

The Japanese Depression in the Interwar Period: A General Equilibrium Analysis

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Abstract

A dynamic stochastic general equilibrium model is developed to study the Japanese depression in the interwar period. The model shows that changes in productivity and the increase in markups beginning in the late 1920s can account for a substantial fraction of the fall and recovery of the economy. This increase in markups is due to the rapid cartelization promoted by the government. Evidence is presented to support this claim.

JEL classification: E32, N15, N45.

Keywords: cartelization, depression, Japan, productivity.

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1 Introduction

This paper examines the Japanese depression during the interwar period in the framework of a general equilibrium growth model. In doing so, the paper accomplishes its two main objectives. The first is to complement other works that study depression episodes using a similar framework (such as Cole and Ohanian 1999). The second is to provide a quantitative benchmark for studying the Japanese economy during the interwar period.

Figure 1 plots detrended real per capita GNP of Japan from 1919 to 1940 (see the next section for detrending procedure). Japan experienced a decade-long economic stagnation throughout the 1920s, and output fell below the trend level by about 20% in 1931. In 1932, output began to recover and came back to the trend level by 1940. The recovery of output, however, was weaker than the strong recovery of productivity. I find that increase in markups from the late 1920s explains this weak recovery.

The research that is most closely related to this study is Kobayashi and Inaba (2006), which applies business cycle accounting (Chari et al. 2007) to the Japanese economy in the interwar period.¹ They find that both labor and investment wedges deteriorated from

Figure 1. Detrended real per capita GNP: 1919–1940



¹There are, however, several differences between the formulation of Kobayashi and Inaba (2006) and my paper. For example, their target period is 1920–1935, while it is 1921–1936 in my paper. In addition, their model is deterministic while mine is stochastic.

the late 1920s and did not recover throughout the 1930s. I contribute to their research by proposing and simulating a model that can explain the movement of both of these wedges.

The present paper also contributes towards understanding prewar Japanese economic development. Hayashi and Prescott (2006) find that their model over-predicts interwar output growth and speculate that the rapid cartelization in the 1930s may have something to do with this. I confirm that they are right. Both the model and historical evidence suggest that cartel power grew from the late 1920s throughout the 1930s. A counterfactual experiment reveals that output in the 1930s would have been about 20% larger, had it not been for cartelization.

Finally, this paper adds to the literature which examines the role of government policies during the Great Depression. Recent studies reveal that these these policy changes considerably affected the economy. For example, Cole and Ohanian (2004) conclude that New Deal cartelization policies, which limited competition and raised labor bargaining power, are key towards understanding the weak recovery from the Great Depression. Fisher and Hornstein (2002) find that high real wages, resulting from the collective bargaining system, are important in accounting for Germany's Great Depression. Beaudry and Portier (2002) speculate that an institutional change, which may be the consequence of a change in government policy, can explain the French depression in the 1930s. I complement these studies by showing how the Major Industries Control Law and the Industry Unions Law of 1931 contributed to the weak recovery of output relative to productivity in Japan, in the 1930s.

The rest of the paper is organized as follows. After documenting some facts about the Japanese economy between 1921 and 1936, I build a simple DSGE model with shocks to productivity, government spending, and markups in Section 3. Section 4 compares the predicted path of the model with the actual path. The calibrated model traces the behavior of the economy during this period quite well. I cite a number of evidence of cartelization in this section and argue that the fall in output in the early 1920s resulted from a fall in productivity, while the fluctuations from the late 1920s were characterized by the recovery of productivity combined with cartelization. Section 5 concludes with several remarks.

2 The Japanese Economy: 1921–1936

The Japanese economy experienced a long period of stagnation during the 1920s, following the post-war boom in the late 1910s. There were three main economic events in the 1920s. In 1923, the Great Kanto Earthquake hit the capital Tokyo. More than 140 thousand people died in this earthquake. In 1927, the financial panic occurred following the slip of the tongue by the Minister of Finance. During this panic, many bank suspended operations as a result of bank runs. The Great Depression started from 1929. In 1931,

Table 1. Output and its components

Year	Output	Con.	Inv.	Gov. Spending	Exports	Imports
1921	100.0	100.0	100.0	100.0	100.0	100.0
1922	94.2	102.8	85.9	95.4	116.3	115.3
1923	87.0	101.1	62.6	84.1	97.4	113.7
1924	86.7	99.6	76.5	78.2	118.4	126.3
1925	88.5	98.1	76.2	76.4	139.1	111.4
1926	86.0	96.0	77.5	78.2	139.5	121.3
1927	85.7	95.2	76.4	84.6	149.7	120.7
1928	88.0	94.5	70.1	93.0	151.7	115.9
1929	85.3	90.5	74.6	87.7	161.3	118.6
1930	83.1	87.7	71.2	80.8	147.0	96.9
1931	80.6	86.5	56.2	90.4	140.1	102.7
1932	81.4	82.4	48.7	98.5	161.2	97.8
1933	86.6	85.2	58.1	101.5	176.3	99.1
1934	91.3	87.8	74.7	94.3	208.4	108.5
1935	92.7	84.5	84.6	94.8	244.8	109.1
1936	91.6	83.9	88.5	93.7	253.1	114.4

Notes: All variables are detrended. **Bold types** indicate their lowest levels.

Korekiyo Takahashi was appointed as the Minister of Finance. He abandoned the gold standard and adopted a reflationary monetary policy and an expansionist fiscal policy by issuing government bonds.² The economy showed a rather quick recovery from the Great Depression; output returned to its pre-Depression levels by 1933.

I now move on to the discussion of data from 1921 to 1936. I end my analysis in 1936, since in 1937 the Sino-Japanese War began and Japan entered the war economy. Data sources are described in the Appendix. Most of the series (except for working hours) exhibit a trend, so I need to remove the trend in these variables. As a first step, all variables are divided by the working-age (15 years and older) population. Then, I detrend the series by the trend growth rate, since neoclassical growth theory indicates that output and its components would grow at that rate on a steady-state growth path. I use the value 2.1% for the trend growth rate, which is the average growth rate of per capita GNP for the period 1901–1940.³ Unless otherwise noted, all variables are in real terms.

Table 1 reports output and its components from 1921 to 1936. Output and private investment fell considerably in the 1920s and were at their lowest levels during the Great Depression. In fact, output was almost 20% and investment was more than 50% below the trend level in 1931 and 1932, respectively. Though the economy began to recover from 1932, both output and investment were still about 10% below the trend level in 1936.

²See Nanto and Takagi (1985) for details of Takahashi's policy.

³The average growth rate for the period 1901–1921 was also 2.1%.

