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Financial Constraints and Firms' Pricing Decisions

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Abstract

This paper empirically examines the impact of financial constraints on Japanese firms' pricing behavior. In spite of a large swing in demand in the bubble era and the lost decade, aggregate prices did not fluctuate much in these periods. Such price rigidity can be explained by customer market theory, which suggests that firms invest in the customer stock, i.e., market share, by charging low prices in booms, while they do not cut their prices for locked-in customers in recessions. This theory implies that the pricing decision is an investment problem, and opens the possibility for financial factors to affect the pricing decision. The estimation results show that financial positions affect the pricing behavior of large firms, but not that of small firms. The impact of financial positions on large firms' prices is counter-cyclical, and this characteristic is clearly observed in the industries that produce differentiated goods such as advanced machines. In contrast, small firms whose product brand is not well established in the market cannot lock in customers, and hence financial constraints do not affect their pricing decisions.

JEL CLASSIFICATION: D4, E31, L11

KEYWORDS: customer market theory, price rigidity, financial constraints.

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1. Introduction

Since the latter half of the 1980s, Japan's economy experienced an extremely large swing against the backdrop of the emergence, expansion, and bursting of asset price bubbles. The average growth rate of real GDP was +3.5% during the period of the prebubble economy (1983:Q1-1986:Q4), +5.2% during the period of the bubble economy (1987:Q1-1991:Q1), and +1.2% during the lost decade (1991:Q2-2000:Q1). In spite of such large fluctuations in the real economy, however, general prices were fairly stable. The average annual rate of CPI inflation (adjusted for a change in the consumption tax rate) was +1.6% during the period of the prebubble economy, +1.4% during the period of the bubble economy, and +0.8% during the lost decade. The average rate of CGPI inflation also seems to have been stable, although it had been negative because of technological progress. The inflation rate of final goods (domestic products for domestic demand) was -0.2% during the pre-bubble era, -0.7% during the bubble era, and -1.0% during the lost decade. Interestingly, deflation stayed at moderate levels even at the bottom of the recessions. This relative unresponsiveness of prices to cyclical fluctuations remains a puzzle.

The purpose of this paper is to attempt to solve this puzzle and provide empirical evidence. Although several theories such as collusive oligopoly models may provide useful insight into this puzzle,[1] we focus on customer market theory. This is because the degree of financial constraints that Japanese firms faced in the last two decades fluctuated significantly, and customer market models combined with financial constraints leads to price rigidity.

In a customer market, each firm has a stock of customers and, because of the cost of switching to a different supplier and/or imperfect information (in the sense that customers compare prices only occasionally), they do not immediately switch to

[1] Rotemberg and Saloner (1986) and Rotemberg and Woodford (1991, 1992) claim that markups are countercyclical because it is harder for oligopolistic firms to sustain collusive prices during booms. When current demand is high relative to future demand, the incentive for any firm to cut its price rises because it becomes more valuable to capture current sales than to maintain collusion in the future.

See Phelps and Winter (1970) and Okun (1981) for customer market theory.

the firm with the lowest price, but tend to purchase from the same firm repeatedly.[2] Therefore, the firm faces inelastic demand for its products at least in the short run, and it trades off the benefits of charging a low price to attract first-time buyers against the gains of charging a high price to locked-in customers who remain loyal. The basic prediction of the customer market models is that firms charge prices below the single-period profit-maximizing level in order to build a base of locked-in customers; they invest in the customer stock (market share), which affects future profits, by keeping prices down. That is, the pricing decision is an investment problem, which opens the possibility for financial factors to affect pricing decisions.[3] Gottfries (1991) and Chevalier and Scharfstein (1996) showed that if firms in a customer market are financially constrained, markups may be counter-cyclical. In a recession, financially constrained firms abstain from price cuts in order to maintain cash flows and pay their debts, while in booms liquidity-abundant firms invest in valuable market share by keeping prices down. Empirical evidence supporting this hypothesis is reported by Bhaskar et al. (1993), Chevalier and Scharfstein (1996), Gottfries (2002) and Asplund et al. (2005).

