Markup Pricing and Monetary Policy: A Reexamination of the Effectiveness of Monetary Policy under Imperfect Competition

Naohiko Baba

If markup ratios fluctuate widely, so does output volume and investment. This magnifies the business cycle and increases uncertainty about future economic conditions. This paper investigates the implication for monetary policy by analyzing markup ratios. The main conclusions are (1) as a result of the failure of Japanese firms to fully adjust their prices to exogenous shocks, markup ratios sometimes greatly deviate from trend lines. (2) According to the menu-cost theorem, the existence of costs associated with price changes prevents firms from changing prices to the level consistent with marginal costs, thus reducing social welfare. In this regard, establishing a money supply rule under which monetary authorities accommodate exogenous shocks provides an incentive for firms to change their prices. (3) Markup pricing magnifies the social welfare cost of inflation. In this argument, monetary authorities have the optimal choice of tightening monetary policy even under low inflation, if they observe that markup ratios have remained high.

Key words: Markup pricing; Monetary policy; Welfare cost of inflation

Research Division 1, Institute for Monetary and Economic Studies (currently in the Personnel Department), Bank of Japan

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I. Introduction

Some argue that, if markups move procyclically, the magnitude of business cycles is increased by the greater fluctuation of corporate profits, possibly impeding sustainable growth.[1] For example, Kosai (1992) argues in the light of the experience of the United States in the 1920s that a type of inflation exists in which a fall in costs does not lead to a fall in prices, and that the monetary authorities should tighten monetary conditions in such situations despite apparent price stability.

According to Rothbard (1963), in the 1920s the Federal Reserve was deceived by the apparent price stability then existing and failed to tighten monetary policy expeditiously, when in fact profits were being inflated by an improvement in productivity and declining costs. As a result, a sharp increase in stock prices was caused on Wall Street, followed by the stock market crash of 1929 and the Great Depression of the 1930s. In this view, the objective of monetary policy is not simply to maintain price stability but to maintain the price level consistent with cost structures.

If markups are maintained at a level higher than optimal after external shocks (e.g., a favorable oil shock or sharp yen appreciation) occur, the welfare that should belong to the consumers (i.e., consumers' surplus) is transferred to the producers (as producers' surplus), and social welfare, which is the sum of both surpluses, is reduced. From this standpoint, social welfare considerations may dictate that the price level be lowered to the marginal cost corresponding to a business cycle phase or a particular external shock. If so, it is worthwhile to discuss what role monetary policy can play in attaining that objective.

Unfortunately, little theoretical research has so far been done in this context, making it impossible at this time to reach a consensus on policy implications. However, the few existing theories may broadly be classified into the following two types.[2] First, there are the lines of the New Keynesian theories, represented mainly by the theories of menu cost and near-rationality. The thrust of these theories is that the attempt to use monetary policy to influence aggregate demand creates incentives for firms to revise prices by raising the opportunity cost of not revising them.

Thus, monetary policy controls the markups of firms by shifting the aggregate demand curve appropriately, and makes it possible to enhance social welfare. However, as will be discussed later, this line of argument has been criticized as follows: (1) this is contrary to the experience at the time of the first oil shock; and (2) changes in markups are essentially determined by the degree of competition in the market, and cannot be controlled by monetary instruments alone.

The second type of argument stresses the social welfare cost of inflation when there is markup pricing. According to Goodfriend (1995), when the goods market is

1. Empirical studies in the United States generally show that markups are countercyclical. For Japan, however, more studies show that markups are procyclical. See, for example, Ariga and Ohkusa (1994), Nishimura and Inoue (1994), and Baba (1995).
2. In addition, there are game-theoretic models of cooperation failure or coordination failure, when the firm is assumed to have price-setting power. As will be shown later, however, these models assume that prices are flexible with respect to external shocks.

under imperfect competition and markup pricing is in operation, the social welfare cost of inflation is given by the product of the social welfare cost under perfect competition shown by Lucas (1993) and the marginal markup ratio. This type of argument provides an interpretation as to why the monetary authorities should pay attention to the markup ratio when seeking to minimize the social welfare cost of inflation. That is to say, if the markup ratio is in fact observed or forecast to remain substantially high for some reason, the socially optimal policy for the monetary authorities is to tighten monetary conditions further so as to reduce the rate of inflation, even though the nominal rate of inflation may remain low and stable.

These theories, however, are nothing more than propositions because of data limitations as well as many unresolved technical problems relating to the method of calculating the marginal markup ratio. Moreover, the cumulative body of research in this area is inadequate. This paper will introduce and organize major theoretical issues by citing, as appropriate, empirical analyses based on the industry-wide data of the past 20 years, as follows:

[1] First, we calculate the benchmark markup ratios (assumed to be constant during the sample period) by the methodology of Hall (1988), which utilizes the properties of Solow residuals. We then obtain the variable markup ratios by adjusting the benchmark ratios by the input ratios of various inputs as well as by the rates of change of input prices, and observe how the markup ratios changed for different groups of industries over the past 20 years. We will make a simple analysis of the relationship between the markup ratios, business cycles, indexes of average profits, and various external shocks that are thought to affect directly the structure of marginal cost, such as the two oil shocks and the sharp yen appreciation following the Plaza Accord (Section II).

[2] We use the New Keynesian theory of menu cost to organize our ideas concerning the effectiveness of monetary policy, when firms set prices in consideration of the cost of changing prices under conditions of imperfect competition with markup pricing. We then investigate empirically whether or not firms actually set prices in consideration of the cost of revising prices. We add a critical assessment of the menu-cost theorem (Section III).

[3] We will clarify how the discussion of the usual social welfare cost of inflation should be modified when there is markup pricing in the goods market. We will then estimate the social welfare cost of inflation over the past 20 years or so, in an attempt to grasp quantitatively how the markups that were kept high lowered social welfare (Section IV).

The major points of the paper can be summarized as follows:

[1] The price-setting behavior of Japanese industries did not fully adjust to external shocks that affected marginal cost, such as the oil shocks and the sharp yen appreciation following the Plaza Accord. Thus, the markup ratio temporarily deviated substantially from the trend line. Moreover, the deviation of the markup ratio from the trend line when there was an external shock was found to be greater in the manufacturing sector than in the non-manufacturing sector.

[2] The markup ratio tended to remain roughly constant for the manufacturing sector, while it had a declining trend in the non-manufacturing sector, particularly

the wholesale and retail, finance and insurance, and other service industries. As these industries had been tightly regulated, the importance of deregulation and other competition promotion policies is underscored.

[3] In connection with business cycles, the market ratio was generally procyclical for both manufacturing and non-manufacturing sectors, although the procyclicality is weak. It is thus possible to conjecture that the impact of the business cycle on the markup ratios is relatively small in Japan and that the impact of oil shocks and other external shocks is much more important.

[4] According to the menu-cost theorem, when there is a cost associated with revising prices under imperfect competition, firms are unable to change prices sufficiently in response to an external shock that has changed marginal cost. As a result, the markup ratio fluctuates sharply, thus lowering social welfare. Under these situations, it becomes possible to increase social welfare in the long run by supplying money so as to accommodate external shocks, because such a policy will provide firms with incentives to revise prices sufficiently.

[5] By examining whether or not firms actually set prices in explicit consideration of the cost of revising prices in terms of a simple multi-equation model, the significance level of the parameter associated with price revision was found to be high for both manufacturing and non-manufacturing sectors, suggesting the high probability that firms set prices in consideration of the cost of revising prices. Also, it was found that the level and statistical significance of the parameter were higher in the non-manufacturing sector than in the manufacturing sector. This empirical result may be interpreted as supporting the appropriateness of the assumptions underlying the menu-cost theorem to some extent.

[6] However, the ability of the menu-cost theorem to prescribe policy is limited by its failure to consider the role of inflationary expectations explicitly. For example, when there is an oil shock or some other external shock that tends to increase marginal cost, the theorem prescribes that monetary policy be eased to prompt firms to revise prices. This does not fit the experience of the period of strong inflationary expectations.

[7] Inflation forces firms and households to spend more time and energy on search activities by increasing the variance of prices. This is the thrust of the discussion concerning the social welfare cost of inflation. It should be noted, however, that much of the existing discussion assumes that the goods market is under perfect competition. Under the framework of imperfect competition, changes in the markup ratio reduce the volume of employment, hence the real wage, through a reduction in the volume of output. Then, there arise consequences that are not considered under the usual framework of perfect competition, whereby consumers have no choice but to spend more time on search activities, thus creating a loss of social welfare.

[8] By making an estimate of the social cost of inflation in full consideration of these effects, we find that the social welfare cost of inflation amounted to 3 percent–6 percent of real GDP at the time of the two oil shocks. For the period after the Plaza Accord, the fall in the rate of inflation led to a reduction of the social welfare cost to less than 2 percent of GDP. This indicates that the positive effect of the fall in the rate of inflation on social welfare exceeded the negative effect of the increase in the markup ratio. Thus, it was ascertained that the social welfare cost of inflation was

reduced during that period, even though the markup ratio was temporarily kept high. However, the social welfare cost began to rise considerably from 1987 to 1990.

[9] When the analysis of the paper is taken as a whole, we may reach the following tentative conclusion. There are objections to the view that monetary policy can directly affect the markup ratio of firms in the manner suggested by the menu-cost theorem. However, in view of the discussion of the social welfare cost of inflation when there is markup pricing, it is possible to regard changes in the markup ratio as providing useful information for the monetary authorities.

II. Observation of the Markup Ratio

A. Methodology of Deriving the Markup Ratio

Several studies have estimated the markup ratios of Japanese industries. However, only a few studies have derived the marginal markup ratio (defined as the ratio of price to marginal cost) from any theoretical basis. The greatest problem in deriving the marginal markup ratio is that marginal cost is not directly observable. Existing studies in Japan have often regarded the ratio of sales to costs obtained from the Ministry of Finance's *Quarterly Statistics of Financial Statements of Incorporated Enterprises* or the ratio of output price to input price obtained from the Bank of Japan's *Input-Output Price Indexes of Manufacturing Industry by Sector* as a proxy of the markup ratio. Although both sets of data are easily obtainable on a quarterly or monthly basis, it is important to note that the markup ratio so obtained is a concept based on average cost. In deriving marginal cost by estimating the cost function, moreover, there are always problems regarding the choice of functional form and the estimation problem of multicollinearity.

In order to avoid these problems, Hall (1988) has proposed a method of estimating the markup ratio using Solow residuals. The method of Hall is receiving increasing attention because it does not suffer from arbitrariness in the choice of functional form.[3] However, the method is based on the strict assumption that the markup ratio is constant over time.[4] In this paper, we consider the markup ratio obtained by the Hall-type methodology for each industry group as the average for the sample period, and transform it into a variable ratio by adjusting it by annual changes in factor prices and factor input ratios.[5] This allows us to derive theoretically how the marginal markup ratio has changed over the past 20 years.[6] Price,[7] marginal

3. Applications of this methodology include Haskel, Martin, and Small (1995) and Ariga et al. (1992).
4. The markup ratio derived by this method does not allow an analysis of whether it reflects the degree of vertical integration or changes in the elasticity of demand.
5. See Benabou (1992) for details.
6. See Appendix 1 for the derivation.
7. There is an alternative view that, when discussing the markup ratio in the context of monetary policy, purchaser prices (inclusive of transportation and sales margins) are preferable to producer prices, which are used in the text. However, because of the need to clarify industry-specific characteristics, the paper uses producer prices even for the wholesale and retail industry by treating it as an economic entity in which factor inputs are used to produce output. Because there has been an increasing number of commodities with open pricing in recent years, the difference between the two indexes is likely to diminish in the future.

cost, and markup ratios are all expressed in output terms, including intermediate inputs.[8]

B. Time-Series Variations in Price, Marginal Cost, and the Markup Ratio

The markup ratio has been derived for five manufacturing and eight non-manufacturing industries.[9] In this section, we will show only the results for the broad categories of the manufacturing and non-manufacturing sectors in order to grasp the overall picture.[10]

In Figure 1, P indicates output price, and MC marginal cost, both expressed in terms of the deviation rate from the period average; μ is the calculated markup ratio (price/marginal cost). From this, we observe for both the manufacturing and non-manufacturing sectors that the markup ratio deviated substantially from the trend line because it could not adjust sufficiently to such external shocks as the first and the second oil shocks and the sharp appreciation of the yen following the Plaza Accord.