Figure 2. Share of government spending in output

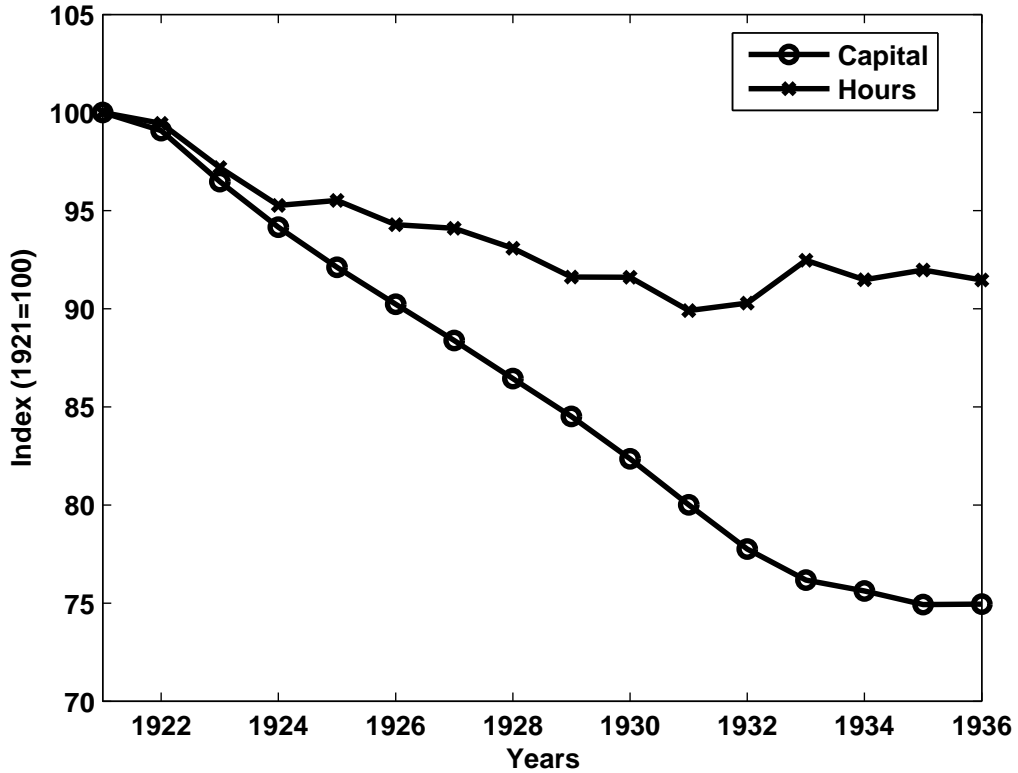


Compared to output and investment, the recovery of consumption was much weaker. Consumption in the 1930s never returned to its 1920s level. Moreover, it remained more than 15% below the trend level as late as 1936. As Hall (1978) stresses, optimization of the household implies that every expectation of future income should be incorporated into present consumption. This observation suggests that the economy was hit by a persistent shock which depressed household consumption.⁴ Imports and especially exports were in a good shape. Imports grew at the trend rate during most of the period, and exports grew by more than twice the 1921 level by 1936. This suggests that the depression was caused by domestic, rather than international factors.

Figure 2 shows that share of government spending in output was at its lowest level in the mid 1920s and at its highest in 1932, when Korekiyo Takahashi was in office. Figure 3 reports inputs. Net (net of depreciation) private capital stock continued declining during the period. Total working hours (see the Appendix for definition) also fell considerably in the 1920s and reached its lowest levels during the Great Depression. In particular, it barely increased while the output recovered. This is puzzling; standard real business cycle models (as in Prescott 1986) predict that hours should rise during expansions.

⁴Cole and Ohanian (1999) report a similar observation in their study of the Great Depression in the United States.

Figure 3. Private capital stock and total working hours



3 The Model

I build a simple DSGE model with shocks to productivity, government spending, and markups. Shocks to productivity are assumed since many papers (such as Hayashi and Prescott 2002) find them important in accounting for other depression episodes. Shocks to government spending are assumed to account for the role of fiscal policy by Korekiyo Takahashi during the Great Depression. Finally, shocks to markups are assumed to assess the changes in the structure of competition among firms following Christiano et al. (2003). The economy is composed of a continuum of homogeneous households, perfectly competitive firms producing final goods, monopolistically competitive firms producing intermediate goods, and a government.

The household has preferences with respect to consumption C_t , and leisure $1 - H_t$:

$$E_t \sum_{t=0}^{\infty} \beta^t [\ln C_t + \psi \ln(1 - H_t)]$$

The household constraints are

$$K_{t+1} = I_t + (1 - \delta)K_t$$

$$C_t + I_t = w_t H_t + r_t K_t + TR_t + \int_0^1 \pi_t(i) di$$

where K_t is the capital stock at the beginning of the period, I_t is investment, TR_t is a lump-sum transfer from the government, and $\pi_t(i)$ is profits from intermediate goods firm i . Capital depreciates at rate δ .

The output of the final good is Y_t . Perfectly competitive firms combine intermediate goods and produce according to

$$Y_t = \left[\int_0^1 Y_t(i)^{q_t} di \right]^{\frac{1}{q_t}}$$

where $Y_t(i)$ is the input of intermediate good i and $0 < q_t \leq 1$. The smaller that q_t is, the more market power intermediate-goods firms have, since a smaller value of q_t implies that intermediate goods are less substitutable for each other. I allow this q_t to change over time. The price of final goods is P_t .

Profit maximization by final-goods firms yields the following input-demand functions for intermediate goods:

$$Y_t^D(i) = \left[\frac{P_t}{P_t(i)} \right]^{\frac{1}{1-q_t}} Y_t \quad (1)$$

where $P_t(i)$ the relative price of intermediate good i . The zero-profit condition implies that:

$$P_t = \left[\int_0^1 P_t(i)^{\frac{q_t}{q_t-1}} di \right]^{\frac{q_t-1}{q_t}}$$

Each intermediate-goods firm has access to the following Cobb-Douglas production technology:

$$Y_t(i) = z_t (K_t(i))^\alpha (X_t H_t(i))^{1-\alpha} \quad (2)$$

Here $z_t X_t^{1-\alpha}$ is total factor productivity (TFP), where z_t is a stochastic productivity shock and X_t is a labor augmenting deterministic trend which follows: $X_t = \gamma X_{t-1}$. Each firm maximizes its profits, subject to equations (1) and (2). This yields the following relations of labor and capital demand:

$$w_t/P_t(i) = q_t(1-\alpha)Y_t(i)/H_t(i)$$

$$r_t/P_t(i) = q_t\alpha Y_t(i)/K_t(i)$$

In a symmetric equilibrium, this further reduces to

$$w_t/P_t = q_t(1-\alpha)Y_t/H_t$$

$$r_t/P_t = q_t\alpha Y_t/K_t$$

Here q_t drives a wedge between real prices of inputs and marginal products.

Government spending, G_t , is not productive and follows: $G_t = s_t Y_t$. The flow government budget constraint is $G_t = -TR_t$. The aggregate resource constraint is $Y_t = C_t + I_t + G_t$.

