.32 - \chi) n_f(\chi, \omega) w_f(\chi, \omega)}{\chi n_m(\chi, \omega) + (.32 - \chi) n_f(\chi, \omega)}.$$

where all objects in this equation are detrended balanced growth path value of these variables

under the calibration (χ, ω). The results were almost identical.

The third experiment evaluates the importance of our assumption that all industries were competitive prior to 1933. In this experiment, we assume that 16 percent of the industries were able to behave monopolistically before the onset of the Depression. We assumed that the impact of the policy was to expand collusion to 32 percent of the industries, and tie collusion to wage bargaining We re-calibrated ω so that the wage rate was 20% higher than the average wage in our economy with partial monopolization. With partial monopoly, steady state output fell 11 percent, compared to 13 percent in our baseline model.

G. Computation

Computing the detrended balanced growth path variables requires solving a 17 equation nonlinear system. This is because the conditions of proposition 2 are trivially satisfied. Computing the equilibrium path of the model to the balanced growth path when $m > 0$ and $\omega < 1$ is more complicated, because the possibility of layoffs of insiders introduces a kink in the objective function of the cartel workers.

If the initial level of insiders starts out above level of employment associated with the maximum possible wage, w_t^*, then one must determine the upper bound on the zone of inactivity in order to determine whether employment in the cartel sector will shrink at the attrition rate, or whether there will be layoffs.

If the initial level of insiders starts out below the optimal size, as it did in our simulations, then this problem does not arise and computation is simple. In our computations, we posited that the conditions of proposition 2 were satisfied, and then verified that this was true. In this case, the cartel wage rate is the sequence of maximum possible wages, $\{w_t^*\}$ and the employment level in the cartel sector is that chosen by a profit maximizing monopolist who faced the wages $\{w_t^*\}$. The computation requires solving a system of equations where the list of variables includes the capital stock in each period, and where the system of equations includes the transition equations for capital in each sector, and equation (23, 33, 34) have been replaced with their nonstationary analogs.

Table 1: The Continuation of the Depression (1929 = 100)

Year	GNP	C	I	TFP	W^{mfg}	$H^{private}$
1934	64.4	71.9	27.9	92.6	111.1	68.7
1935	67.9	72.9	41.7	96.6	111.2	71.4
1936	74.7	76.7	52.6	99.9	110.5	75.8
1937	75.7	76.9	59.5	100.5	117.1	79.5
1938	70.2	73.9	38.6	100.3	122.2	71.7
1939	73.2	74.6	49.0	103.1	121.8	74.4

Table 2: Indexed Real Wages Relative to Trend[26]

Year	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939
Manufacturing	101.7	106.3	105.1	102.9	110.8	112.0	111.6	118.9	122.9	123.6
Bituminous Coal	101.2	104.8	91.4	90.4	110.1	119.1	125.3	127.8	130.9	132.7
Anthracite Coal	n.a.	n.a.	100.0	100.0	92.7	90.3	89.9	89.1	94.1	94.4
Petroleum	n.a.	n.a.	100.0	103.6	108.9	113.6	115.4	124.8	129.1	128.8
Farm	94.6	78.8	63.0	60.9	60.8	64.1	67.7	72.9	68.5	68.6

[26]Wages are deflated by the GNP deflator, and a 1.4% trend which is the growth rate of manufacturing compensation in the postwar period. They are index to be 100 in 1929, except for the wages in antracite and petroleum, which are index to 1932 = 100 because of data availibility

Table 3: Monthly Wages

Relative to GNP deflator

(2/33 = 100)

Dates	4/33	12/33	6/34	5/35	12/35	6/36
Leather Tanning	96.6	124.0	122.2	121.9	123.0	124.9
Boots and Shoes	104.7	145.9	138.1	139.0	139.7	137.0
Cotton	96.7	142.0	133.2	135.2	133.4	134.3
Iron/Steel	100.2	123.1	122.7	124.6	125.0	127.0
Foundaries and Machine Shops	99.4	112.6	111.9	113.4	113.6	115.9
Autos	98.9	115.5	121.3	121.0	123.1	125.8
Chemical	102.8	117.6	118.2	121.5	123.1	124.1
Pulp/Paper	100.7	117.5	111.4	115.3	116.4	117.9
Rubber Manufacturing	100.7	121.3	125.9	134.1	137.0	128.6
Furniture	102.3	118.9	125.9	129.2	129.0	130.3
Farm Implements	96.5	107.1	105.6	115.3	116.9	113.7

Table 4: Price of Investment Goods and Farm Goods

Relative to Personal Consumption Services

(1929=100)