The fluctuation of the markup ratio arising from an external shock was observed to be greater for the manufacturing sector than for the non-manufacturing sector. Presumably, this reflects the fact that the share of intermediate inputs in total factors of production is greater in the manufacturing sector, so that the impact of external shocks on marginal cost is greater. For this reason, the price-setting behavior of manufacturing firms could not keep up with the changes in marginal cost. As a general tendency, while the markup ratio of the manufacturing sector remained roughly constant, the markup ratio of the non-manufacturing sector showed a clear downward trend, although, even during the most recent past, the markup ratio of the non-manufacturing sector remained considerably higher than that of the manufacturing sector. This implies that, although the non-manufacturing sector has become more competitive because of deregulation and other long-run competition promoting measures, it remains much less competitive than the manufacturing sector, which is facing competition from imports.[11]

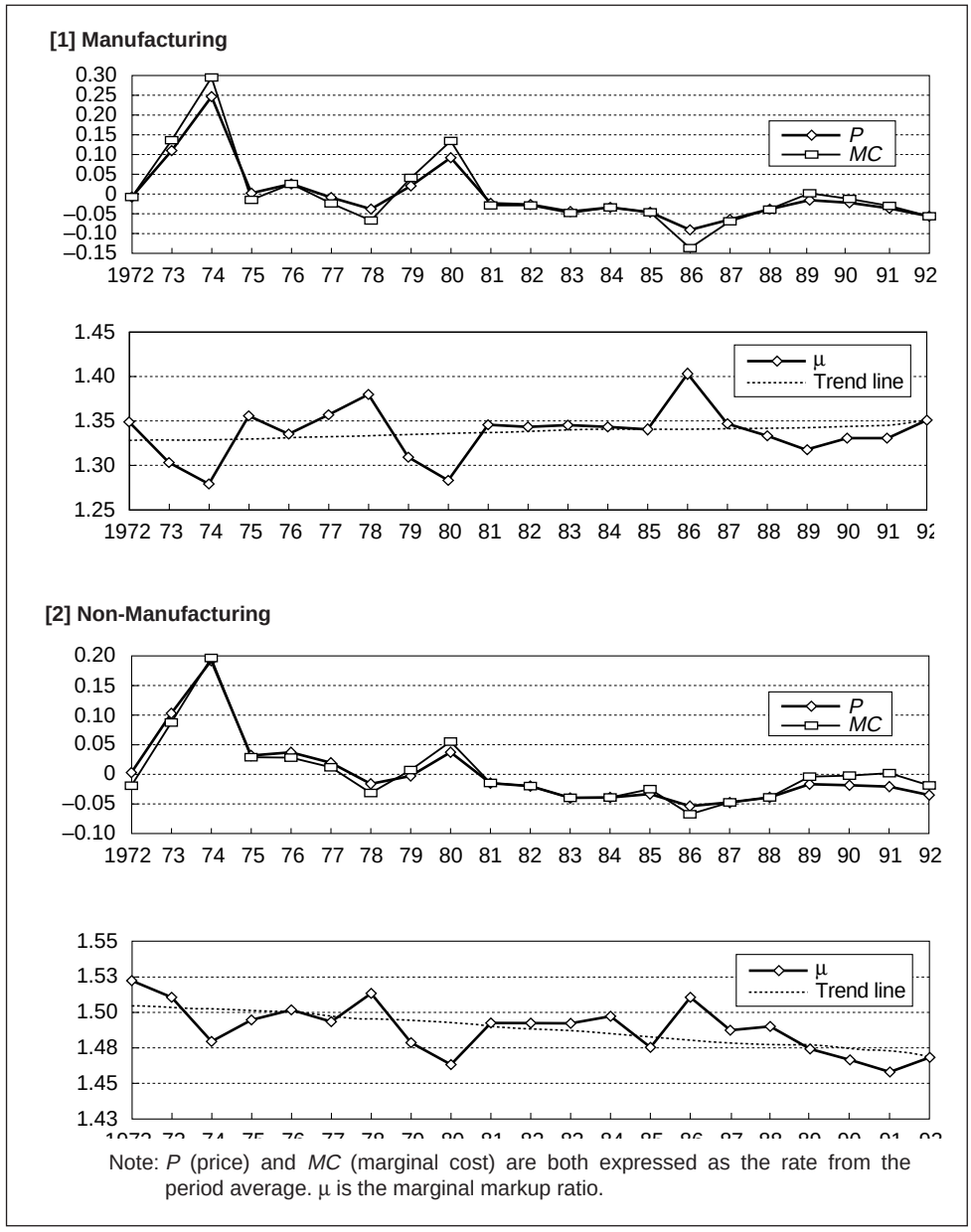
In terms of further breakdown by type of industry within the manufacturing sector, the markup ratio of the transportation equipment industry tended to decline. In the non-manufacturing sector, the markup ratios of the wholesale and retail, finance and insurance, and other services industries have shown a downward trend (see Appendix 2).

8. See Baba (1995) for the bias that results when value-added data are used.
9. The sample for estimation covers the five industry groups of foodstuffs, textiles, pulp and paper, general machinery, and transportation equipment in the manufacturing sector, and the eight industry groups of agriculture, forestry, and fisheries; mining; construction; electric power, gas, and water; wholesale and retail; finance and insurance; transportation and telecommunications; and other services in the non-manufacturing sector. The choice of these industry groups was dictated by the ability to obtain stable markup ratios for the sample period by applying the methodology of Hall (1988) to output-based data inclusive of intermediate inputs (for details, see Baba [1995]). In the analysis of this section, moreover, we used output-based prices, inclusive of intermediate inputs, as the price variables; and the wage rate used was the per capita wage obtained by dividing employee income by the number of employees. Volume of output, output prices, number of employees, the value of intermediate inputs, and intermediate input prices, employee income, fixed capital depreciation, and indirect taxes (negative subsidies) were obtained from the Economic Planning Agency, *National Accounts*; industry-wide data on capital stock were obtained from the Economic Planning Agency, *Annual Report on Capital Stock of Private Enterprises.*
10. For the other results, see Appendix 2.
11. On this point, see Baba (1995).

C. The Relationship between the Markup Ratio and Major Economic Variables

Next, let us look at the relationship between the markup ratio, as calculated above, and some representative economic variables (such as the growth rate of real GDP, indexes of business conditions, the ratio of current profits to sales, and the ratio of sales to costs). Of these, the growth rate of real GDP and indexes of business conditions are meant to capture the business cycle, while the ratio of current profits to sales

Figure 1 Movements of Price, Marginal Cost, and the Markup Ratio



Note: *P* (price) and *MC* (marginal cost) are both expressed as the rate from the period average. μ is the marginal markup ratio.

and the ratio of sales to costs are meant to represent the indexes of average profits, as opposed to the marginal markup ratio calculated in the text.

First, from the results of the regression analysis reported in Table 1, we find that the markup ratio was procyclical with business conditions. However, particularly for the manufacturing sector, the procyclicality is extremely weak. How are we to understand this result? Theoretically speaking, there are many views of the relationship between the markup ratio and the business cycle, so that the direction of influence cannot unequivocally be ascertained. The most basic view stresses the condition for profit maximization by the monopoly firm. From the condition of profit maximization (i.e., the equating of marginal cost with marginal revenue), the higher the price elasticity of demand is, the lower the markup ratio. Because the price elasticity of demand is considered to be procyclical and to move in line with business conditions, the markup ratio should become countercyclical.

On the other hand, from the point of view of industrial organization theory, there exist two theories. In situations where there is a collusive price agreement in an oligopolistic market, whether or not a firm will breach the agreement depends on whether or not the increase in present gains from breaching the agreement exceeds the resulting expected loss in future collusive gains. Rotemberg and Saloner (1986) assume that a stochastic demand shock determines the condition of the economy. When current demand is large and business conditions are good, the gains from breaching the agreement become greater, and the markup ratio declines. As a result, the markup ratio shows a countercyclical movement.

In contrast, if expectations of even greater future demand during the period of good business conditions predominate, the firm may increase the markup ratio. Conversely, the firm lowers the markup ratio during a period of unfavorable business conditions. Hence, in this view the markup ratio should move procyclically with business conditions (Haltiwanger and Harrington [1991]).

Thus, theoretically there is no unequivocal relationship between the markup ratio and the business cycle. The result of the empirical analysis may be a reflection of this ambiguity. During the past 20 years or so, it is possible to conjecture that the markup

Table 1 The Markup Ratio and the Business Cycle (Ordinary Least Squares)

	Constant	Time trend	Growth rate of real GDP	Index of business conditions	R^2	D.W.
Manufacturing	1.248 (14.471)*	0.001 (1.032)	0.274 (0.773)	— —	0.072	1.699
	1.253 (14.282)***	0.001 (0.959)	— —	0.001 (0.441)	0.051	1.729
Non-manufacturing	1.619 (38.701)***	–0.002 (–3.135)***	0.282 (1.639)	— —	0.459	1.971
	1.615 (39.313)***	–0.002 (–3.093)***	— —	0.002 (1.927)*	0.495	1.892

Note: Figures in parentheses are t-statistics. *, **, and *** indicate that the statistic is significant at the 10, 5, and 1 percent levels, respectively.
The index of business conditions is a coincident index (/10).

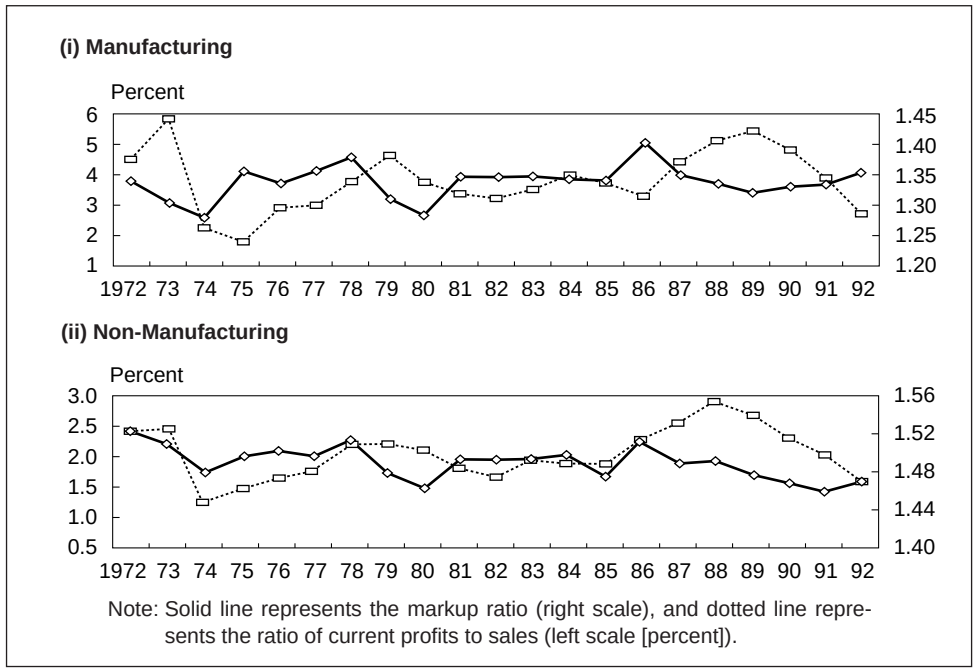
ratios of various industrial sectors in Japan were influenced more by external shocks[12] that directly affect the structure of marginal cost than by the business cycle.

Second, let us look at the relationship with the ratio of current profits to sales and the ratio of sales to costs, which are thought of as the indexes of average profits (Figure 2).

Figure 2 The Markup Ratio and the Indicator of Average Profits

[1] Relationship with the Ratio of Current Profits to Sales

■ Graphical Presentation



Note: Solid line represents the markup ratio (right scale), and dotted line represents the ratio of current profits to sales (left scale [percent]).