Finally, z_t , s_t , and q_t are assumed to follow an autoregressive process:

$$\begin{bmatrix} \ln(z_t/\bar{z}) \\ \ln(s_t/\bar{s}) \\ \ln(q_t/\bar{q}) \end{bmatrix} = \begin{bmatrix} \rho_z & 0 & 0 \\ 0 & \rho_s & 0 \\ 0 & 0 & \rho_q \end{bmatrix} \begin{bmatrix} \ln(z_{t-1}/\bar{z}) \\ \ln(s_{t-1}/\bar{s}) \\ \ln(q_{t-1}/\bar{q}) \end{bmatrix} + \begin{bmatrix} \epsilon_{zt} \\ \epsilon_{st} \\ \epsilon_{qt} \end{bmatrix}, \quad \begin{bmatrix} \epsilon_{zt} \\ \epsilon_{st} \\ \epsilon_{qt} \end{bmatrix} \sim N(0, \Sigma) \quad (3)$$

where \bar{z} , \bar{s} , and \bar{q} are the means of each shock process. Σ is a variance-covariance matrix:

$$\Sigma = \begin{bmatrix} \sigma_z^2 & 0 & 0 \\ 0 & \sigma_s^2 & 0 \\ 0 & 0 & \sigma_q^2 \end{bmatrix}$$

Solution and Calibration

I employ the following equilibrium concept for this economy:

Definition: Given $(K_t, X_t, z_t, s_t, q_t)$, a *symmetric monopolistically competitive equilibrium* is a collection of allocations for the household (C_t, K_{t+1}, H_t) , allocations for final goods firms $(Y_t, Y_t(i))$, and intermediate goods firms $(K_t(i), H_t(i))$, together with prices $(w_t, r_t, P_t, P_t(i))$ such that:

- Given all prices, households maximize their utility.
- Given all prices, final goods firms maximize their profits.
- Given all prices but her own, each intermediate goods firm maximize her profit at $(K_t(i), H_t(i), P_t(i)) = (K_t, H_t, P_t)$ for all i .
- Government budget constraint is satisfied.
- Markets clear.

I first transform the model into a stationary one by dividing the system variables by the growth component X (King et al. 1988). The equilibrium of the transformed model can be characterized by the following first-order conditions and resource constraints:

$$\hat{w}_t = q_t(1 - \alpha)\hat{Y}_t/\hat{H}_t \quad (4)$$

$$r_t = q_t\alpha\hat{Y}_t/\hat{K}_t \quad (5)$$

$$\frac{\hat{w}_t}{\hat{C}_t} = \frac{\psi}{1 - H_t} \quad (6)$$

Table 2. Calibrated values

Parameter	ψ	δ	α	β	γ	ρ_z, ρ_s, ρ_q	$\bar{z}, \bar{s}, \bar{q}$
Value	1.65	0.061	0.355	0.96	1.021	0.8	1921 level

$$\frac{\gamma}{\widehat{C}_t} = \beta \mathbf{E}_t \left[\left(\frac{1}{\widehat{C}_{t+1}} \right) \left(r_{t+1} + 1 - \delta \right) \right] \quad (7)$$

$$\widehat{Y}_t = z_t \widehat{K}_t^\alpha H_t^{1-\alpha} \quad (8)$$

$$\gamma \widehat{K}_{t+1} = \widehat{I}_t + (1 - \delta) \widehat{K}_t \quad (9)$$

$$(1 - s_t) \widehat{Y}_t = \widehat{C}_t + \widehat{I}_t \quad (10)$$

where $\widehat{w}_t = w_t/X_t$, $\widehat{C}_t = C_t/X_t$, $\widehat{Y}_t = Y_t/X_t$, $\widehat{K}_t = K_t/X_t$, $\widehat{I}_t = I_t/X_t$. The set of equations (4)–(10) with the exogenous shock process (3) is log-linearized around the steady state to obtain linear decision rules of endogenous variables. This is done by the method introduced by Uhlig (1997).

I move on to the calibration of the model parameters. ψ is chosen so that the average markup during the period 1921–1936 is about 1.2. The depreciation rate δ is set to 0.061. This is the average depreciation rate calculated from the data. Minami and Ono (1979) report capital’s share of income was 0.322 in 1920–29 and 0.387 in 1930–39, so I take the mean value of the two and set α : 0.355. β is set to 0.96, which implies an annual interest rate of about 4%. γ is set to match the average growth rate of real per capita GNP for the period 1901–1940. Autocorrelation coefficients for exogenous shocks are set to 0.8.⁵ Mean values of exogenous shocks are set to the 1921 level. The calibrated values are summarized in Table 2.

4 Simulation and Discussion

I conduct the analysis by assuming that the capital stock in 1921 was equal to the steady-state value⁶, and then plugging the sequence of observed levels of productivity⁷, government spending, and markups into the linear decision rules. Markups are estimated from the intratemporal first-order condition (6). Given the initial state and series of these exogenous shocks, the model predicts output, investment, working hours, and capital stock throughout the period. The simulation results are plotted in Figure 4. For comparison, I also plot the actual path of variables in dashed lines. All variables, except for working hours, are detrended.

⁵The value is consistent with a quarterly value of 0.95.

⁶I conducted another analysis by assuming the capital stock in 1929 was equalled to the steady-state value. The performance of the model was satisfactory and the results are available from the author upon request.

⁷This is obtained by a standard growth accounting exercise.