In this paper, we empirically examine the impact of financial constraints on Japanese firms' pricing behavior. Our empirical approach is different from the previous literature in several ways. First, the coverage of our analysis is the manufacturing sector, and wider than that of the previous literature that focus on specific firms' pricing behavior.[4] We investigate the effects of the financial constraints on aggregate price changes, and show how pervasive those effects are on prices from the macroeconomic perspective, which the previous literature has not shown.

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[2] See Klemperer (1987,1995) for switching cost models, and Gottfries (1991) for an imperfect information model.

[3] By using customer market theory combined with financial constraints, Lundin et al. (2005) develop a dynamic model of a firm that takes into account the interaction between price and investment decisions.

[4] Chevalier and Scharfstein (1996) examine the pricing behavior of supermarket chains in the US, and Asplund et al. (2005) examine the prices of newspapers in Sweden. Borenstein and Rose (1995) analyze pricing behavior in the US airline markets.

Second, we analyze the effects of financial positions on pricing behavior not only for the manufacturing sector but also for each industry in the sector. The structure and competitiveness of the markets may differ across industries, and customer market theory can be applied only to markets in which customers respond slowly to price changes. This condition is likely to hold in the differentiated goods market, such as the machinery industry, in which a change of supplier is likely to be more costly for customers and price comparisons are more difficult. However, it is not the case in standardized goods markets, such as raw materials, in which a change of supplier is likely to be less costly and price comparisons are easier. Obviously, firms in perfectly competitive markets, where goods are standardized, cannot increase profits in the short run by raising prices, while financial constraints make markups more countercyclical (or less procyclical) in imperfectly competitive markets where goods are differentiated. Therefore, it is very interesting to analyze cross-industry differences, on which the previous literature has not yet focused.

Third, we also analyze the effects of financial positions on pricing behavior by firm size. Customer market theory may be applied only to large firms, because they provide the differentiated products (and brand) in the market, and hence can lock in customers. In contrast, it is difficult for small firms, whose brand is not well established in the market, to lock in customers. In addition, business transactions in Japanese manufacturing are distinguished by a subcontracting structure, and large firms account for a relatively high percentage of customers for small firms. For example, small firms in a *keiretsu* do not have strong negotiating powers for large firms and will not raise their prices, even when they are financially constrained, in order to keep long-term business relations with large firms, such as ensuring a stable flow of work.[5] Therefore, we hypothesize that financial constraints do not affect small firms' pricing decision, and we examine whether this hypothesis is correct. This point has not yet been investigated by the previous literature.

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[5] A *keiretsu* pattern of subcontracting within corporate groups with large firms at their core is particularly apparent in the contracting out of manufacturing activities. These keiretsu relations developed between large firms and small firms.

Fourth, by using *Tankan* (i.e., Short-term Economic Survey of Enterprises in Japan), we use direct information on the degree of financial constraints that firms perceives, while the previous literature use proxies for financial constraints, such as net borrowing and cash flow.[6] Net borrowing may not be a good proxy for financial constraints, because high borrowing does not make the constraints tight when the lending attitude of banks is accommodative. Similarly, low cash flows do not mean that financial constraints are tight for firms who have access to capital markets. In contrast, *Tankan* provides useful information on firms' qualitative judgment of the general cash position, taking into account the level of cash and cash equivalent, lending attitude of financial institutions, and payment and repayment terms. Such firms' judgments of financial position matter more for their pricing decision than proxies such as debts and cash flows do.

Our empirical analyses suggest that financial positions affect the pricing behavior of large firms, but not that of small firms. The impact of financial positions on large firms' prices is counter-cyclical, and this characteristic is clearly observed in the industries that produce differentiated goods such as advanced machines. Although customer market theory is not applied to all the industries in the manufacturing sector, we find that the financial constraints of large firms make aggregate prices rigid. An increase of 1 percent in the percentage share of firms whose financial position is tight, ceteris paribus, leads to an increase in CGPI inflation by about 0.1 percent.

The paper proceeds as follows. Section 2 presents the empirical methodology and data set. Section 3 presents the estimation results, and Section 4 shows the impact of financial constraints on aggregate prices. Section 5 offers conclusions.