Year	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939
Fixed Investment	96.9	95.1	93.2	99.9	108.3	110.0	109.5	115.0	114.0	112.5
Durable Equipment	97.1	98.1	101.8	99.5	110.2	109.6	107.6	111.3	113.4	111.3

Table 5: Wholesale Prices

Relative to Personal Consumption Services deflator

(2/33 = 100)

Dates	4/33	12/33	6/34	5/35	12/35	6/36	6/37	6/38	6/39
Leather/Hides	102.1	131.2	126.1	127.5	137.8	126.7	128.5	143.0	121.1
Textiles	131.8	149.2	143.8	133.1	140.4	131.9	142.3	116.9	120.1
Furniture	99.4	110.3	108.1	105.3	105.3	103.9	112.2	106.2	103.0
All Home Furnishings	98.9	112.0	111.6	109.5	109.5	107.9	115.3	110.1	108.2
Anthracite Coal	91.8	91.9	85.3	80.8	91.8	84.1	78.2	76.8	77.8
Bituminous Coal	98.4	114.1	117.8	117.0	119.3	117.8	115.6	112.2	110.1
Petroleum Products	94.8	150.4	145.2	145.2	142.6	162.4	167.0	150.0	139.9
Chemical	100.6	100.3	97.9	108.8	108.8	107.8	104.6	99.7	97.4
Drugs/Pharmaceuticals	99.6	107.7	131.3	133.0	133.0	138.6	144.8	127.4	129.1
Iron/Steel	97.9	108.2	97.0	114.6	108.7	108.2	120.2	119.3	112.6
Non-Ferrous Metals	106.5	144.2	145.9	147.1	147.1	146.8	185.3	133.0	144.2
Structural Steel	100.0	106.2	113.8	110.6	110.6	109.7	131.0	126.4	120.0
All Metal Products	99.4	107.9	111.5	109.9	110.1	107.9	115.4	113.5	110.1
Autos	99.4	100.0	102.9	102.0	102.0	n.a.	n.a.	96.5	93.5
Pulp/Paper	98.1	114.4	114.0	108.5	108.5	107.1	122.8	108.4	101.3
Auto Tires	87.8	101.4	103.0	103.7	103.7	102.3	123.3	123.2	129.8
Rubber	121.3	295.1	446.9	400.8	400.8	413.0	626.2	394.1	515.5
Farm Equipment	100.0	102.4	107.9	110.6	118.8	109.8	105.5	105.7	102.7
All Bldg. Materials	100.6	122.6	123.8	119.3	119.3	119.1	129.3	117.5	117.2
Average[27]	103.2	117.1	120.0	122.6	123.7	116.8	124.6	117.9	113.8

[27] The average does not include rubber.

Table 6: Cartel Model Steady State Variables Relative to Competitive Model Steady State Variables

χ = 0.25						
ϕ	ω	y	n	w_m	n_m	s
0	1.00	0.97	0.98	0.96	0.91	0.00
-1	1.00	0.97	0.98	0.96	0.94	0.00
-2	1.00	0.97	0.98	0.96	0.96	0.00
0	0.50	0.94	0.96	1.04	0.82	0.01
-1	0.50	0.94	0.95	1.04	0.87	0.01
-2	0.50	0.95	0.95	1.04	0.89	0.01
0	0.05	0.86	0.90	1.35	0.57	0.04
-1	0.05	0.85	0.88	1.34	0.67	0.05
-2	0.05	0.86	0.87	1.34	0.70	0.06

χ = 0.50						
ϕ	ω	y	n	w_m	n_m	s
0	1.00	0.94	0.96	0.93	0.91	0.00
-1	1.00	0.94	0.96	0.93	0.93	0.00
-2	1.00	0.93	0.96	0.93	0.94	0.00
0	0.50	0.89	0.92	0.98	0.82	0.02
-1	0.50	0.89	0.92	0.98	0.86	0.02
-2	0.50	0.89	0.91	0.98	0.87	0.02
0	0.05	0.76	0.81	1.18	0.58	0.09
-1	0.05	0.75	0.79	1.16	0.65	0.11
-2	0.05	0.75	0.78	1.15	0.67	0.11

Table 7: The Equilibrium Path from the Competitive Model

	Y	C	I	N	W
1934	0.87	0.90	0.73	0.98	0.89
1935	0.92	0.91	0.97	1.01	0.91
1936	0.97	0.93	1.18	1.03	0.94
1937	0.98	0.94	1.14	1.03	0.95
1938	0.98	0.95	1.12	1.02	0.96
1939	0.99	0.96	1.09	1.02	0.97