Figure 4. Simulation results

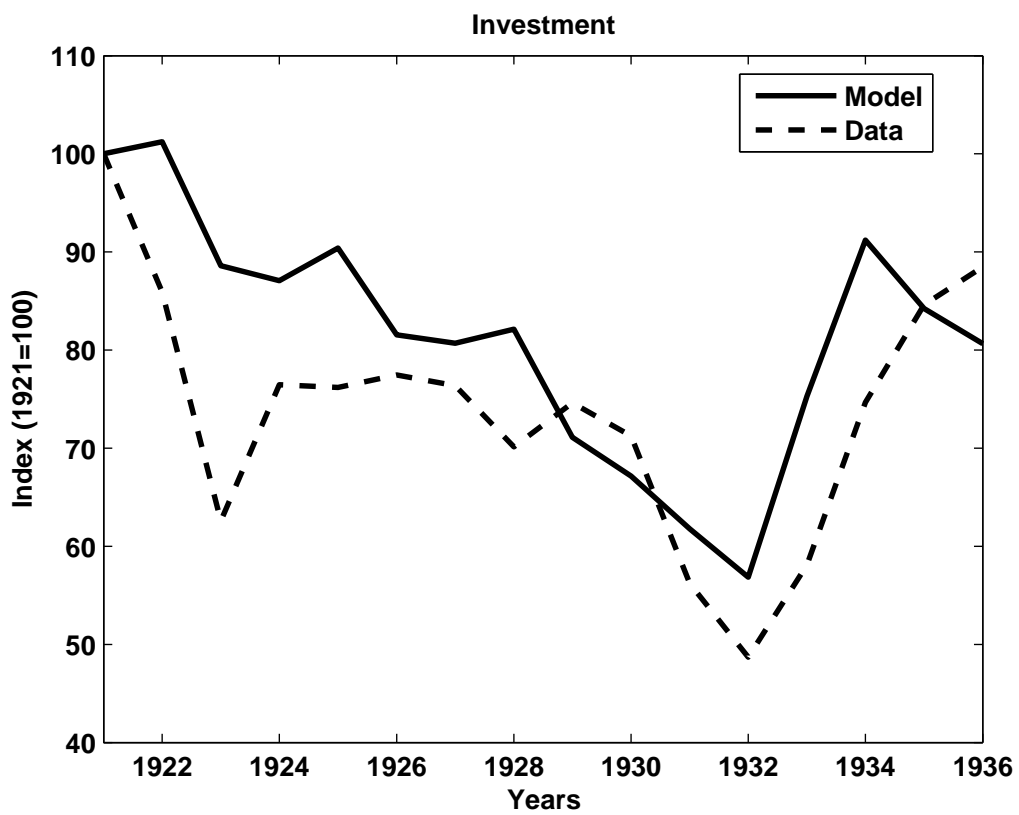
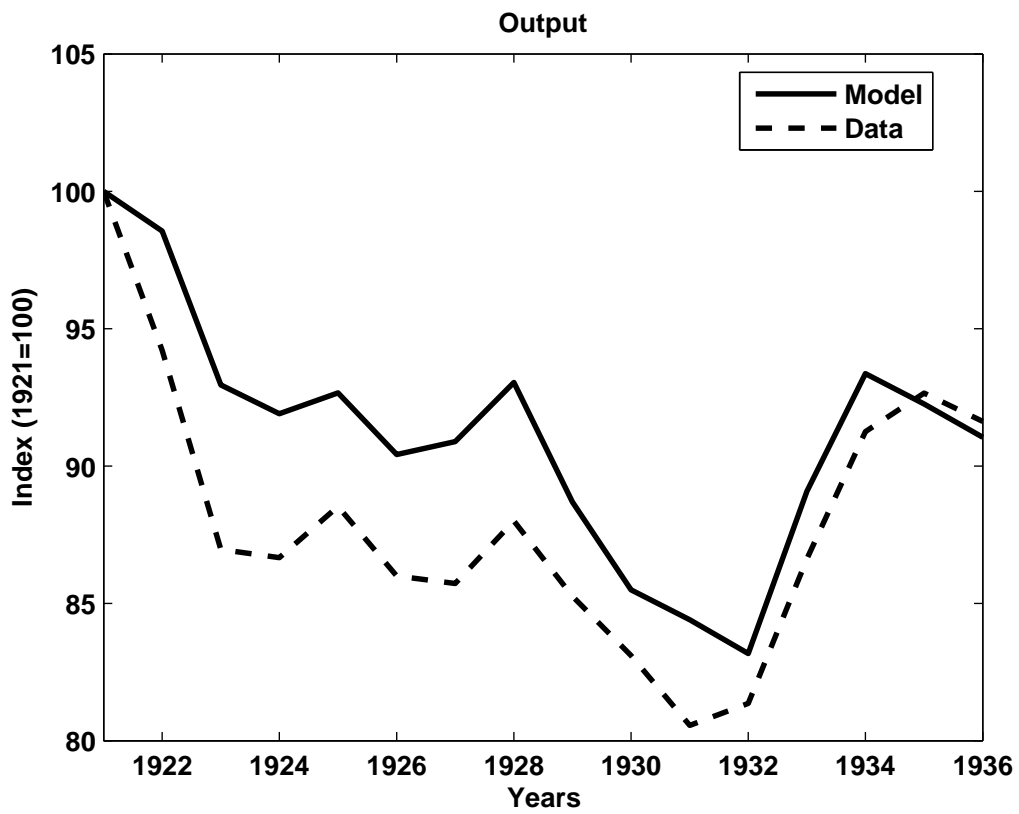


Figure 4. (Continued)