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[6] For example, Gottfries (2002) uses net borrowing relative to equity, and Bhaskar et al. (1993) use cash flow as a proxy of financial constraints. Chevalier and Scharfstein (1996), who analyze the pricing behavior of supermarkets in the US in economic downturns, use more indirect information on financial constraints. The sharp fall in oil prices in 1986 had a negative effect on the economy in the oil producing states. They show that in these states, prices increased more in cities where regional supermarkets were dominating. Their analysis is based on the assumption that the national chains, with operations also in areas that were unaffected by the oil price fall, had less binding liquidity constraints than regional chains.

2. Empirical Approach and Data

To examine the effects of financial constraints on firms' pricing decision, we adopt two empirical approaches; single equation approach and VAR approach.

2.1. Specification

The single equation approach is very simple, and firms are assumed to decide their prices taking into account cost factors and demand factors as well as their financial position (i.e., degree of financial constraints).[7] The price equation to be estimated is:

$$OP_t = \alpha_{OP} OP_{t-1} + \alpha_{IP} IP_t + \alpha_{\Delta IP} \Delta IP_t + \alpha_{SD} SD_t + \alpha_{\Delta SD} \Delta SD_t + \alpha_{FP} FP_{t-1} + c + \varepsilon_t \,, \qquad (1)$$

where OP_t is output price changes, IP_t is input price changes, SD_t is supply and demand conditions, and FP_t is firms' financial positions. The parameter c is a constant term, and ε_t is an error term. With regard to cost and demand factors, equation 1 includes both level effects (IP_t and SD_t) and speed limit effects (ΔIP_t and ΔSD_t). To examine the impact of financial positions on output price changes and avoid the simultaneity problem between output price and financial position,[8] we use lagged financial position (FP_{t-1}).

Excess demand ($SD_t > 0$) and a rise in input price inflation ($IP_t > 0$) leads to a rise in output price inflation, and hence the expected signs of the parameters are $\alpha_{SD} > 0$ and $\alpha_{IP} > 0$. The speed limit effects of excess demand and input price changes also lead to a rise in output price changes, and hence $\alpha_{\Delta SD} > 0$ and $\alpha_{\Delta IP} > 0$. Customer market theory suggests that an easy financial position ($FP_{t-1} > 0$) restrains output prices from rising, and a tight financial constraint ($FP_{t-1} < 0$) restrains output prices from falling. Therefore, the expected sign of α_{FP} is negative, i.e., $\alpha_{FP} < 0$.

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[7] See Gottfries (2002) and Lundin et al. (2005) for a similar approach.

[8] While liquidity may affect prices—the link explored in the customer market model—, prices almost certainly affect liquidity via changes in profits.

In addition to the single equation approach, we also estimate an impulse response function by using a VAR model in order to investigate the dynamic response of prices to a financial position shock. The VAR is identified by using the Choleski decomposition, with the order being IP_t, SD_t, OP_t and FP_t. By placing OP_t prior to FP_t in the ordering, we assume that output price has a contemporaneous effect on financial position while financial position affects output price with a lag.

2.2. Tankan and Diffusion Index

We estimate equation 1 not only for the manufacturing sector but also for each industry in the sector, and also estimate that equation by firm size. Thus, the availability of data on OP_t, IP_t, SD_t and FP_t by industry and firm size is essential. Although using quantitative indices for these variables is desirable, appropriate indices are not available. In our analysis, instead of quantitative indices, we use the qualitative indices of *Tankan*, because it provides a unique data set by industry and firm size.

Tankan is the abbreviation of "Tanki Keizai Kansoku Chousa (in Japanese)," which means "Short-term Economic Survey of Enterprises in Japan." It is a nationwide business survey conducted on a quarterly basis (in March, June, September, and December) by the Bank of Japan. In Tankan, the manufacturing sector is classified into 15 industries, according to the "Japan Standard Industrial Classification." Responding firms are asked to choose one alternative among three as the best descriptor of the prevailing change from three months earlier, or the prevailing conditions, excluding seasonal factors at the time of the survey. In our analysis, the following four items are used.

- Change in output prices: judgment of the direction of change in the selling prices of major products (including yen-based prices for exports) provided by the responding firm.
  [1) Rise. 2) Unchanged. 3) Fall.]

- Change in input prices: judgment of the direction of change in the purchasing prices of main raw materials, processing fees for subcontractors, and/or the prices of main purchasing merchandise paid by the responding firm.
  [1) Rise. 2) Unchanged. 3) Fall.]