■ Ordinary Least Squares

	Constant	Time trend	Markup ratio (current)	Markup ratio (previous)	R^2	D.W.
Manufacturing	15.189 (1.442)	0.061 (1.559)	–12.342 (–1.527)	— —	0.185	1.361
	–18.210 (–1.755)*	0.035 (0.926)	— —	14.266 (1.823)*	0.225	1.098
Non-manufacturing	–14.486 (–1.414)	0.039 (2.242)**	8.916 (1.412)	— —	0.230	0.941
	–21.576 (–2.367)**	0.048 (2.933)***	— —	13.155 (2.371)**	0.354	1.719

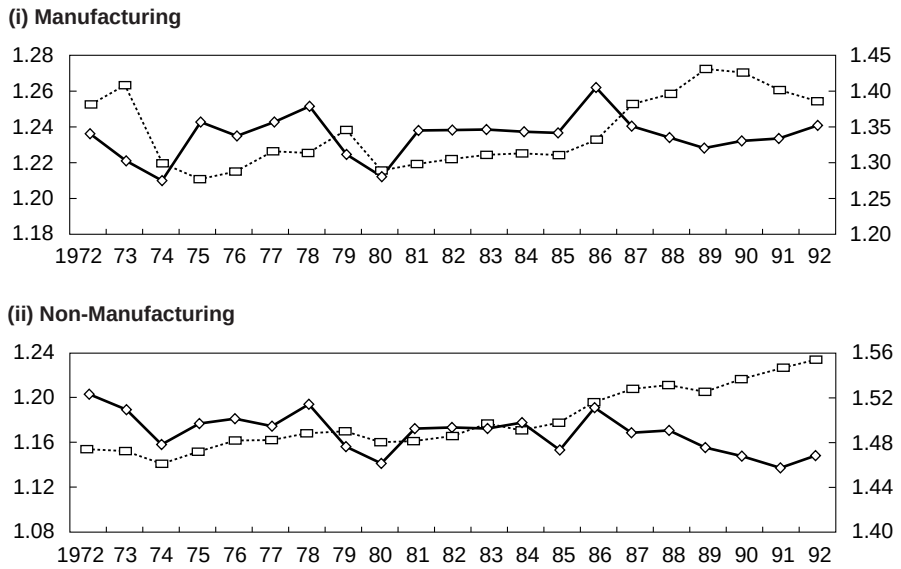
Note: Figures in parentheses are t-statistics. *, **, and *** indicate that the statistic is significant at the 10, 5, and 1 percent levels, respectively.

12. Truly external shocks are limited to such exceptional ones as earthquakes. It is said that what appears to be an external shock is often closely connected with a domestic problem. Okina (1995) argues that even oil shocks, yen appreciation, and the introduction of an indirect tax, which are usually treated as external shocks, should in fact be treated as internal shocks under some conditions.

For both, a quick look seems to indicate no clear relationship with the markup ratio. However, regression analysis shows a statistically significant correlation between the ratio of current profits to sales and the lagged value of the markup ratio (in the preceding period), although there was no statistically significant relationship for the ratio of sales to costs. Roughly speaking, this suggests the possibility that the marginal markup ratio, as calculated in the text, can serve as a leading indicator of average profits.

[2] Relationship with the Ratio of Sales to Costs

■ Graphical Presentation



Note: Solid line represents the markup ratio (right scale), and dotted line represents the ratio of sales to costs (left scale [percent]).

■ Ordinary Least Squares

	Constant	Time trend	Markup ratio (current)	Markup ratio (previous)	R^2	D.W.
Manufacturing	1.314 (7.895)***	0.002 (3.531)***	–0.194 (–1.516)	— —	0.433	1.030
	0.921 (5.263)***	0.002 (2.930)***	— —	0.121 (0.916)	0.386	0.643
Non-manufacturing	0.745 (2.921)***	0.004 (9.377)***	0.064 (0.412)	— —	0.875	0.646
	0.713 (2.889)***	0.004 (9.265)***	— —	0.084 (0.558)	0.976	0.725

Note: Figures in parentheses are t-statistics. *, **, and *** indicate that the statistic is significant at the 10, 5, and 1 percent levels, respectively.

III. Theoretical Issues Relating to the Effectiveness of Monetary Policy under Imperfect Competition

A. A Review of the Theoretical Framework

From the rough observation of the previous section, we have found that the markup ratio often deviated substantially from the trend line in Japan. This reflects not only the presence of various degrees of market power in many of the industries but also the inability of the price-setting behavior of firms to keep up with changes in marginal cost when there was an external shock, such as the oil shocks and the sharp yen appreciation. Under the conditions of imperfect competition with markup pricing, what role can monetary policy play? In this section, we will take up the menu-cost theorem as a representative New Keynesian framework in order to discuss the effectiveness of monetary policy.

At the outset, we need to clarify why we want to use a New Keynesian framework for the purpose of our discussion in the paper. To do so, let us schematically organize the various existing theoretical frameworks in the light of the discussion of the previous section. Silvastre (1993) classifies the major existing frameworks into four categories from the standpoints of (1) the responsiveness of price to an external shock; and (2) the existence or absence of market power.

According to this classification (Table 2), theoretical frameworks applicable to the situation of market power include models of cooperation or coordination failure based on game theory, and New Keynesian-type models based on menu cost, etc. In terms of the first type, the model of cooperation failure,[13] for example, requires that the rules of the game be changed in order to improve social welfare.

On the other hand, in the model of coordination failure in which there are multiple equilibria, a one-time implementation of monetary policy can serve as a signal and thereby create an incentive for the players to change prices, thus leading the economy to a Pareto optimal equilibrium.[14] Although these models do provide interesting insights into the management of monetary policy, they both assume that prices are flexible. From the observation made in the previous section, however, prices are sticky with respect to external shocks. Thus, we will adopt a New Keynesian-type approach in discussing the effectiveness of monetary policy throughout this paper.

Table 2 Classification of Theoretical Frameworks

		Responsiveness of price to an external shock	
		Responsive	Sticky
Market power	No	New classical model	Keynesian model (IS-LM model)
	Yes	Cooperation failure Coordination failure	New Keynesian model (menu cost, near-rational model)

Source: Silvastre, J., "The Market-Power Foundation of Macroeconomic Policy," *Journal of Economic Literature*, 31, 1993, p. 106.

13. The case of the prisoner's dilemma is an example.
14. For details, see Cooper and Andrew (1988).

B. The Role of Monetary Policy in New Keynesian Models

1. Cost of revising prices and the price-setting behavior of firms

Here, we will present a framework for examining the effectiveness of monetary policy under the conditions of imperfect competition with markup pricing and sticky prices, by referring to Akerlof and Yellen (1985).[15]

The market is not under perfect competition, so that the firm has price-setting power. When there is an external shock and marginal cost is changed, it is desirable from the point of view of social welfare that the firm change the price in accordance with the change in marginal cost. However, there is a possibility that, because of the existence of the cost of revising prices (menu cost), the firm does not change the price in accordance with the change of marginal cost, thus creating a loss for society.

Figure 3 depicts the price-setting behavior of the firm when an external shock reduces the marginal cost from MC_0 to MC_1. In the absence of menu cost, the firm can maximize profits by changing the price[16] from P_0 to P_1 in accordance with the reduction in marginal cost. This is the best choice for the firm from the standpoint of profit maximization. However, when there is a menu cost, the firm changes the price only under the following conditions.

That is to say, the firm has an incentive to change the price only when the difference (given by HGC) between the producers' surplus (α) when the price is at P_0 (given by ABCD) and the producers' surplus (β) when the price is at P_1 (given by EFGD) exceeds the cost of changing the price. This cost of changing prices can be accompanied by a social cost. To understand this point, we will consider the following three cases.[17] For simplicity, the social surplus (the sum of the producers' surplus and the consumers' surplus) when the price is at P_0 is denoted as γ, and the social surplus when the price is at P_1 is denoted as δ.

(a) $\delta - \gamma >$ menu cost $> \beta - \alpha$.

Although it is socially desirable to change the price, the firm does not change the price, thus causing inefficiency. Then, the presence of menu cost creates a social cost.

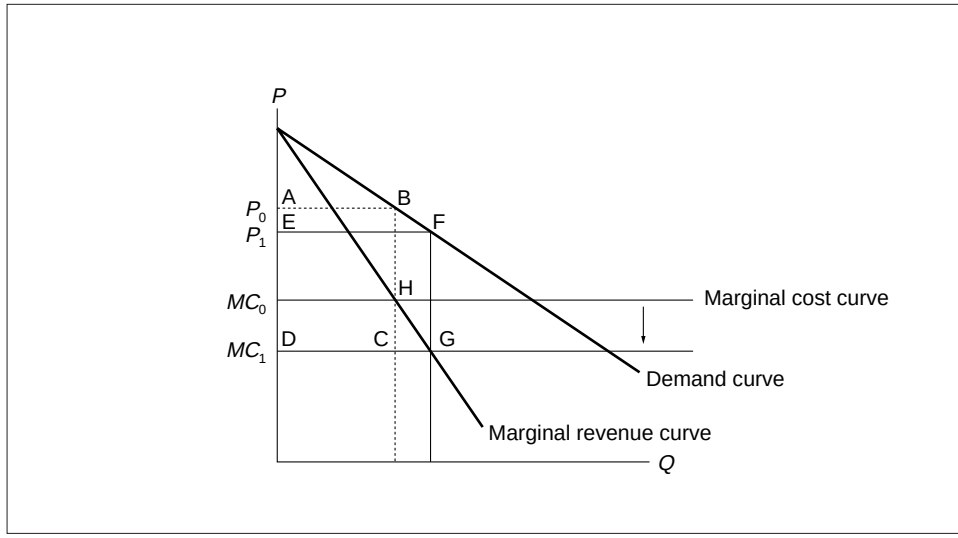
(b) Menu cost $> \delta - \gamma > \beta - \alpha$.

For both society and the firm, it is optimal not to change the price. In this case, there is no social inefficiency.

(c) $\delta - \gamma > \beta - \alpha >$ menu cost.

15. Akerlof and Yellen (1985) in fact do not use the term menu cost. Instead, they use the term "near-rational" to refer to the possible presence of market participants who do not necessarily behave rationally. Regardless of which term is used, the essence of the argument is the same.
16. To be precise, the price should be defined as a relative price, i.e., the ratio of the price of the commodity concerned to the general price level. For simplicity of presentation, however, the price is here expressed as the price of the commodity in question.
17. In terms of Figure 3, $\delta - \gamma$ corresponds to BFGC, and $\beta - \alpha$ corresponds to HGC. Thus, it is sufficient to consider these three combinations.

Figure 3 Price-Setting Behavior of the Firm as a Result of a Change in Marginal Cost



For both society and the firm, it is optimal to change the price. Thus, in this case, there is no social inefficiency.

2. The effectiveness of monetary policy

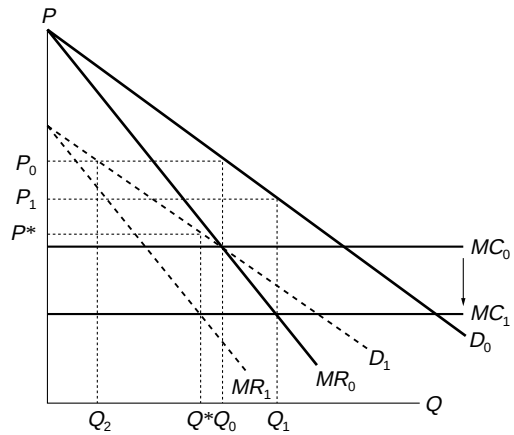
***a)* An analytical framework**

When there is no menu cost so that the firm can smoothly change the price to a level desirable for profit maximization, money is neutral both in the short run and in the long run, rendering monetary policy ineffective. However, in cases where social inefficiency is generated as in (a) above, monetary policy can affect the real economy and have a positive impact on social welfare. In what follows, we will discuss the effectiveness of monetary policy separately for the short run and for the long run.

Suppose that there is an external shock that reduces marginal cost, such as a sharp yen appreciation (Figure 4). In this case, the firm is faced with a decision as to whether or not it should change the price from P_0 to P_1. When the firm does not change the price because of the menu cost, as in the case of (a) above, social inefficiency is generated. In such a case, monetary tightening can be effective in the short run as it causes a leftward shift of the demand curve. We will consider the effect of monetary tightening below. If the firm keeps the price unchanged at P_0 because of the menu cost, the leftward shift of the demand curve causes the quantity demanded to move from Q_0 to Q_1. For this reason, with the price left unchanged, the profit of the firm is reduced substantially. This creates an incentive for the firm to reduce the price. In this manner, monetary tightening can reduce the markup ratio and thus improve social welfare, when an external shock reduces marginal cost.