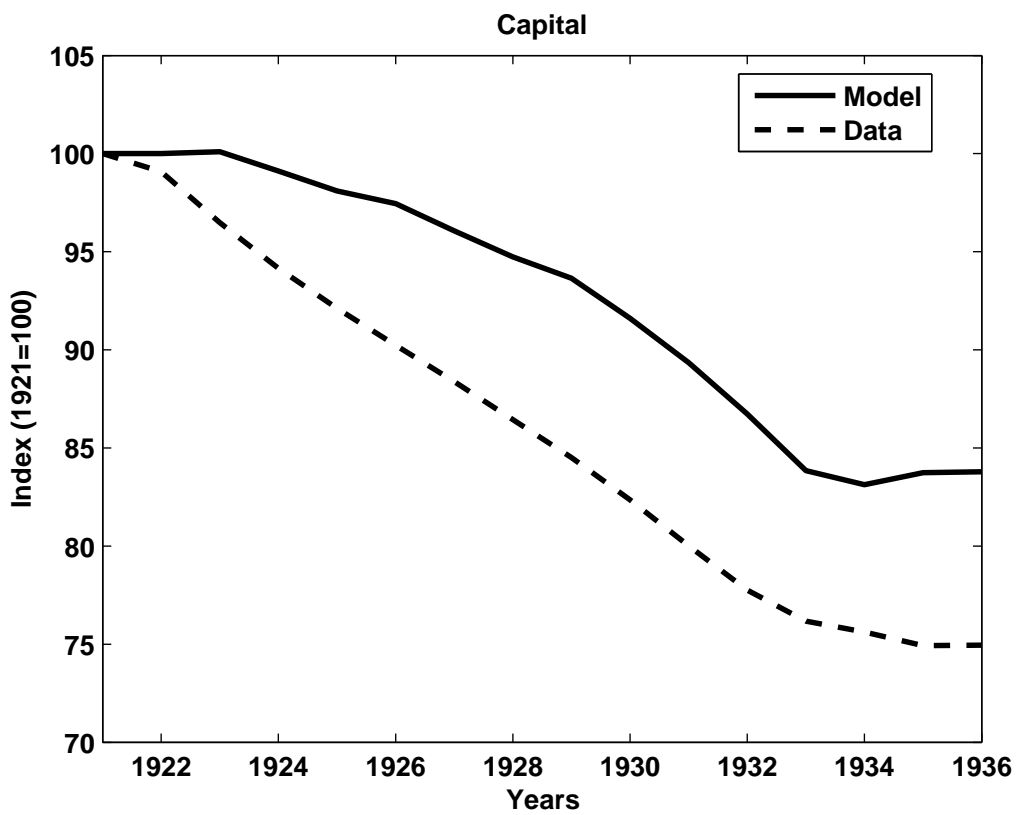
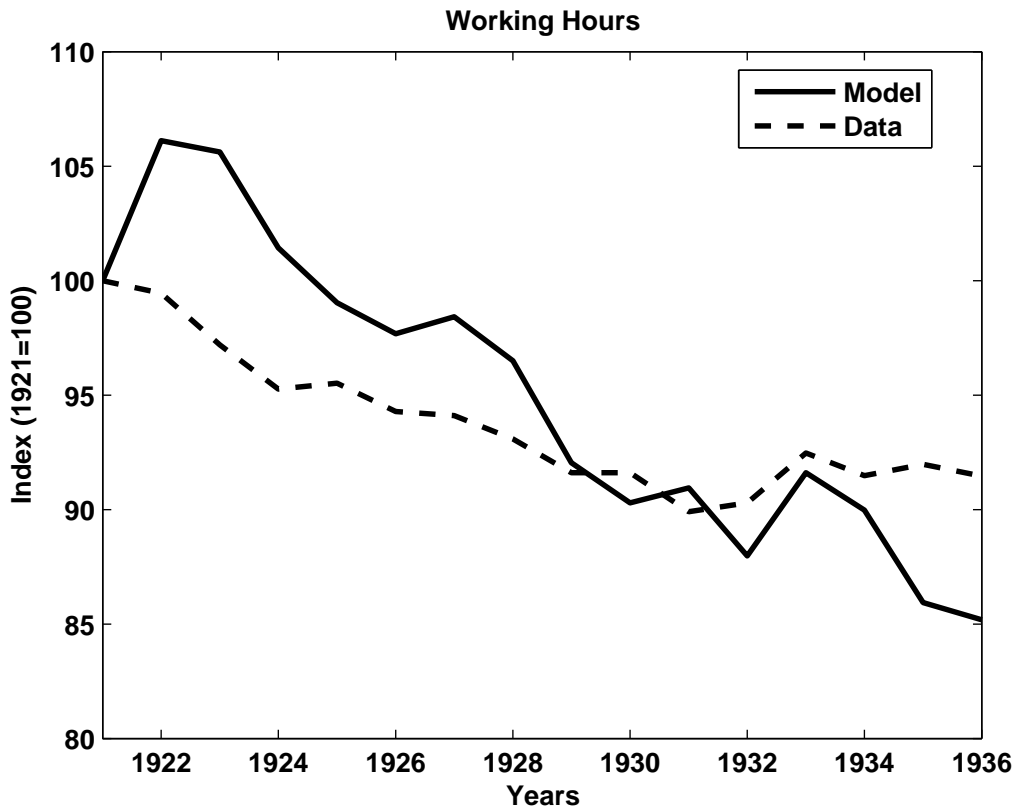
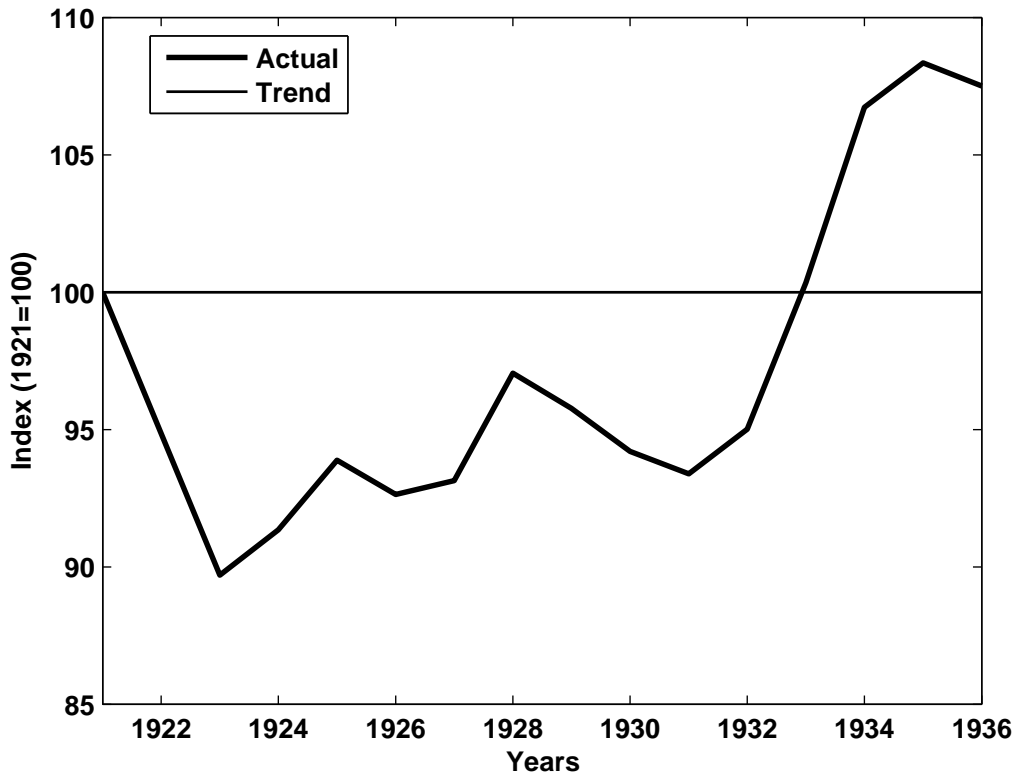


Figure 5. Detrended TFP



The simple model can account for a substantial fraction of the depression in the interwar period. The model is able to reproduce the decline of output in the 1920s and the early 1930s, and the recovery after that. The model is also satisfactory with respect to the investment and total working hours. I suspect that the overestimation of the two variables in the early 1920s is due to an issue regarding the measurement of working hours.⁸ The model predicts that the capital stock declined throughout the interwar period, which is consistent with the data.