- Supply and demand conditions for products and services: judgment of the supply and demand conditions for major products and services in the industry of the responding firm.
  [1) Excess demand. 2) Almost balanced. 3) Excess supply.]

- Financial position: judgment of the general cash position of the responding firm, taking into account the level of cash and cash equivalent, lending attitude of financial institutions, and payment and repayment terms.
  [1) Easy. 2) Not so tight. 3) Tight.]

In the judgment survey of Tankan, answers from the responding firms are aggregated into the diffusion index (DI) as shown below:[9]

$$\text{DI (\% points)} = \begin{pmatrix} \text{percentage share of firms} \\ \text{responding Choice 1} \end{pmatrix} - \begin{pmatrix} \text{percentage share of firms} \\ \text{responding Choice 3} \end{pmatrix}$$

For instance, with respect to the financial position of large manufacturing firms in the December 2003 survey, 21 percent replied "1. Easy," 73 percent replied "2. Not so tight," and 6 percent replied "3. Tight." As a result, the DI of financial positions is calculated as "21 % - 6% = 15% points."

For OP_t, IP_t, SD_t and FP_t in equation 1, we use the DI of the change in output prices, change in input prices, supply and demand conditions for products, and financial position, respectively.[10]

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[9] In calculating the DI, firms are not weighted according to their sizes. This means that we adopt the simple average of the so-called "1 vote per firm."

[10] Here, we must note that the diffusion index is not the only measure to quantify survey data. To check the robustness of our results, we also use the probability approach by applying the Carlson-Parkin (1975) method, instead of the diffusion index. Firms are assumed to respond with choice 2 if their conditions lie between an upper threshold δ and a lower threshold $-\delta$, and choice 1 or 3 otherwise. Suppose that the firms' prevailing conditions at any t are normally distributed, and

In Tankan, firms are classified by size into “large,” “medium” and “small” according to their number of employees. The number of employees in large firms is 1000 or more, that in medium-sized firms is 300-999, and that in small firms is 50-299. The population of Tankan is private firms employing 50 or more persons that are listed in the “Establishment and Firm Census of Japan” released by the Ministry of Public Management, Home Affairs, Posts and Telecommunications. Sample firms are selected from the population by industry and size classification. The sample size of large firms is around 800, that of medium-sized firms is around 1000, and that of small firms is around 2000.[11]

The sample period of our analysis is from 1976Q1 to 2003Q4.[12] We set the beginning of the sample period at 1976Q1 to avoid the high inflation period of the first-round increases in oil prices, because the expectation formation process of firms may have changed after the transition to a moderate or low inflation period.[13] The end of the sample period is set at 2003Q4, because the size classification was

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the threshold δ is fixed across time. Then, the mean of the distribution, μ_t, can be calculated as follows:

$$\mu_t = -\delta \frac{F^{-1}(1-S_t^1) + F^{-1}(S_t^3)}{F^{-1}(1-S_t^1) - F^{-1}(S_t^3)},$$

where F is the cumulative density function, S_t^1 is the percentage share of firms responding with choice 1, and S_t^3 is the percentage share of firms responding with choice 3. For OP_t, IP_t, SD_t and FP_t in equation 1, we can use the mean μ_t instead of DIs. Without loss of generality, we can assume that δ is unity in the estimation. Although we omit the estimation results because of limited space, we confirm that using this alternative measures does not change our main results in Section 3.

[11] In principle, sample firms are fixed. However, statistical accuracy may decline because of the decrease in the number of sample firms caused by bankruptcies, mergers and spin-offs, etc. Therefore, in Tankan, statistical examination is conducted annually, and when the statistical accuracy actually declines, new sample firms are added.

[12] All the DIs for the manufacturing sector are available for our sample period, but some DIs for the non-manufacturing sector are not. For example, the DI of supply and demand conditions for the non-manufacturing sector is not available for the 1980s. Therefore, we focus on the pricing behavior of the manufacturing sector.

[13] It may be interesting to split our sample into two periods: one is the moderate inflation period (1976Q1-1990Q4), and the other is the low inflation period or prolonged deflation period (1991Q1-2003Q4). Splitting our sample period does not change our main results in Section 3.

switched from the basis of a number of regular employees to a capital basis in the March 2004 survey and there is a discontinuity in the DIs because of this revision.