On the other hand, however, monetary tightening can also exert deflationary pressure in the short run. In the long run, however, because the firm reduces the price in the manner described above, money becomes neutral, and the demand curve returns to the initial position, eliminating deflationary pressure. Thus, when there is an external shock that reduces marginal cost, the optimal choice from the point of

Figure 4 The Effectiveness of Monetary Policy



MC_0: Marginal cost curve prior to the shock
MC_1: Marginal cost curve after the shock
$D_0(MR_0)$: Initial demand curve (the corresponding marginal revenue curve)
$D_1(MR_1)$: Demand curve after tightening of monetary policy (the corresponding marginal revenue curve)
$P_0(Q_0)$: Price (quantity) under initial equilibrium
$P_1(Q_1)$: Price (quantity) after the shock
Q_2: Quantity that would result if the price were maintained at P_0 despite the shift in demand curve
$P^*(Q^*)$: Equilibrium (short-run equilibrium) after the tightening of monetary policy

view of social welfare is to tighten monetary conditions so as to accommodate the external shock.

Similarly, when there is an external shock that raises marginal cost (e.g., oil shocks and the Gulf War), it is desirable to ease monetary conditions so as to create an incentive for the firm to raise prices.

b) A simulation exercise involving menu cost, monetary policy, and the social surplus

Here, we will introduce the simulation exercise of Blanchard and Kiyotaki (1987) as a way of ascertaining that monetary policy can create an incentive for the firm to change prices by increasing the opportunity cost associated with not changing prices because of the menu cost.[18]

Blanchard and Kiyotaki (1987) consider two money supply rules to estimate the potential loss to the firm from not changing the price in the goods market because of the menu cost, as well as the associated loss in utility to the worker from not changing wage rates in the labor market. They then estimate the change in social welfare in the short run (tables 3 and 4).[19]

18. This type of simulation was also conducted by Akerlof and Yellen (1985) and Ball and Romer (1990).
19. The model is so designed that the firm choosing not to revise prices because of the menu cost does not change factor prices (wages), either.

According to their trial estimates, the potential loss (opportunity cost) associated with keeping the price unchanged becomes larger as the money supply is increased, indicating that a rightward shift of the demand curve can bring about a large increase in social welfare relative to the menu cost. This result does not much depend on the assumed magnitude of various parameters that constitute the model. If the cost of changing prices is actually kept constant, we do find that, as the money supply is increased, the potential loss from not changing the price is increased, giving an incentive for the firm to change the price.

Table 3 Losses to the Firm and the Worker Associated with the Presence of Menu Cost

(a) Loss to the firm from not revising the price (percent level of initial revenue)				(b) Loss in utility to the worker from not revising the wage rate (percent level of initial revenue)			
		M1/M0 =				M1/M0 =	
a	θ	1.05	1.10	*b*	σ	1.05	1.10
1.0	5	0.000	0.000	1.2	5	0.025	0.100
1.1	5	0.003	0.013	1.4	5	0.066	0.265
1.1	2	0.001	0.004	1.4	2	0.027	0.111
	20	0.008	0.031		20	0.105	0.418
1.3	5	0.018	0.071	1.6	5	0.112	0.451

Note: M0: Initial nominal money balance
M1: Nominal money balance after the change
a: Inverse of the indicator of the economy of scale
b: Substitutability of marginal disutility of labor
θ: Elasticity of substitution between goods in the utility function
σ: Elasticity of substitution between factors of production (here, there exist *n* types of labor)
Source: Blanchard, O., and N. Kiyotaki, "Monopolistic Competition and Effects of Aggregate Demand," *American Economic Review*, 77, 1987, pp. 647–666.

Table 4 Sum of Losses to the Firm and the Worker and the Change in Social Welfare

a	*b*	M1/M0 = 1.05			M1/M0 = 1.10		
		Sum of losses A (percent)	Change in social welfare B (percent)	B/A	Sum of losses A (percent)	Change in social welfare B (percent)	B/A
(θ = σ = 5)							
1.1	1.2	0.03	1.79	60	0.11	3.54	32
	1.4	0.07	1.83	26	0.28	3.60	13
	1.6	0.11	1.91	17	0.46	3.72	8
1.2	1.2	0.04	1.82	45	0.15	3.57	24
	1.4	0.08	1.87	24	0.33	3.67	11
	1.6	0.13	1.98	15	0.53	3.85	7
(θ = σ = 10)							
1.1	1.2	0.03	0.94	31	0.11	1.86	17
	1.4	0.03	1.02	17	0.23	1.93	17
	1.6	0.06	1.11	12	0.36	2.05	8
1.2	1.2	0.04	0.99	25	0.16	1.87	12
	1.4	0.07	1.07	16	0.29	2.01	7
	1.6	0.11	1.27	12	0.44	2.42	5

Source: Blanchard, O., and N. Kiyotaki, "Monopolistic Competition and Effects of Aggregate Demand," *American Economic Review*, 77, 1987, pp. 647–666.

However, although the trial estimates do suggest that an increase in the money supply certainly works in the direction of creating an incentive for the firm to change the price, it is debatable whether or not the estimated loss is sufficiently large to force the firm actually to change the price. It should be noted in this context, however, that the trial estimates do not take into consideration the loss associated with the external shock that affects the structure of marginal cost (i.e., the shock that increases marginal cost, such as an oil shock). In this sense, the estimated loss is underestimated to that extent.

3. An empirical analysis of the existence of the cost of revising prices

The assumption underlying the preceding menu-cost theorem is that the firm sets prices in explicit recognition of the cost of revising prices. Although this point is extremely important, it has not been subjected to much empirical analysis. Thus, we will below take a macroeconomic model approach by estimating a system of structural equations that is based on a theoretical foundation and allows an easy interpretation. Estimation will be performed separately for the manufacturing sector and the non-manufacturing sector.

a) A basic framework

When the firm faces a demand curve with a constant price elasticity, it determines the price at a level given by the product of marginal cost and the markup ratio (as specified by the price elasticity) so as to maximize profits (or minimize cost), provided that there is no menu cost. However, when there is a menu cost, the behavior of the firm is modified as follows. First, the objective function of the firm becomes the amount of profits obtainable with the optimal price level in the absence of menu cost less (1) the cost attributable to the difference between the optimal price level in the absence of menu cost (corresponding to the level given by the product of marginal cost and the markup ratio) and the current price level (expressed as the squared difference in log-linear form); and (2) the cost of changing prices (expressed as the squared difference between the price of the previous periods and the current price in log-linear form). From the maximization of this objective function, it becomes possible to express the current price as a nonlinear function of the optimal price when there is no menu cost and the price of the previous periods, making it feasible to perform a regression analysis.[20]

Roberts, Stockton, and Struckmeyer (1994) present one of the few studies that have used this concept to analyze empirically different manufacturing industries in the United States. The problem with their model, however, is that, although there is only one equation to be estimated, there are two endogenous variables (i.e., price and output). Thus, theoretically, these two variables cannot be distinguished. Thus, in this section, in order both to avoid this problem and to clarify the economic meanings of estimated parameters, we will simultaneously estimate the system of three structural equations, consisting of the demand function, the Cobb-Douglas cost function,[21] and the price-setting function.[22]

20. For the derivation and specification of a system of estimation equations, see Appendix 3.
21. The assumption of the cost function takes either of the following forms: (1) a reduction of cost associated with technical progress is constant (so that it is treated as part of the constant term); and (2) technical progress occurs at a constant rate every year (so that the cost reduction is treated as a trend term).
22. Except for the income variable and the rental cost of capital, the data used here are the same as the data used in Section II. For the income variable, we have used real GDP. In estimating the rental cost of capital, the usual

b) Estimation results

According to the estimation results (Table 5), the coefficient of determination is high for each of the three equations, and all the parameters are significant and have the expected signs. The parameter relating to price revision is statistically significant at 1 percent for both the manufacturing and non-manufacturing sectors, indicating the

Table 5 Estimation Results of the System of Equations (Seemingly Unrelated Regression)

Parameter	Manufacturing		Non-manufacturing	
	With trend term	Without trend term	With trend term	Without trend term
Demand function				
Constant	0.117 (0.376)	0.032 (0.102)	–0.873 (–3.515)***	–0.229 (–0.863)
Price elasticity	–0.109 (–3.364)***	–0.154 (–4.090)***	–0.091 (–4.801)***	–0.128 (–3.836)***
Income elasticity	0.984 (40.011)***	0.990 (39.981)***	1.074 (54.962)***	1.008 (48.210)***
R^2	0.988	0.988	0.998	0.990
Cost function				
Constant	— (—)	0.795 (5.903)***	— (—)	0.967 (6.305)***
Trend term	–0.008 (–10.963)***	— (—)	–0.004 (–3.511)***	— (—)
Wage rate	0.226 (11.986)***	0.097 (5.787)***	0.425 (10.945)***	0.099 (5.163)***
Capital rental ratio	0.048 (4.916)***	0.074 (5.328)***	0.043 (2.833)***	0.068 (5.103)***
Intermediate input price	0.778 (53.512)***	0.918 (36.031)***	0.425 (10.945)***	0.940 (37.850)***
R^2	0.995	0.996	0.998	0.995
Price-setting function				
Constant	1.074 (22.828)***	1.069 (16.337)***	1.194 (42.837)***	1.194 (35.706)***
Parameter related to price changes	0.083 (2.815)***	0.148 (4.157)***	0.235 (4.776)***	0.224 (5.662)***
R^2	0.999	0.999	0.999	0.999

Note: Figures in parentheses are t-statistics. *, **, and *** indicate that the statistic is significant at the 10, 5, and 1 percent levels, respectively.

practice is to express interest rates in real terms by using the rate of the rise of capital goods prices as the deflator. In this paper, however, we did not express them in real terms because of the following problems: (1) immediately following the oil shock, capital goods prices rose sharply, causing the real interest rate to become negative; (2) when nominal interest rates fall along with the fall in the price level, the markup ratio apparently declines because the real interest rate and the rental cost of capital do not change; and (3) there is a possibility that the relationship between capital goods prices and investment depends on the expectations of future prices, and cannot be ascertained unequivocally. In this paper, the rental cost of capital rK is estimated as follows.

rK = fixed capital depreciation + subscriber's yield on 10-year government bonds
× real stock of capital × the index of capital goods prices.

Real GDP, subscriber's yield on 10-year government bonds, and capital goods prices are obtained from the Bank of Japan, *Economic Statistics Annual*.

possibility that firms do set prices in consideration of the cost of revising prices. The parameter is more significant and greater in value for the non-manufacturing sector, suggesting that non-manufacturing firms are more conscious of the cost of revising prices.

4. A summary and critical examination of the menu-cost theorem

Let us summarize the argument of this section. Where there is a cost of revising prices under conditions of imperfect competition, the firm cannot change the price sufficiently in response to an external shock that changes marginal cost. As a result, the markup ratio changes substantially, and social welfare is reduced significantly. In such cases, it is possible to improve social welfare in the long run by establishing a money supply rule to accommodate the external shock, thereby creating an incentive for firms to revise prices.

An empirical analysis based on a simple system of equations suggests the possibility that, both for the manufacturing and non-manufacturing sectors, firms set prices in explicit consideration of the cost of revising prices. Although the empirical results are indirect, they may to some extent establish the feasibility of the menu-cost theorem. On the other hand, it is also true that many objections exist to the menu-cost theorem. Some of the representative objections are reviewed below.

The first objection stresses the experience at the time of the first oil shock. Heightened inflationary expectations were caused primarily by the substantial easing of monetary policy (the "excessive liquidity" phenomenon) in 1971 and 1972, and then the rising prices resulting from the first oil shock of 1973 were curtailed by the consistent tightening of monetary policy. Thus, the economy was temporarily placed in a deflationary situation in 1975 before starting on a relatively smooth recovery path. What then would have happened if an accommodative monetary policy had been pursued, as suggested by the menu-cost theorem? Many argue that inflationary expectations would have been accelerated, preventing the economy from resuming a smooth recovery path.