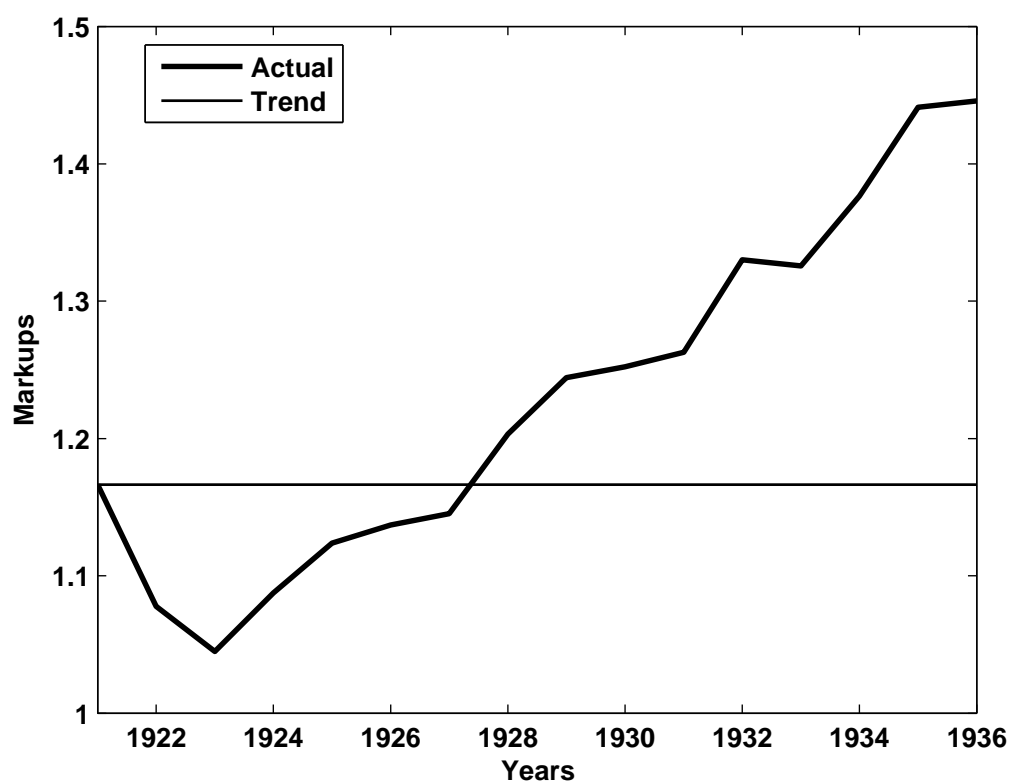
Given the success of the model for replicating the key data dynamics, I can answer the question: *What are the sources of these fluctuations?*

Figure 5 plots detrended TFP throughout the period. The large productivity drop in the early 1920s coincided with a decline in output during the same period.⁹ Productivity continued to recover from the mid 1920s and returned to its trend level by 1933. In sharp contrast, output stayed below the trend level until 1936. This suggests some other factors

⁸Since data for manufacturing hours was not available for 1921 and 1922, they were kept constant at the 1923 level. Given that the markups are estimated from intratemporal first-order condition, this may have distorted the prediction of variables in the early 1920s.

⁹A particular large drop in productivity occurred in 1923, when the earthquake hit the capital Tokyo. The loss in human resources and corporate failures due to the earthquake may have reduced organizational capital (Ohanian 2001), the knowledge and know-how firms use to organize production, and hence reduced productivity.

Figure 6. Implied markups



that prevented a stronger recovery of output. Figure 6 plots implied markups.¹⁰ There was continuous increase in markups from the late 1920s.

Cartelization and the Major Industries Control Law

Why did markups increase during this period? Most empirical studies find that markups are countercyclical to output over postwar business cycles. A number of papers offer explanations of these countercyclical markups. For example, Edmond and Veldkamp (2007) argue that markups are countercyclical because demand is less elastic during recessions. Chevalier and Scharfstein (1996) construct a model where capital-market imperfections play a key role. According to Rotemberg and Saloner (1986) and Rotemberg and Woodford (1992), firms are less able to collude during expansions. This is because providing incentive to stick to the collusive outcome is difficult since deviation is more profitable than during recessions. None of these theories, however, can explain the increase of markups in 1930s. 1930s was a period of rapid productivity growth. An additional shock is needed to account for this increase in markups.

The number of cartels increased considerably from the late 1920s to the early 1930s (Table 3). A wide range of industries were cartelized, including cement, steel, coal, cotton

¹⁰Markups of firms are calculated as $1/q_t$.

Table 3. The number of major cartels: 1921–1932

Year	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932
Number	15	16	17	19	20	22	31	37	42	62	86	94

Notes: Calculated from Takahashi (1933).

spinning, sugar. A striking feature of the prewar Japanese economy is that there was no anti-trust law. The increase of cartels in this period can be explained by the theory of implicit collusion by Rotemberg and Saloner (1986) and Rotemberg and Woodford (1992).¹¹ Moreover, an important change in government policies toward cartels took place in the 1930s. Government promoted cartelization through the Major Industries Control Law (hereafter MICL) and the Industry Unions Law of 1931. I argue that this government-sanctioned cartelization, which limited competition and raised prices, is a key factor in understanding the continuous increase of markups.¹²

The government at that time believed that the difficulties beginning from the 1920s were due to excessive competitions among firms. It argued that some kind of administrative intervention was needed:

The objective of the MICL is to control domestic industries appropriately in view of the current situation, remove the sources of their instability, ... and bring prosperity to our economy. [Special Bureau of Industry Rationalization (1932), preamble]

The establishment of the law was also supported by the cartels. Many cartels, including those in cement, flour milling, and steel industries, requested that the MICL cover their industries. As a result, more than 20 industries were classified as the target industries of the law. The cornerstone of the MICL was a provision for cartel enforcement. This was stated in Article 2. With petitions from more than two-thirds of participants of the cartel agreement, it allowed the government to order both participants and *non*-participants of the agreement to follow the agreement. The Industry Unions Law was a version of the MICL which aimed at relatively smaller cartels. It also had a provision for cartel enforcement. These laws gave the government significant power in promoting cartel activities and enforcing cartel arrangements. Many studies, including Ikeda (1982), Ministry of Commerce and Industry (1961), and Miyajima (1990), conclude that these cartelization policies had considerable impact on the performance of the cartels.

¹¹As mentioned earlier, the decrease of markups in the early 1920s may be an artifact of the missing hours data problem.

¹²In contrast to Cole and Ohanian (2004) and Fisher and Hornstein (2002), I do not consider the role of labor bargaining power in this paper, as the MICL did not include provisions to raise wages and it is not clear how the law affected labor bargaining power.

Table 4. Investment goods prices relative to the consumer price index: 1926–1936

Year	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936
Overall investment	100.0	99.0	100.4	103.2	95.6	92.1	100.3	108.2	104.9	102.4	102.8
Durable equipment	100.0	100.1	103.7	111.4	106.8	95.3	113.3	126.2	127.2	121.3	120.9

Notes: 1929 = 100. Data sources are Table 2 and 7 in Volume 8 of *LTES*.

Tominaga (1982) carries out statistical tests to see whether the cartelized industries enjoyed greater profits than the non-cartelized industries. Since his paper is in Japanese, I summarize his results. For 79 industries, for which there was sufficient data, he classifies 18 industries as cartelized industries and 61 industries as non-cartelized industries. It is important to note that even in industries classified as non-cartelized, some production control took place. Therefore these tests are conservative estimates of the cartel effects. First, he conducts a t -test to investigate whether average profit rates in cartelized and non-cartelized industries differ. In all periods (1926–1929, 1930–1931, and 1933–1936) the profits in cartelized industries are greater than those of non-cartelized industries. Although the differences are not statistically significant in the first two subperiods, they become significant after 1933. He also conducts a χ^2 -test of independence and obtain similar results. Finally, he compares the cartel goods price index with the overall industrial goods price index. Before 1932, the cartel goods price index moves along with the industrial goods price index. After 1932, however, the cartel goods price becomes relatively higher. For example, the cartel goods price is 12% higher than the overall industrial goods in 1936. Based on these tests and data, Tominaga (1982) concludes that there was a significant cartel effect on the economy after 1932.