2.3. Comparison of Diffusion Index and Quantitative Index

Because appropriate quantitative indices are not necessarily available by firm size and industry level, we use the diffusion indices of Tankan. Given the distribution of the firms experiencing changes in output prices and financial positions, etc., the DIs are expected to be positively correlated with the mean of the distribution, i.e., aggregated quantitative indices, under some assumptions.[14] We can confirm this by using several available quantitative indices.

First, the DI of changes in output prices is expected to be positively correlated with CGPI inflation. As shown in Table 1, the regression of the DI of change in output prices by firm size on CGPI inflation suggests that the DI of large firms is the most highly correlated with CGPI inflation. This is a natural result because the market share of large firms' products is much higher than that of small firms.[15] Then, we focus the regression of large firms' DI of change in output prices on CGPI inflation. Note that CGPI is the domestic price of products. Because the DI of the change in output prices may reflect the change in yen-based prices for exports, we add the change in the exchange rate as the independent variable in the regression.[16] The estimation result in Table 2 shows the high coefficient of determination (0.83), which indicates that they are closely correlated.[17] The result also suggests that the effect of the change in the exchange rate on the DI is statistically significant, but

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[14] See, e.g., Trebing (1998, Appendix) for details.

[15] According to *Tankan*, large firms account for 61.2 percent of the total sales of the manufacturing sector, followed by small firms with 20.7 percent, and medium-sized firms with 18.1 percent.

[16] While the export price based on foreign currency contracts is pre-determined and does not respond to the exchange rate immediately, the yen-equivalent export price responds to it immediately. (Yen-equivalent export price = exchange rate × export price based on foreign currency contracts.)

[17] We also examined the correlation between the DI of changes in output prices and CGPI inflation at the industry level. Relatively high coefficients of determination are obtained in many industries. (The estimation results are omitted, but available at the reader's request.)

very limited, because the improvement of the coefficient of determination is very marginal, and the standard error declines very little. This implies that the DI of the change in output prices mainly reflects the prices of domestic products rather than exports.

Second, the DI of financial position is correlated with several financial variables. Table 2 shows the results of the regression of large firms' DI of financial position. The regression of the DI of financial position on the ratio of current profits to sales, i.e., a proxy of cash flow, indicates that the coefficient of determination is relatively low and standard error is relatively high. This is quite natural, because the DI of financial position is the judgment of the general cash position of the responding firm, taking into account not only the level of cash and cash equivalent but also the lending attitude of financial I nstitutions and payment and repayment terms, as noted in Section 2.2. Including thecall rate (operating target of monetary policy) and proxies of the external finance premium (spread between firms' borrowing rate and government bond rate, leverage ratio) as independent variables in the regression leads to the relatively high coefficient of determination and the relatively low standard error.[18] This result indicates that banks' lending affects large firms' financial position, although large firms have access to capital markets and the degree of dependence on banks' lending is lower in large firms than in small firms. Gertler and Gilchrist (1994) and Chevalier and Scharfstein (1995) use firm size as a proxy for the extent to which firms are financially constrained because small firms are less likely to have access to external capital. However, such an idea is not appropriate, because even the financial positions of large firms are affected significantly by banks' lending attitudes, and their DIs of their financial positions fluctuate with the business cycle, as shown in Figure 1.

Third, the regression of the DI of change in input prices on the import price of petroleum, coal and natural gas or the wholesale price of raw materials indicates that they are positively correlated; however, the coefficient of determination seems to be

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[18] Under asymmetric information between firms and banks, the size of the external finance premium is expected to be positively correlated with the leverage ratio.

relatively low. This is because the DI of change in input prices is the judgment of the direction of change in not only the purchase prices of the main raw materials but also the processing fees for subcontractors and/or the prices of the main merchandise purchased by the responding firm.

Finally, we find that the DI of supply and demand conditions is closely correlated with the operating ratio (capacity utilization rate) of the manufacturing sector.