In response, we may argue in the following way. As explained in this section, the most basic menu-cost theorem is static, and does not explicitly consider the role of inflationary expectations. If the cumulative effect of easy monetary policy prior to the first oil shock had raised the inflationary expectations of economic agents, the demand curve should have shifted rightward to that extent.[23] Then, it is possible to argue that the monetary tightening after the first oil shock was a necessary measure to offset the rightward shift of the demand curve caused by the increase in inflationary expectations.

Taking this line of argument, if such an external shock as the oil shock occurs when inflationary expectations have been eliminated, it may be desirable from the standpoint of increasing social welfare to accommodate the change in marginal cost by easing monetary policy, as suggested by menu-cost theorem. It is, however, necessary to bear in mind that such a view does not take into consideration the presence of

23. The demand for investment may depend not on nominal interest rates but on real interest rates. Then, if only the expected rate of inflation increases with no change in nominal interest rates, the real interest rate falls, and investment increases.

asymmetry in price adjustment (i.e., downward stickiness of prices). There is a good possibility that the downward stickiness of prices can be explained considerably by an increase in inflationary expectations. Even so, if the management of monetary policy is based on the consideration of cost and benefit in pursuit of the policy objective of facilitating a smooth convergence to a new equilibrium price in response to an external shock, the policy response may be different depending on whether the price is lower or higher than the equilibrium price. If a large cost is involved in reducing nominal prices that are kept high, there may not be an incentive to use monetary policy to reduce them.

The second objection is raised in connection with the discussion on the competitive structure of markets. From this standpoint, the absolute level and changes in the markup ratio are basically determined by regulation, market concentration, and other factors related to the competitive structure of markets.[24] The conclusion is that the markup ratio cannot be directly controlled by monetary instruments alone.

In response, it is possible to argue in the following way. The role of monetary policy in the menu-cost theorem is to bring the markup ratio back to a level consistent with the competitive structure of the market by controlling the demand curve appropriately when an external shock causes the ratio to deviate temporarily from the new equilibrium value.

However, the underlying markup ratio in each market is determined by the degree of oligopoly and other aspects of the market structure, so that it cannot be controlled by monetary policy or other monetary instruments. For these matters, it is necessary to apply deregulation and other market-specific industrial policy measures so as to make the market structure more competitive. That is to say, it would become possible to increase social welfare efficiently only by using both types of policy instruments in an appropriate combination.

In addition to these two objections, there are other traditional objections to the menu-cost theorem: (1) the menu cost, even if it exists, should be extremely small, so that it is unreasonable to try to explain large macroeconomic fluctuations on that basis alone; and (2) if one assumes that society is made up of rational individuals, it is difficult to imagine that they will leave the large imbalance of supply and demand unattended. In view of these objections, it is unreasonable that the monetary authorities should rely entirely on the theorem as a theoretical justification for stressing the observed changes in the markup ratio in their conduct of monetary policy. In the following section, we will examine the alternative theoretical basis for such monetary policy, as presented by Goodfriend (1995).

24. In fact, Ariga, Ohkusa, and Nojima (1994) make it clear that, in the case of Japanese manufacturing industries, the ability of marginal cost to explain the movement of price grows smaller as the degree of concentration or the cost of distribution increases.

IV. Markup Pricing and the Social Welfare Cost of Inflation

A. A Basic Line of Thought

An increase in inflation forces firms and households to spend more time and energy on search activities by increasing the dispersion of prices.[25] Although these search activities may be considered rational from the point of view of utility maximization for each economic agent, they are not necessarily desirable from the point of view of society because they represent uses of time and energy that should have been expended to produce goods and services. This is the thrust of the argument concerning the social welfare cost of inflation, which is often employed as a theoretical basis for the government's use of policy measures to achieve price stability.[26]

It should be noted, however, that the condition of perfect competition in the goods market is assumed in these discussions. If there is markup pricing in the goods market, the above discussions must take into consideration the following two effects:[27] (1) under the framework of imperfect competition, a change in the markup ratio affects output, employment, and the real wage rate, bringing about a change in consumers' search activities; and (2) an increase in inflation increases the competitiveness of the market by promoting search activities, and hence increasing social welfare.

Of these two effects, the first effect is analyzed in detail by Goodfriend (1995). The thrust of the Goodfriend model is as follows.[28] Assuming imperfect competition (with only labor as an input), an increase in the markup ratio lowers employment and hence the real wage by reducing output. Thus, a representative consumer is forced to spend more time on search activities. As a result, there is a social welfare loss amounting to the product of the marginal productivity of labor and the additional time spent on search activities.

As will be stated later, the social welfare cost of inflation given by Goodfriend (1995) is equal to the level corresponding to the product of the social welfare cost of inflation under perfect competition given by Lucas (1993)[29] and the marginal markup ratio. This type of argument provides an interpretation as to why the monetary authorities should pay attention to the markup ratio when seeking to minimize the social welfare cost of inflation. That is to say, if the markup ratio is in fact observed or forecast to remain substantially high for some reason, the socially optimal policy for the monetary authorities is to tighten monetary conditions further so as to reduce the rate of inflation, even though the nominal rate of inflation may remain low and stable. This is true even if the policy prescription suggested by the menu-cost theorem is not effective for the reasons mentioned in the previous section.

25. For empirical analyses of this point, see, for example, Ariga et al. (1992) and Fukuda, Teruyama, and Toda (1991).
26. See, for example, *Economic Report of the President* (1990).
27. We do not discuss the second effect in this paper. Benabou (1992) analyzes the relationship between the rate of inflation and the markup ratio in the U.S. retail industry to show that an increase in inflation has the effect of lowering the markup ratio by exerting competitive pressure on the market.
28. See Appendix 4 for the derivation of the model.
29. Lucas (1993) calculated the social welfare cost of inflation by taking note of the fact that economic agents must spend part of their leisure time on search activities because the rise in nominal interest rates associated with inflation causes them to hold less money. The analysis of Lucas, however, is limited to the case where the rate of inflation is at a steady state.

B. A Simple Trial Estimation

The model of Goodfriend (1995) as explained above presents an interesting insight into assessing the monetary policy of the period following the Plaza Accord in 1985. The usual discussion on the social welfare cost of inflation would suggest that, as the rate of inflation has subsided since 1985, the dispersion of prices has decreased, thus raising social welfare. However, as we saw in Section II, the markup ratio remained above the trend line for some time both for the manufacturing and for the non-manufacturing sectors. Consequently, there is a possibility that, contrary to the conventional view, the social welfare cost of inflation following the Plaza Accord was larger than before, as a result of the relative magnitudes of these two conflicting effects. To clarify this point, let us make a simple trial estimation.[30]

The Goodfriend measure of the social welfare cost of inflation, ϕ, can be estimated in the following way:[31]

$$\phi = 100 \times (\alpha / L)\sqrt{R\mu L / \alpha v} \qquad (1)$$

where $v = (\alpha / \mu L) / \{R[(M/P)/C]^2\}$. (2)

Here, L is the amount of labor (employment) input, R is the nominal rate of interest, C is real GDP, μ is the marginal markup ratio, P is the GDP deflator, α is the parameter of labor in the production function (with only labor as an input), and M is the money supply.

Consequently, by substituting Marshall's k (M/PC)and the nominal rate of interest R,[32] it is possible to estimate from equations (1) and (2) the social welfare cost of inflation corresponding to each level of the markup ratio in terms of percentage of real GDP.

Figure 5 [1] depicts the movement of the social welfare cost of inflation, as estimated by the method of Goodfriend (1995), for the post-oil shock period of fiscal 1974 to fiscal 1992. In the estimation, we have calculated the markup ratios separately for the manufacturing and non-manufacturing sectors, and compared them with the case where the markup ratio is one (i.e., the case of perfect competition). This is designed to obtain an intuitive understanding of how much the presence of markup pricing causes a distortion in terms of social welfare.

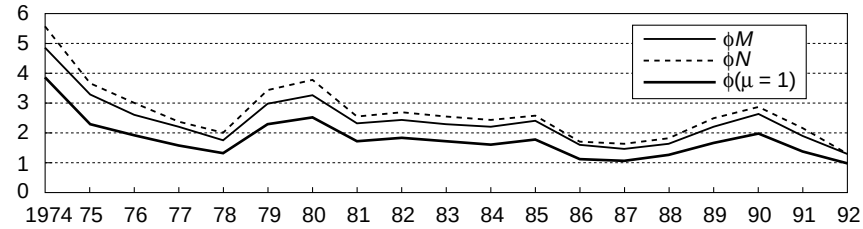
30. It should be noted that the type of inflation considered in the discussion of the social welfare cost of inflation, as in Lucas (1993) and Goodfriend (1995), is a steady-state inflation and can be forecast. Discussions of the social welfare cost of inflation under uncertainty include the following points: (1) inflation makes it difficult for the firms to make production decisions, causing them to behave more conservatively; and (2) because the determination of nominal interest rates does not necessarily incorporate the actual rate of inflation (i.e., there is a difference between the expected rate of inflation and the actual rate of inflation), a forced redistribution of wealth from creditors to debtors occurs during an inflationary process. In this paper, because the purpose is to ascertain to what extent the Lucas measure of the social welfare cost of inflation remains high because of the presence of markup pricing, the estimation is made on the assumption that economic agents can make a perfect forecast of the rate of inflation. See Driffill, Mizon, and Ulph (1990) for a comprehensive survey of the social welfare cost of inflation.
31. For the derivation of the theoretical model, see Appendix 4.
32. In the trial estimation of this section, we are using M_1 as M, and the reference yield on bond repurchase agreements as R.

According to Figure 5 [1], the social welfare cost of inflation amounted to 3 percent–6 percent of real GDP at the times of the two oil shocks. For the period following the Plaza Accord, the social welfare cost of inflation declined to below 2 percent of real GDP because of the deceleration in inflation. This indicates that the positive effect of the deceleration in inflation on social welfare exceeded the negative effect of an increase in the markup ratio. Thus, even if it is acknowledged that the markup ratio remained temporarily high, we can support the usual argument that the social welfare cost of inflation is lower with a lower rate of inflation. However, the social welfare cost of inflation began to rise considerably from 1987 to 1990.

In comparing the result with the case of perfect competition (Figure 5 [2]), the social welfare cost of inflation is higher because of the presence of markup pricing by 0.3 percent–1.8 percent of real GDP. In terms of a trend, the distortion caused by markup pricing decreased because of the trend decline in the markup ratio (also at the bottom of 1987).

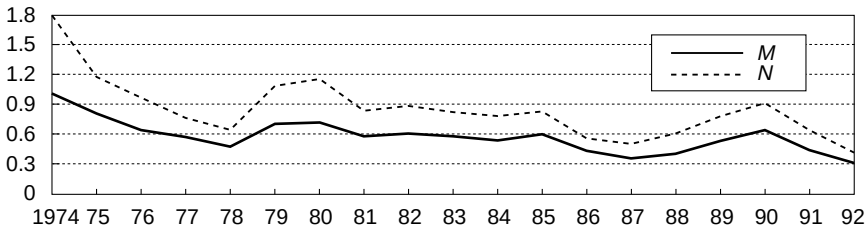
Figure 5 Time-Series Movement of the Social Welfare Cost of Inflation

[1] The Social Welfare Cost of Inflation in the Manufacturing and Non-Manufacturing Sectors (as a Percent Level of Real GDP)



Note: ϕM and ϕN represent the welfare cost of inflation under the markup pricing in the manufacturing and non-manufacturing sectors. $\phi(\mu = 1)$ is the hypothetical welfare cost of inflation under perfect competition.

[2] The Increase in Social Welfare Cost Caused by the Presence of Markup Pricing (as a Percent Level of Real GDP)



Note: ΔM represents the increase in social welfare cost caused by the presence of markup pricing in manufacturing, and ΔN represents that in non-manufacturing. The social welfare cost of inflation is expressed as a percent level of real GDP. The increase in social welfare cost caused by the presence of markup pricing is defined as the difference between the social welfare cost and the hypothetical social welfare cost obtainable under perfect competition ($\mu = 1$), both for the manufacturing and non-manufacturing sectors.