Table 4 reports relative prices of investment goods. It shows that both overall investment goods and durable equipment prices rose higher than the overall consumer price in the 1930s. In particular, relative prices of durable equipment were higher than prices of overall consumer goods in all years except for 1931, and they rose about 20% above the 1926 level in the mid 1930s.¹³ These increases are interesting because typically, expansions are associated with falls of investment good prices (see Fisher 2006). This fact suggests that the cartels raised investment good prices during the recovery in the 1930s.

Minobe (1931)¹⁴ provides a detailed analysis of the cartelization from the late 1920s. He emphasizes that the market power of cartels increased after the financial panic in 1927:

The financial panic in 1927 ... was a process of concentration of production and capital. ... We can find a number of characteristics in cartels after the financial panic in 1927, whose operations became very active. First, the power

¹³Cole and Ohanian (2004) report similar facts during the recovery from the US Great Depression.

¹⁴Minobe is a Japanese economist, who served as Governor of Tokyo after WWII.

of cartels became greater in terms of quantity because of the rise in production control rates. Second, the control of cartels spread in larger regions since many cartels emerged in areas where there was no cartel before. Third, the power of cartels became greater in terms of quality since many new collective sales unions were formed. [Minobe (1931), 589–590]

He also argues that the cartel prevented prices from dropping during the Great Depression:

Despite the aggravation of the Great Depression and the striking decline in the quantity of goods circulated, prices rose in the first half of 1931. As many people point out, production control and price arrangement by cartels are the cause. [Minobe (1931), 596]

There are already a number of industry-level studies investigating Japanese cartels in the interwar period. The general conclusion of this literature is that the cartels played an important role by limiting competition and raising prices. For example, Okazaki (1985) notes that the steel cartel was able to enjoy stable markups by setting minimum prices starting around 1930. Takeda (1985) reports that the superphosphate cartel raised prices by cutting production. Motomiya (1985) documents that the flour milling cartel sustained high profits by controlling both material and product prices.

The evidence presented above suggests that cartels affected economic performance throughout the late 1920s and 1930s. It also shows that the power of the cartels peaked in the mid 1930s, after the government established the MICL. This is encouraging since the movement of markups estimated from the model and data (Figure 6) also supports this view.

Market power in the 1930s was, in fact, quite strong. The Fair Trade Commission (1951) compares the concentration ratio¹⁵ in 1937 and 1949 by industry. It reports a large decline in concentration after the war. This reflects the rise in market power during the interwar period and the postwar economic liberalization policy adopted by the United States.

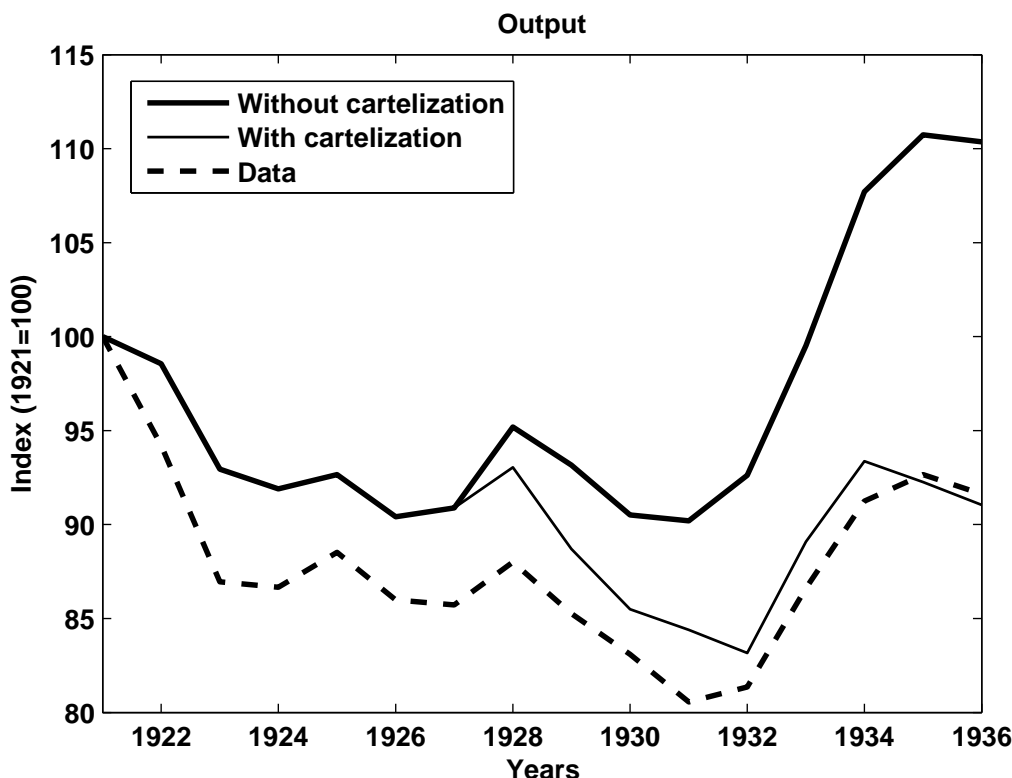
Counterfactual Experiment

To evaluate the quantitative effect of the cartelization, I conduct a counterfactual experiment. I simulate output by assuming that the markups from 1928 equalled to their 1921 (trend) value. What would have happened without the rapid cartelization of the late 1920s? Figure 7 plots the result. In contrast to the data and the benchmark model simulation, predicted output in the mid 1930s is about 10% above trend. Had it not been for the cartelization, output in the 1930s would have been about 20% higher.

One big puzzle related to the Japanese economy is why the Japanese postwar growth

¹⁵The n -firm concentration ratio is the share of total industry sales accounted for by the n largest firms.

Figure 7. Counterfactual simulation



miracle did not take place during the prewar period.¹⁶ In fact, the Japanese real per capita GDP was about 30% of that of the US in 1920 and 40% in 1940, according to Maddison (2003). How much did cartelization contribute to the gap between Japanese and US output? To answer this question, I simply extend the target period to 1940, conduct a counterfactual simulation in the same manner, and compare the predicted path with the actual US output. Figure 8 plots the results. Note that these values are not detrended. It shows that the cartelization can account for about 20% of the gap between Japanese and US output.