Table 8: The Equilibrium Path from the Cartel Model

	Y	C	I	N	S	N_m	N_f	W_m	W_f
1934	0.77	0.85	0.40	0.82	0.07	0.68	0.89	1.16	0.81
1935	0.81	0.85	0.62	0.84	0.11	0.69	0.92	1.19	0.83
1936	0.86	0.85	0.87	0.89	0.06	0.72	0.97	1.20	0.83
1937	0.87	0.86	0.90	0.90	0.04	0.73	0.98	1.20	0.83
1938	0.86	0.86	0.86	0.89	0.06	0.72	0.97	1.20	0.84
1939	0.87	0.86	0.88	0.89	0.04	0.73	0.97	1.20	0.84

Figure 1: Real Output, Consumption and Private Hours

(Per Adult, Index 1929 =100)

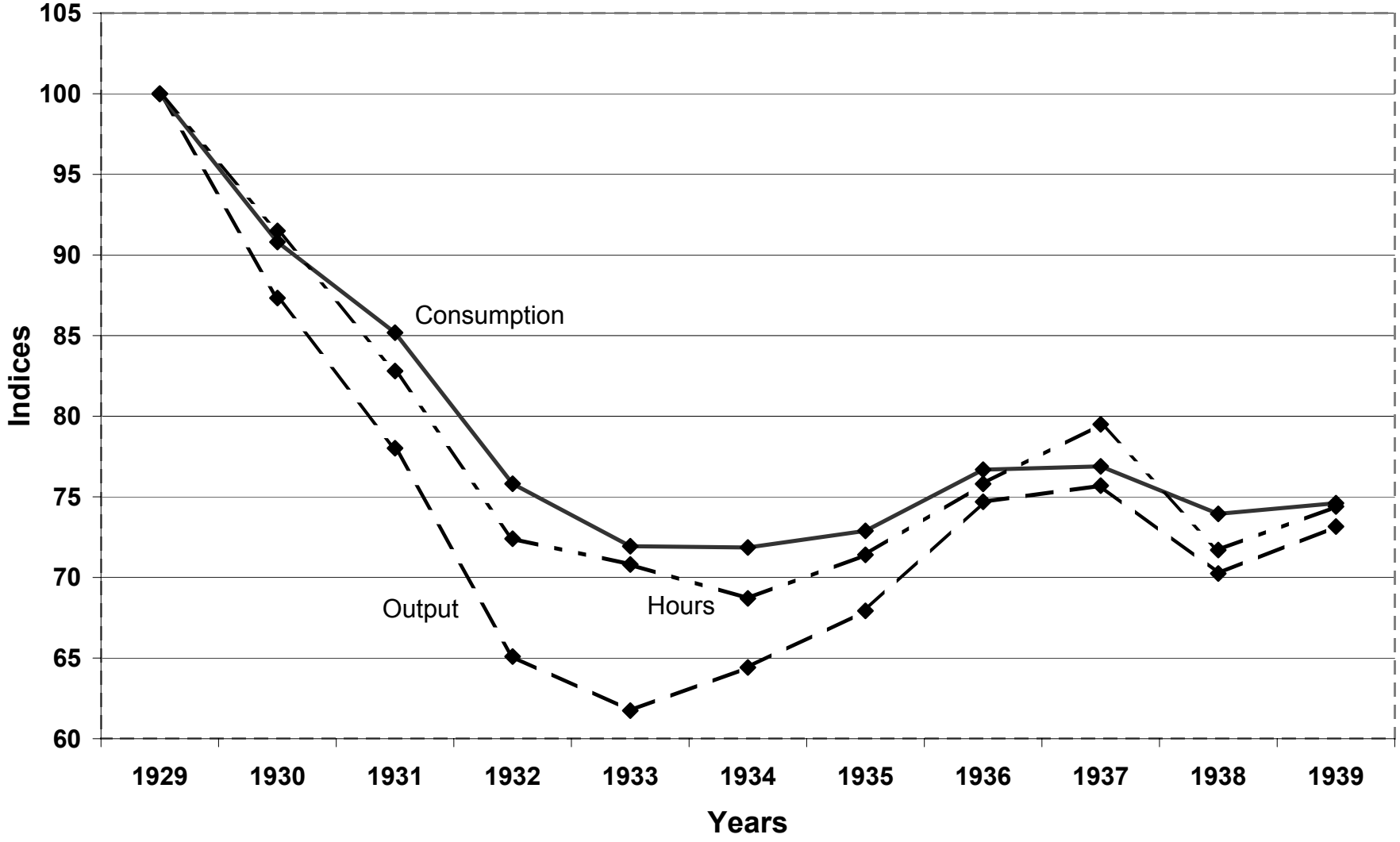

Figure 2: Comparing Output in the Models to the Data