V. Conclusion

In this paper, we first calculated the markup ratios of various industry groups over the past 20 years, using output data inclusive of intermediate inputs. We then analyzed the relationship between the markup ratio and other economic variables, such as external shocks and the business cycle. The analysis has shown that the markup ratio in Japan was influenced more by external shocks than by the business cycle.

Under imperfect competition with markup pricing, the firms were found to be unable to adjust prices fully in response to a change in marginal cost caused by an external shock when they set prices in explicit consideration of the cost of revising prices. As a result, the markup ratio fluctuated sharply. Under these circumstances, at least theoretically, monetary policy can provide incentives for firms to change prices by affecting the volume of output in the short run, hence improving social welfare. This was explained in a simple theoretical model.

On the other hand, with markup pricing, the social welfare cost of inflation was shown to increase to the level given by the product of the cost of inflation under perfect competition and the marginal markup ratio. We then made a trial estimation of the social welfare cost of inflation over the past 20 years or so, and showed that, because of markup pricing, the social welfare cost of inflation remained high at the range of 0.3 percent–1.8 percent of real GDP. It should be noted, however, that because the markup ratio fluctuates less than the rate of inflation, the fluctuation of the social cost of inflation can be explained more by the rate of inflation than by the markup ratio.

Although a series of New Keynesian theories, such as the menu-cost theorem introduced in this paper, do have some theoretical force, not enough empirical research has been conducted to either support or refute these theories, making it difficult to form a definite conclusion. Even so, it is possible that the markup ratio not only reflects the competitive structure of industries but also contains useful information for the conduct of monetary policy. It is hoped that further research will be conducted in this area, both empirically and theoretically.

Appendix 1: Derivation of the Variable Markup Ratio[33]

Think of an industrial sector under monopolistic competition, consisting of firms with the following production function:

$$Q = \min\left[F(L, K) - \Psi, \frac{M}{\gamma}\right] \tag{A.1}$$

where Q is output, L is the amount of labor input, K is the capital stock, M is the amount of intermediate inputs, and intermediate inputs M are assumed to be used in a fixed proportion to output Q (γ is the coefficient of proportionality); Ψ is the amount of fixed factors used in production.

From the first-order conditions for cost minimization, we have

$$M = \gamma Q, \frac{PF_L}{w} = \frac{PF_K}{r} = \lambda \tag{A.2}$$

where w is the wage rate, r is the rental rate of capital, P is the price of goods (or services), and λ is a Lagrangian multiplier. Thus, the markup ratio of a firm (defined as the ratio of price to marginal cost) can be expressed as follows:

$$\frac{1}{\mu} = \frac{1}{\lambda} + s_M. \tag{A.3}$$

Here, $s_M = p_M M/PQ = \gamma p_M/P$, which indicates the share of intermediate inputs in total output (P_M is the price of intermediate inputs). Likewise, the share of labor inputs in total output and the share of capital inputs in total output are defined, respectively, as $s_L = wL/PQ$, $s_K = rK/PQ$. Furthermore, it is assumed that the relationship $s_L + s_K + s_M = 1$ holds in long-run equilibrium, where there is no exit or entry and excess profits are eliminated.

According to Hall (1988), we can obtain from the relationship between factor inputs and output the following markup ratio, as a measure of the monopolistic power of the firm:[34]

$$\hat{Q} = \mu(s_L\hat{L} + s_K\hat{K} + s_M\hat{M}) \tag{A.4}$$

where a circumflex indicates that the variable is expressed as a deviation rate from the average rate of growth during the sample period. By letting $\hat{V}$ denote the deviation from the average rate of growth of output expressed in value-added terms, we have

33. For details, see Benabou (1992).
34. In practice, the method of Hall (1988) is based on the use of output data expressed in value-added terms. For the Japanese data, Baba (1995) summarizes the bias caused by using value-added data as well as how the estimation results change when intermediate inputs are explicitly incorporated into the production function.

$$\hat{V} = \mu_{VA}(s_{L,VA}\hat{L} + s_{K,VA}\hat{K}) \tag{A.5}$$

where $s_{L,VA}$, $s_{K,VA}$ are the shares of labor inputs and capital inputs, respectively, in value-added terms, defined as $s_{L,VA} = s_L/1 - s_M$ and $s_{K,VA} = s_K/(1 - s_M)$. Now, we have the following relationship between the markup ratio in output terms μ and the markup ratio in value-added terms μ_{VA}:

$$\mu_{VA} = \frac{\mu(1 - s_M)}{1 - \mu s_M}. \tag{A.6}$$

By running a regression on equation (A.4) or (A.5), it is possible to estimate the average markup ratio during the sample period. The variable markup ratio can be obtained from the estimated average markup ratio in the following way.

From equation (A.3), the rate $\hat{\mu}$ of the markup ratio from the period average is given by

$$\hat{\mu} = \frac{\hat{\lambda} - \lambda s_M \hat{s}_M}{1 + \lambda s_M} = \frac{1 - s_M}{1 + (\mu_{VA} - 1)s_M}\left(\hat{\lambda} - \frac{s_M}{1 - s_M}\mu_{VA}\hat{s}_M\right) \tag{A.7}$$

where $\hat{s}_M = \hat{p}_M - \hat{P} = (1 - s_M)(\hat{p}_M - \hat{\rho})$ and $\hat{\rho}$ is defined as $\rho \equiv (\hat{P} - s_M\hat{p}_M)/(1 - s_M)$.

In order to obtain $\hat{\lambda}$, let us specify the production function as $F(L, K) = L^{\alpha}K^{1-\alpha}$, so that we derive the relationships $s_{L,VA} = \alpha = 1 - s_{K,VA}$ and $\hat{\lambda} + \hat{w} - \hat{P} = s_{K,VA}(\hat{K} - \hat{L})$.

Finally, from equations (A.6) and (A.7), we have

$$\hat{\mu} = \frac{1 - s_M}{1 + (\mu_{VA} - 1)s_M}\{-\hat{s}_{L,VA} - (\mu_{VA} - 1)[s_{L,VA}\hat{L} + s_{K,VA}\hat{K} + s_M(\hat{p}_M - \hat{\rho})]\}. \tag{A.8}$$

By replacing μ_{VA}, $s_{L,VA}$, $s_{K,VA}$, s_M with the average values for the sample period, it is then possible to obtain the deviation rate of the markup ratio from the period average in output terms.

However, since the statistical reliability of markup ratios in value-added terms is extremely low compared with that of markup ratios in output terms inclusive of intermediate inputs when Japanese data are used for estimation, we have decided first to transform the markup ratio in output terms for each industry group, as estimated by Baba (1995) into the markup ratio in value-added terms, by using equation (A.6). We then derived the variable markup ratio from equation (A.8). We have eliminated those markup ratios, as estimated by Baba (1995), when they were not found to be statistically significant at 5 percent or when the data on the capital stock were not available for the period after 1972.

For reference purposes, the average markup ratios for each industry group are summarized in the following table (the figures in shaded cells are those used in this paper as the average markup ratios).[35]

Table for Appendix 1

Industry classification	Estimates using output data		Estimates using value-added data	
	Instrumental variable method	OLS	Instrumental variable method	OLS
Manufacturing	1.337 (15.811)***	1.283 (22.562)***	2.726 (2.600)***	2.319 (3.675)***
Foodstuffs	0.696 (4.176)***	0.734 (6.413)***	–1.046 (–1.167)	–0.299 (–0.624)
Textiles	0.849 (3.157)***	0.791 (4.550)***	–3.136 (–1.207)	0.250 (0.359)
Pulp and paper	1.450 (7.705)***	1.200 (13.610)***	–0.059 (–0.027)	0.997 (0.999)
General machinery	1.144 (10.900)***	1.206 (19.325)***	1.163 (1.132)	1.758 (2.854)***
Transportation equipment	1.105 (4.720)***	0.968 (8.110)***	3.905 (1.573)	1.538 (1.646)
Non-manufacturing	1.488 (10.052)***	1.461 (15.868)***	5.655 (1.980)*	1.669 (4.643)***
Agriculture, forestry, and fisheries	1.955 (3.131)***	1.096 (3.003)***	6.944 (2.196)*	4.057 (1.839)*
Mining	1.530 (3.211)***	1.101 (5.724)***	–0.375 (–0.146)	0.865 (0.696)
Construction	1.323 (9.986)***	1.332 (11.716)***	3.446 (3.550)***	2.425 (4.935)***
Electric power, gas, and water	0.914 (4.916)***	0.653 (5.813)***	1.924 (1.141)	2.856 (2.290)**
Wholesale and retail	1.214 (4.783)***	1.328 (6.425)***	1.446 (1.732)	0.936 (1.545)
Finance and insurance	3.273 (2.252)**	1.589 (2.686)***	4.981 (1.144)	0.674 (0.451)
Transportation and telecommunications	0.951 (3.406)***	1.160 (12.718)***	0.755 (1.211)	1.256 (7.509)***
Services	1.020 (6.953)***	0.878 (8.219)***	1.064 (1.450)	0.740 (1.621)

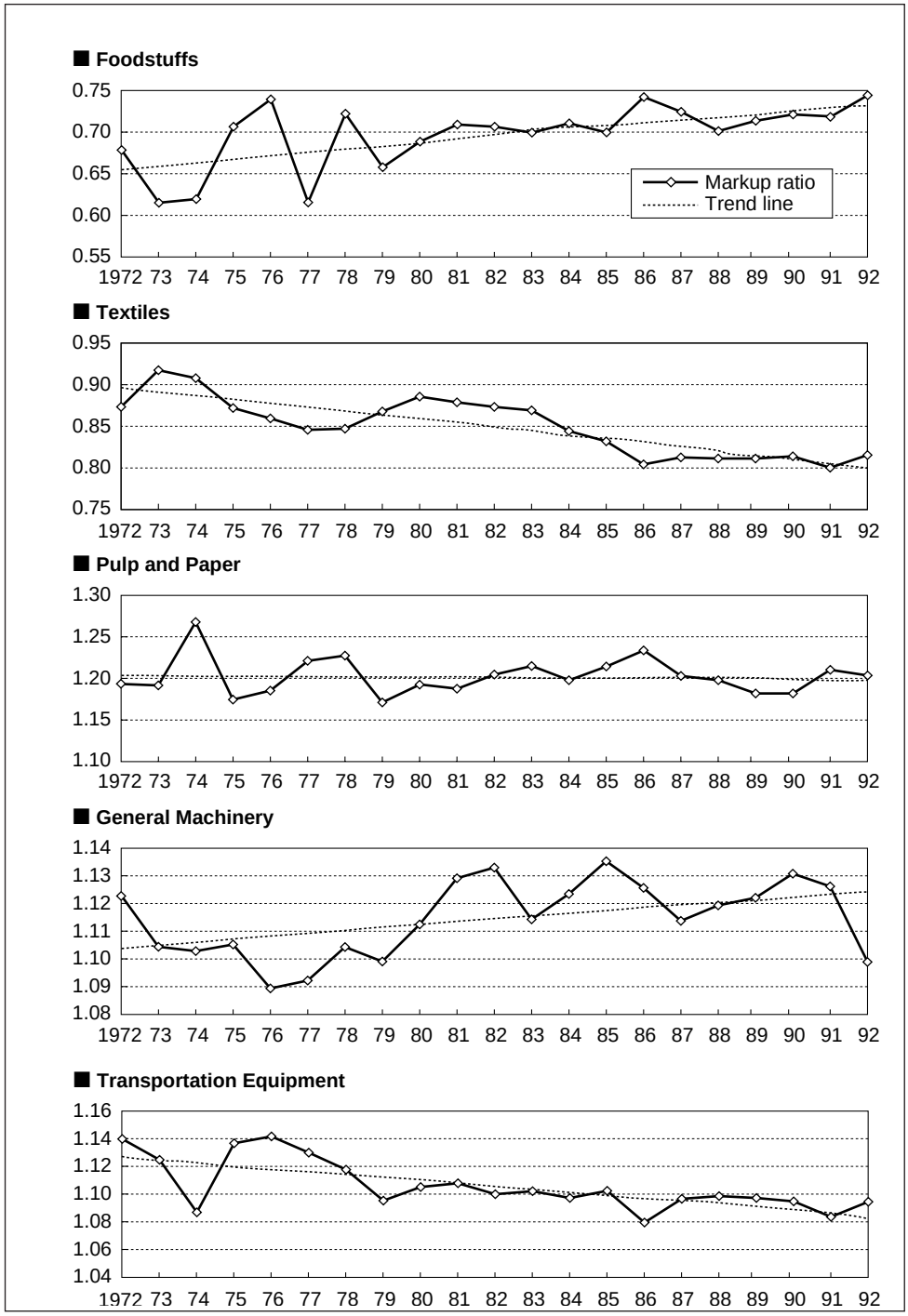
Note: Figures in parentheses are t-statistics. *, **, and *** indicate that the statistic is significant at the 10, 5, and 1 percent levels, respectively.
Source: Pertinent sections only taken from Baba (1995).