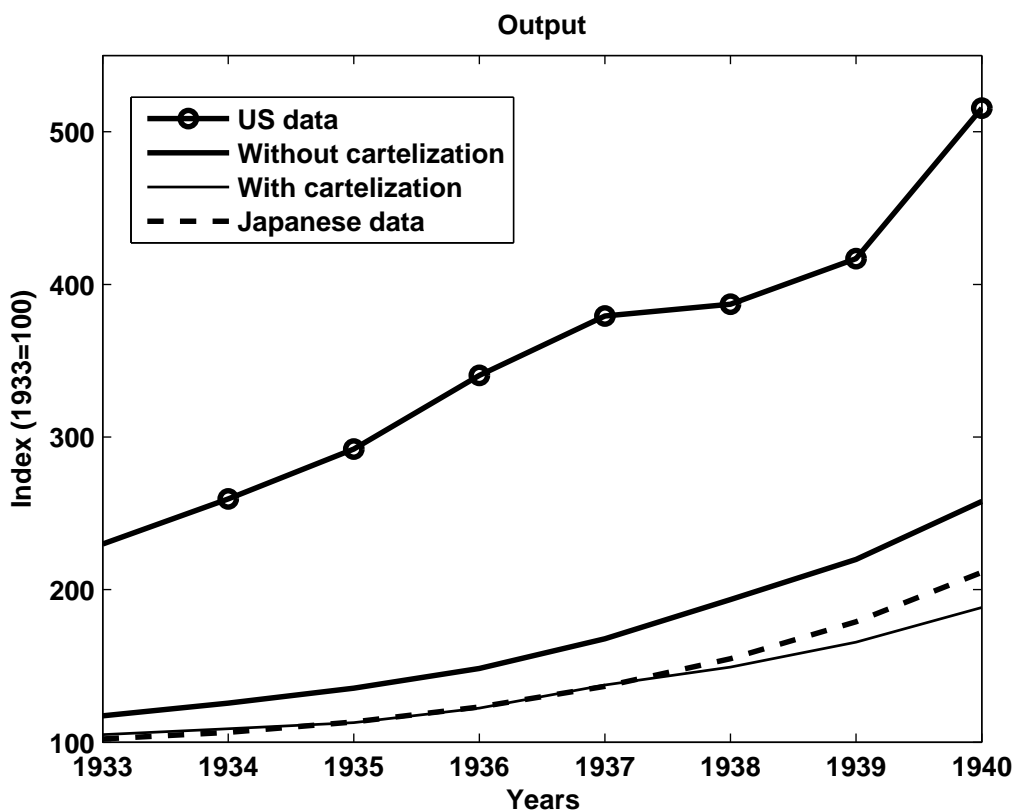
The analysis of this section suggest that, the fall in output in the early 1920s was mainly caused by a decline in productivity, while the fluctuations starting in the late 1920s were characterized by the recovery of productivity combined with cartelization; the increased market power of firms prevented output from returning to the trend level.

5 Conclusion

This paper developed a simple DSGE model to study the Japanese depression in the interwar period. My analysis revealed the importance of changes in productivity and markups in understanding the fall and recovery of the economy. It also explained why

¹⁶Hayashi and Prescott (2006), for example, study this issue.

Figure 8. Japanese and US output: 1933–1940



both labor and investment wedges deteriorated and did not recover in Kobayashi and Inaba (2006). In addition, I evaluated and confirmed Hayashi and Prescott (2006)'s conjecture that the rapid cartelization might explain the over-estimation of output during the interwar period.

I have ignored several factors which may have driven the economy during this period. In particular, variations in markups in my model may represent the movements of other shocks, if such factors are important. First, I have not included monetary factors in my model. Japan has experienced a severe deflation during the Great Depression as did other industrialized countries, so it may be reasonable to think that deflation prevented the economy from recovering strongly back to trend. However, the recent evidence of Cole et al. (2007) shows that deflation has only moderate explanatory power in accounting for the International Great Depression. Another problem with this view is that existing monetary business cycle theory (such as Lucas 1972) predicts that monetary shocks can only have transient effects on output.¹⁷ This suggests that deflation cannot explain the long period of weak recovery of output relative to recovery of productivity.

Second, I have not considered the role of shocks to financial intermediation. In particular, one may think that financial panic in 1927 had significant effects on economic

¹⁷See Cole and Ohanian (2002) for related discussion.

Table 5. Deposits and investment relative to nominal output: 1926–1936

Year	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936
Deposits	57.5	55.4	56.5	57.1	59.5	62.1	60.9	57.4	55.6	54.4	57.0
Investment	10.7	10.4	9.2	9.9	9.0	7.9	7.1	8.5	10.1	11.0	11.4

Notes: In percent. Data sources are Bank of Japan (1937) and Table 1, 4, 8 of Volume 1 of *LTES*.

activities by, e.g., increasing the costs of financing investment.¹⁸ However, deposits as a fraction of output were roughly constant in 1926–1936 (see Table 5), which suggests that the financial system was relatively stable after the panic. Moreover, Okazaki (1993) presents empirical evidence which contradicts this view. He finds no statistically significant drop in stock prices or rise in interest rate spreads between risky and riskless assets, and argues that the macroeconomic consequences of the panic were small.¹⁹ This evidence casts some doubt on the view that the financial panic in 1927 had persistent and important effects on investment.

Appendix

Data Sources

Two major data sources in this paper are Hayashi and Prescott (2006) and Ohkawa (known as *Long Term Economic Statistics*) hereafter referred to as *LTES*.

I use real GNP series as a measure of output. This is taken from Table 23 in Volume 1 of *LTES*. Series of private consumption, private investment, and government spending are constructed from Table 18 and 21 in Volume 1 of *LTES*. Exports and imports are taken from commodity exports of Table 3 and commodity imports of Table 4, both of which can be found in Volume 14 of *LTES*.

To obtain net private capital stock, I first calculate the government fraction of gross aggregate capital stock, x . This is calculated from the series of gross private capital stock (JK102_001) and gross government capital stock (JK102_003) available on the Hitotsubashi University’s website.²⁰ Then the net private capital stock is the net aggregate capital stock (taken from Table 1 in Volume 3 of *LTES*) times x .

¹⁸Bernanke (1983) presents evidence which suggests that bank failures were key factors in the decline of output in the US Great Depression. On the other hand, Cole and Ohanian (1999) argue that they were not important for the recovery. Hayashi and Prescott (2002) conclude that the “credit crunch” hypothesis alone cannot account for the poor performance of the Japanese economy in the 1990s.

¹⁹Mishkin (1990), on the other hand, confirms that the two features were evident in financial crises in the US.

²⁰<http://rciss.ier.hit-u.ac.jp/cgi-bin/Ltes>.

I calculate the working-age population from Table 1 and 2 in Volume 2 of *LTES*, and the number of workers in the agricultural and manufacturing sectors from Table 6 and 9 in Volume 2 of *LTES*. The sector share of workers in a population is defined as the number of workers in a sector divided by the working-age population. Weekly hours is the average hours worked by a worker in a week. Both agriculture and manufacturing hours are taken from Hayashi and Prescott (2006). Since data for manufacturing hours is not available for 1921 and 1922, I set them to the 1923 value. Total working hours is calculated by adding up the product of each sector's share of workers and weekly hours.

US real per capita GNP is obtained as: Japanese real per capita GNP times y . Here y is US real per capita GDP divided by Japanese real per capita GDP, both of which are taken from Maddison (2003).

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