35. For the pulp and paper and the finance and insurance industries, when the estimates obtained from the instrumental variable method are transformed by using equation (A.6), the resulting figures become negative. For these industries, therefore, the method of ordinary least squares was used.

Appendix 2: Time-Series Movements of the Markup Ratio by Industry Group

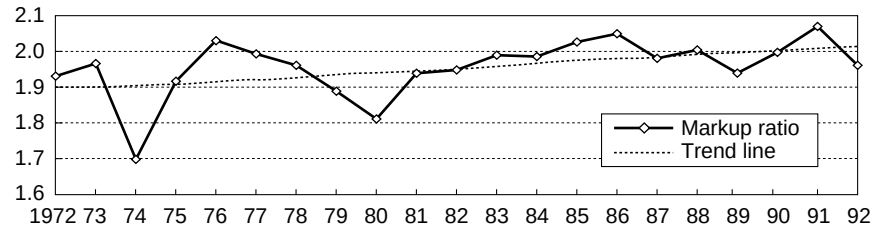
Figure for Appendix 2

[1] Manufacturing

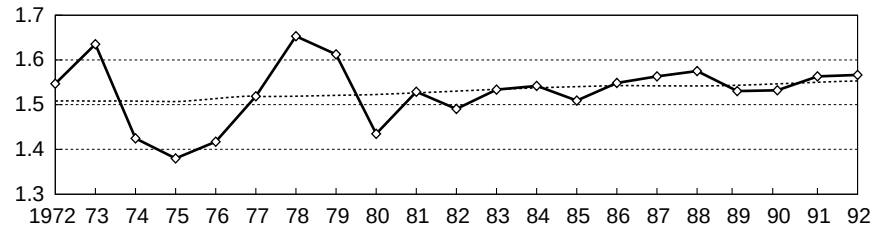


[2] Non-Manufacturing

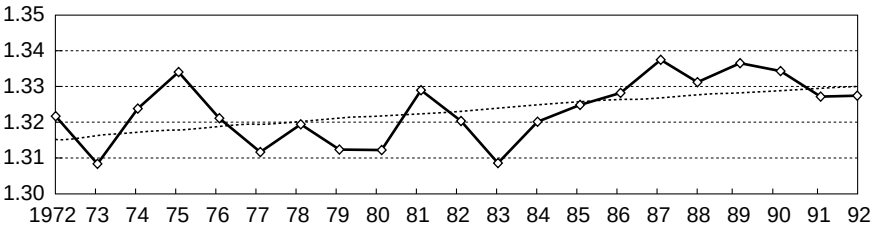
■ **Agriculture, Forestry, and Fisheries**



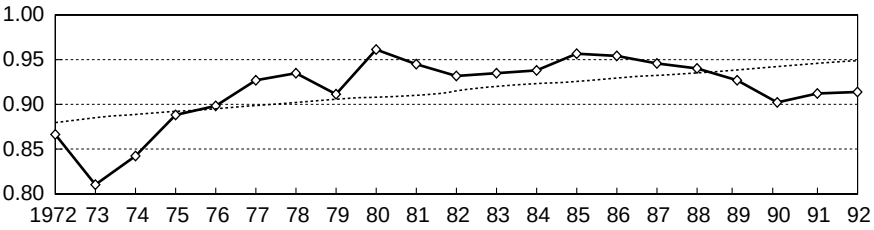
■ **Mining**



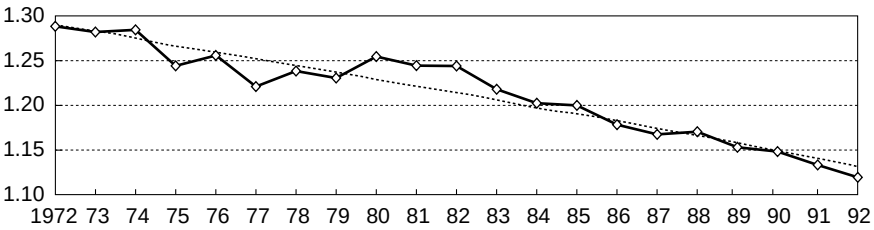
■ **Construction**

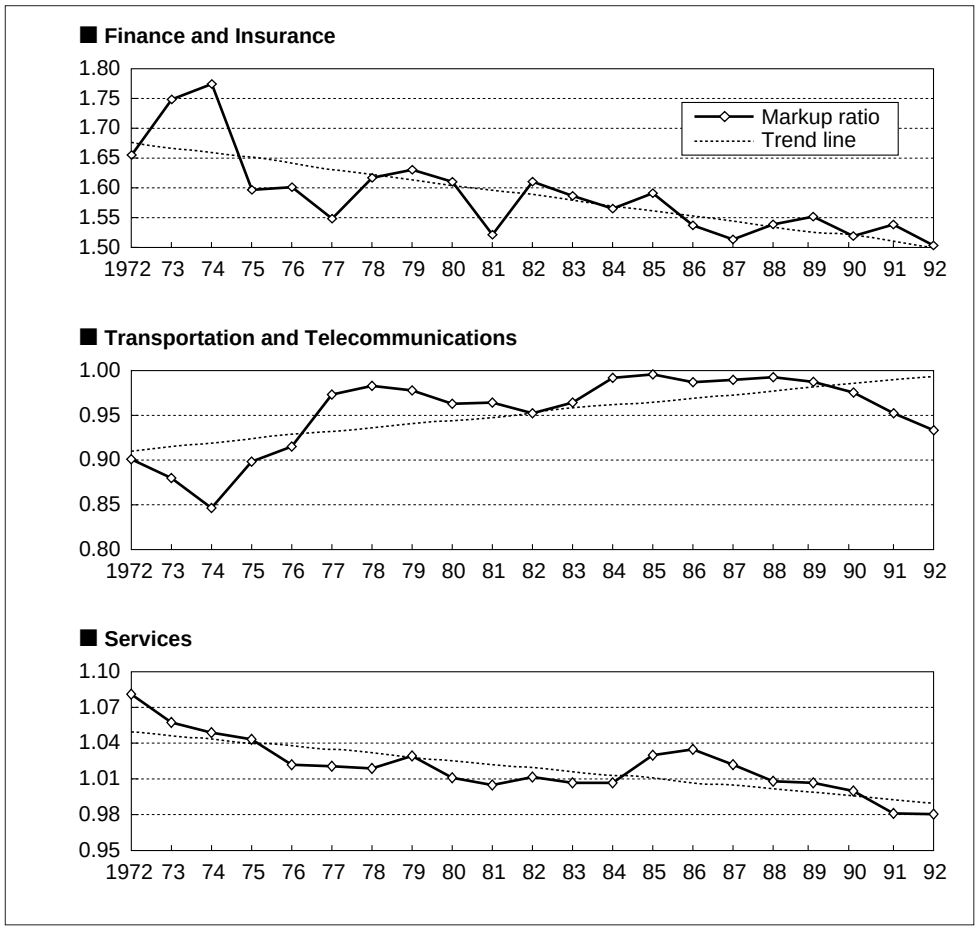


■ **Electric Power, Gas, and Water**



■ **Wholesale and Retail**




■ Finance and Insurance
1.80
1.75
1.70
1.65
1.60
1.55
1.50
Markup ratio
Trend line
1972 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92
■ Transportation and Telecommunications
1.00
0.95
0.90
0.85
0.80
1972 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92
■ Services
1.10
1.07
1.04
1.01
0.98
0.95
1972 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92

Appendix 3: Derivation of the System of Equations Used to Estimate Empirically the Price-Setting Behavior

First, we will derive the price-setting function when there is no menu cost under the framework of imperfect competition where the firm has price-setting power. Then, we will use a quadratic function to describe the cost of revising prices in order to derive the price-setting function when the firm explicitly considers the cost of revising prices.

A. Derivation of the Price-Setting Function When There Is a Menu Cost

Let us assume that each firm has the following Cobb-Douglas production function:

$$Q = \theta L^{\alpha} K^{\beta} M^{\gamma}. \tag{A.9}$$

By minimizing cost, we obtain the following demand functions for each factor of production:

$$L^D = \theta^{-\frac{1}{\rho}} w^{-\frac{\beta+\gamma}{\rho}} r^{\frac{\beta}{\rho}} p_M^{\frac{\gamma}{\rho}} Q^{\frac{1}{\rho}} A \tag{A.10}$$

$$K^D = \theta^{-\frac{1}{\rho}} w^{\frac{\alpha}{\rho}} r^{-\frac{\alpha+\gamma}{\rho}} p_M^{\frac{\gamma}{\rho}} Q^{\frac{1}{\rho}} B \tag{A.11}$$

$$M^D = \theta^{-\frac{1}{\rho}} w^{\frac{\alpha}{\rho}} r^{\frac{\beta}{\rho}} p_M^{-\frac{\alpha+\beta}{\rho}} Q^{\frac{1}{\rho}} C \tag{A.12}$$

where $\rho = \alpha + \beta + \gamma$ and A, B, C are constants. Hence, total cost TC is given by the following:[36]

$$TC = wL^D + rK^D + p_M M^D = \theta^{-\frac{1}{\rho}} (A + B + C) w^{\frac{\alpha}{\rho}} r^{\frac{\beta}{\rho}} p_M^{\frac{\gamma}{\rho}} Q^{\frac{1}{\rho}}. \tag{A.13}$$

Therefore, marginal cost MC is given by the following:

$$MC = \frac{\partial TC}{\partial Q} = \frac{1}{\rho} \theta^{-\frac{1}{\rho}} (A + B + C) w^{\frac{\alpha}{\rho}} r^{\frac{\beta}{\rho}} p_M^{\frac{\gamma}{\rho}} Q^{\frac{1}{\rho}-1}. \tag{A.14}$$

Concerning the demand for final goods, we assume that the firm faces a demand function with a constant price elasticity and that it sets the price by adding a markup over marginal cost. Given this assumption and from the marginal cost specified by equation (A.14), the firm's optimal price level P^* when there is no menu cost is given by

$$\ln P^* = \ln\left(\frac{\varepsilon}{\varepsilon - 1}\right) + \frac{\alpha}{\alpha+\beta+\gamma} \ln w + \frac{\beta}{\alpha+\beta+\gamma} \ln r + \frac{\gamma}{\alpha+\beta+\gamma} \ln p_M + \left(\frac{1}{\alpha+\beta+\gamma} - 1\right) \ln Q^* \tag{A.15}$$

36. Hereafter, we will simply refer to it as the cost function.

where ε is the constant price elasticity of demand, Q^* is the quantity demand when the price is at P^*, and $\varepsilon/(\varepsilon - 1)$ corresponds to the markup ratio (price/marginal cost).

Here, according to Rotemberg (1982), we assume that the firm maximizes the following objective function, when it faces the cost of revising prices:

$$\Pi(\ln P^*) - k(\ln P - \ln P^*)^2 - c(\ln P - \ln P_{-1})^2 \qquad \text{(A.16)}$$

where $\Pi(\ln P^*)$ is the logarithm of the profits obtainable under the price P^*, k is a parameter applicable to price revision, and $k(\ln P - \ln P^*)^2$ is the second-order term when $\Pi(\ln P^*)$ is approximated in the neighborhood of $\ln P^*$ by a Taylor-series expansion. Since, given the price level of P^*, the derivative of $\Pi(\ln P^*)$ with respect to price is zero, the first-order term is deleted. The maximization of equation (A.16) is equivalent to the minimization of the following loss function:

$$\Omega = (\ln P - \ln P^*)^2 + \frac{c}{k}(\ln P - \ln P_{-1})^2 \qquad \text{(A.17)}$$

where we impose the restriction that $k = 1$ for simplicity. The first-order condition for the minimization of equation (A.17) is given by

$$\frac{\partial \Omega}{\partial \ln P} = 2(\ln P - \ln P^*) + 2c(\ln P - \ln P_{-1}) = 0 \qquad \text{(A.18)}$$

which can be alternatively expressed as

$$\ln P = \frac{1}{1+c}(\ln P^* + c \ln P_{-1}). \qquad \text{(A.19)}$$

Thus, when there is a cost of revising prices, the firm determines the price in the current period $\ln P$ by the relationship obtained from equation (A.15) and equation (A.19).

B. The Specification Used in the Empirical Analysis of the Paper

Given the above theoretical framework, the estimation will be performed on the following system of structural equations.

[Demand function][37]

$$\ln Q = a_0 + \varepsilon \ln P + a_1 \ln Y + v_Q \qquad \text{(A.20)}$$

[Cost function]

$$\ln TC = b_0 + \frac{\alpha}{\alpha+\beta+\gamma}\ln w + \frac{\beta}{\alpha+\beta+\gamma}\ln r + \frac{\gamma}{\alpha+\beta+\gamma}\ln p_M + \frac{1}{\alpha+\beta+\gamma}\ln Q + v_{TC0} \qquad \text{(A.21)}$$

37. In the estimation, P is deflated by the output-weighted price deflator for all industries.

or

$$\ln TC = b_1 TIME + \frac{\alpha}{\alpha+\beta+\gamma}\ln w + \frac{\beta}{\alpha+\beta+\gamma}\ln r + \frac{\gamma}{\alpha+\beta+\gamma}\ln p_M + \frac{1}{\alpha+\beta+\gamma}\ln Q + v_{TC1} \quad \text{(A.22)}$$

[Price-setting function]

$$\ln P = \frac{1}{1+c}\left[\left(\ln\mu + \frac{1}{\alpha+\beta+\gamma}\ln\frac{TC}{Q}\right) + c\ln P_{-1}\right] + v_P \quad \text{(A.23)}$$

Here, μ is a constant that corresponds to the markup ratio in the model; and v_Q, v_{TC0}, v_{TC1}, v_P are random error terms for the respective equations. For the cost function, we have used two specifications, namely, that in which technical progress is assumed to be constant and thus is treated as a constant term in the equation, and that in which the reduction in cost associated with technical progress is treated as a trend.[38] In estimation, moreover, the actual quantity demanded Q is substituted for the unobservable Q^*.[39]

38. There is a possibility that energy-saving technical progress, which occurred after the oil shock, has not been captured.
39. In view of the cross-equation correlation among error terms, we have used the seemingly unrelated regression in estimation.

Appendix 4: A Theoretical Model of the Social Welfare Cost of Inflation

In this appendix, we will derive the methodology of estimating the social welfare cost of inflation under markup pricing, based on Goodfriend (1995). The theoretical framework is a real business cycle model in which the only factor of production is labor (with no capital).

First, it is assumed that a representative agent has the following utility function whose arguments are consumption C and leisure F:

$$\sum_{t=0}^{\infty}(1+\rho)^{-t}\left[(1-\phi)\ln C_t + \phi \ln F_t\right]. \tag{A.24}$$

Consumption depends on the real balance of money M/P and the time spent on search activities S, as follows:[40]

$$C_t = v\left(\frac{M}{P}\right)_t S_t. \tag{A.25}$$

On the other hand, the production function, in which the only output is non-storable consumer goods, is defined as follows:

$$C_t = X_t L_t^{\alpha} \tag{A.26}$$

where L is employment in time units, X is a technology parameter, and the restriction $0 < \alpha < 1$ holds. The time constraint for the representative economic agent is given by

$$1 = L_t + F_t + S_t. \tag{A.27}$$

The budget constraint in real terms is given by

$$\begin{aligned} &M_{t-1}/P_t + H_t/P_t + B_{t-1}/P_t + (W/P)_t L_t + X_t \hat{L}_t^{\alpha} - (W/P)_t \hat{L}_t - C_t \\ &= (M/P)_t + (B/P)_t/(1+R_t) \end{aligned} \tag{A.28}$$

where H is the fixed transfer payment, B is the balance of bonds held, and $\hat{L}$ is the average economy-wide labor inputs in time units. Given the constraints of equations (A.25), (A.27), and (A.28), the first-order conditions for utility maximization are given from equation (A.24) as

$$R_t\left(\frac{M}{P}\right)_t = \left(\frac{W}{P}\right)_t S \tag{A.29}$$

$$1 - L_t - S_t = \left[\phi/(1-\phi)\right]\left[C_t/\left(\frac{W}{P}\right)_t\right]\left[1 + \left(\frac{W}{P}\right)_t/k\left(\frac{M}{P}\right)_t\right]. \tag{A.30}$$

40. When conducting costly search activities under the conditions where the real wage rate cannot become infinite, economic agents must want to increase consumption in order to raise utility more than the cost of search activities. Given the assumption that bonds must be sold first and converted into money before they can be used for consumption, moreover, the specification of consumption does not depend on net financial assets (money and bonds) but only on money.

Equation (A.29) shows that the opportunity cost (lost interest) of holding an additional unit of money is equated with the opportunity cost (lost wage income) of spending an additional unit of time on search activities. On the other hand, equation (A.30) shows that the marginal utility of leisure is equated with the marginal utility of labor.

Here, we define the marginal markup ratio μ as follows:

$$\mu_t = P_t/(W_t/\alpha X_t L_t^{\alpha-1}). \tag{A.31}$$

From this, we know that, because of the presence of markup pricing, the real wage rate is below the marginal product of labor when price is above marginal cost.

Based on this system of equations, we find the following relationships:

$$S_t = 1 - \phi - \{\phi[(\mu_t/\alpha) - 1] + 1\}L_t \tag{A.32}$$

$$S_t^2 = (R_t/\alpha v)\mu_t L_t. \tag{A.33}$$

Finally, the equilibrium amount of employment L and the equilibrium amount of time required for search activities S can be expressed as follows:

$$L_t = L(\mu_t, R_t) \tag{A.34}$$

$$S_t = S(\mu_t, R_t) \tag{A.35}$$

where $L_1 < 0$, $L_2 < 0$ and $S_1 > 0$, $S_2 > 0$.

The demand for money in equilibrium is given from equations (A.25) and (A.29) as

$$\left(\frac{M}{P}\right)_t = C_t\sqrt{\alpha/v\,\mu_t L_t R_t}. \tag{A.36}$$

Under this model, the social welfare cost of inflation in a steady state is derived in the following manner. From equation (A.33), S is the time spent on search activities because the nominal rate of interest is positive. Then, in order to obtain the social welfare cost of inflation as a percent of real GDP, we have only to evaluate S in terms of the social opportunity cost of the time required for search activities (the marginal product of labor) and to compare it with the level of real GDP.

That is to say, under markup pricing, the social welfare cost of inflation can be obtained as follows:[41]

$$\phi = 100 \times (\alpha/N)\sqrt{R\mu L/\alpha v} \tag{A.37}$$

$$v = (\alpha/\mu L)/\left\{\left[\left(\frac{M}{P}\right)/C\right]^2\right\}. \tag{A.38}$$

41. If we set the markup ratio as equal to one in equation (A.37), we have the methodology of deriving the social welfare cost of inflation under perfect competition, as shown by Lucas (1993).

References

Akerlof, G., and J. Yellen, "Can Small Deviation from Rationality Make Significant Differences to Economic Equilibria?" *American Economic Review*, 75, 1985, pp. 708–721.

Ariga, K., T. Kaneko, K. Sakamoto, and N. Sano, "Sengo Nihon no Keiki Junkan (Business Cycles in Post-War Japan)," *Financial Review*, 22, Institute of Financial and Monetary Studies, Ministry of Finance, March 1992 (in Japanese).

———, Y. Ohkusa, and T. Nojima, "Nihon no Seizogyo ni Okeru Kakaku Keisei to Markup ni Kansuru Kenkyu (A Study of Price Formation and Markups in Japanese Manufacturing)," Institute of International Price Structure, March 1994 (in Japanese).

———, and ———, "Procyclical Markups in Japan," *Discussion Paper*, No. 405, Kyoto Institute of Economic Research, Kyoto University, 1994.

Baba, N., "On the Cause of Price Differentials between Domestic and Overseas Markets: Approach through Empirical Analyses of Markup Pricing," *Monetary and Economic Studies*, 13 (2), Institute for Monetary and Economic Studies, Bank of Japan, 1995, pp. 45–74.

Ball, L., and D. Romer, "Real Rigidities and the Nonneutrality of Money," *Review of Economic Studies*, 57, 1990, pp. 183–203.

Benabou, R., "Inflation and Markups—Theories and Evidence from the Retail Sector," *European Economic Review*, 36, 1992, pp. 566–574.

Blanchard, O., and N. Kiyotaki, "Monopolistic Competition and Effects of Aggregate Demand," *American Economic Review*, 77, 1987, pp. 647–666.

Cooper, R., and J. Andrew, "Coordinating Coordination Failures in Keynesian Models," *Quarterly Journal of Economics*, 103 (3), 1988, pp. 441–463.

Driffill, J., G. Mizon and D. Ulph, "Costs of Inflation," in B. M. Friedman and F. H. Hahn, eds. *Handbook of Monetary Economics*, Vol. II, Elsevier Science Publishers B.V., 1990.

Economic Report of the President, Washington, D.C.: United States Government Printing Office, 1990.

Fukuda, S., H. Teruyama, and H. Toda, "Inflation and Price-Wage Dispersions in Japan," *Journal of the Japanese and International Economies*, 5, 1991, pp. 160–188.

Goodfriend, M., "A Framework for the Analysis of Moderate Inflation," discussion paper presented to the March 1995 Swiss National Bank Conference on Rules versus Discretion in Monetary Policy.

Hall, R., "The Relation between Price and Marginal Cost in U.S. Industry," *Journal of Political Economy*, 96, 1988, pp. 921–947.

Haltiwanger, J., and J. Harrington, "The Impact of Cyclical Demand Movements on Collusive Behavior," *Rand Journal of Economics*, 22, 1991, pp. 89–106.

Haskel, J., C. Martin, and I. Small, "Price Marginal Cost and the Business Cycle," *Oxford Bulletin of Economics and Statistics*, 57 (1), 1995, pp. 25–41.

Kosai, Y., "Baburu no Hassei to Kin'yu Seisaku (Bubbles and Monetary Policy)," *Nihon Keizai Kenkyu Sentah Kaiho*, Japan Center for Economic Research, 769, 1992 (in Japanese).

Lucas, R. E., Jr., "On the Welfare Cost of Inflation," mimeo, University of Chicago, January 1993.

Nishimura, K., and A. Inoue, "Kodo Seichoki Igo no Nihon Seizogyo no Rodo Bunpairitsu (The Share of Labor in Japanese Manufacturing following the End of the High-Growth Period: Dual Structure and Imperfect Competition, Income and Wealth Distribution in Japan)," in T. Ishikawa, ed. *Nihon no Shotoku to Tomi no Bunpai* (Japanese Income and Distribution of Wealth), University of Tokyo Press, 1994 (in Japanese).

Okina, K., "Kin'yu Seisaku to Chuo Ginko (The Central Bank and Monetary Policy Objectives)," *Kin'yu Kenkyu* (Monetary and Economic Studies), 9 (3), Institute for Monetary and Economic Studies, Bank of Japan, 1995 (in Japanese).

Roberts, J., D. Stockton, and S. Struckmeyer, "Evidence on the Flexibility of Prices," *The Review of Economics and Statistics*, 76, 1994, pp. 142–150.

Rotemberg, J., "Sticky Prices in the United States," *Journal of Political Economy*, 90, 1982, pp. 1187–1211.

———, and G. Saloner, "Supergame-Theoretic Model of Price Wars during Booms," *American Economic Review*, 76, 1986, pp. 390–447.

Rothbard, M., *America's Great Depression*, Van Nostrand, 1963.

Silvastre, J., "The Market-Power Foundation of Macroeconomic Policy," *Journal of Economic Literature*, 31, 1993, p. 106.