3. Results

3.1. Estimation Results by Firm Size: Single Equation and VAR Approaches

Table 3 shows the single equation estimation results by firm size. All the estimated parameters have the expected sign. With regard to the level effect and the speed limit effect of supply and demand conditions and input prices, all the estimated parameters are statistically significant for each firm size. The parameter of particular interest is α_{FP}, which measures the degree of the impact of financial positions on firms' pricing behavior.[19] The estimation results indicate that the significance of the parameter α_{FP} differs across firm sizes, and that our hypothesis is correct. As the theory suggests, the sign of the parameters is negative for all firm sizes. However, the smaller the firm size, the smaller the absolute value of the estimated parameter α_{FP}, and the larger the standard error. Indeed, the parameter α_{FP} is statistically significant only for large firms, but not for medium-sized firms and small firms.

Next, we estimate VAR model by firm size in order to investigate the dynamic response of prices to a financial position shock. The specific VAR that we consider contains four endogenous variables: OP_t, IP_t, SD_t and FP_t. We include four lags

[19] As an alternative variable of financial constraints, the percentage share of firms responding "Tight" may be more appropriate than the DI of financial position. [DI of financial position= % of firms responding "Easy" - % of firms responding "Tight".] In order to check the robustness of our results, we estimated equation 1 by using the percentage share of firms responding "Tight" instead of the DI of financial position, FP_t. However, the main results do not change. This is because the percentage share of firms responding "Tight" is strongly and positively correlated with the DI of financial position, FP_t. See Figure 1.

in the VAR according to AIC. Table 4 reports the results of lag exclusion tests. For large firms (and medium-sized firms), financial positions are significant predictors of changes in output prices. In contrast, for small firms, the financial position has no marginal predictive power for output prices, and the sum of the coefficients on financial position does not differ significantly from zero. Figure 2-4 displays impulse response functions based on the estimated VAR. Irrespective of firm size, output prices (OP_t) respond positively to an innovation in both input prices (IP_t) and supply-demand conditions (SD_t). These responses are statistically significant for all firm sizes. However, the impulse responses of output prices (OP_t) to an innovation in financial position (FP_t) differ according to firm size. For large firms, the changes in output prices become statistically negative at the third quarter after the easy financial position shock. In contrast, for small and medium-sized firms, output prices do not respond to financial position shock.

Both the single equation approach and VAR approach suggest that financial position affects only the pricing behavior of large firms, but not that of small firms. Customer market theory suggests that financially constrained firms abstain from price cuts in a recession in order to maintain cash flows and pay their debts, while in booms liquidity-abundant firms invest in valuable market share by keeping prices down in order to build a base of locked-in customers. Our analysis indicates that large firms behave in such a manner.

We must note that our results are in marked contrast to those of Chevalier and Scharfstein (1995) and Bhaskar et al. (1993). Using US data, Chevalier and Scharfstein (1995) find that financially-constrained firms raise markups during economic downturns in order to harvest locked-in demand, and that markups are more countercyclical in industries dominated by small firms that are more financially-constrained than large firms. Using UK data, Bhaskar et al. (1993) also show that credit-constrained small firms are more likely to pursue less-cyclical pricing policies. However, in Japan, small firms are unlikely to behave in such a manner. Indeed, as shown in Figure 5, a survey conducted by the Small Business Institute indicates that financially-constrained small firms rarely try to raise their prices. Unlike large firms that produce differentiated goods, it is difficult for small

firms to lock-in customers partly because their product brand is not well established in the market. In addition, many small firms are subcontractors of large firms, and they are likely to be requested to cut their prices by large firms in recessions. Because small firms do not have strong negotiating powers for large firms, they cannot raise their prices even when they are financially constrained. Instead of raising prices, as many previous studies suggest, financially-constrained small firms are more likely to reduce wages, labor and fixed investment in recessions than large firms.[20]

3.2. Estimation Results by Industry Level

We now turn to the estimation results by industry. Because, as indicated in Table 3, the parameter α_{FP} is statistically significant only for large firms, we focus on them. Using ordinary least squares, we estimate equation 1 for 15 industries in the manufacturing sector.[21] As shown in Table 5, most of the estimated parameters have the expected sign for each industry. The estimated parameter α_{FP} is negative in 13 of the 15 industries. What is interesting is that the statistical significance of the parameter α_{FP} differs across industries. A statistically significant effect of financial constraints on prices is found in eight industries, but not in others.

What causes the difference in statistical significance among industries? Although we need rigorous analysis to identify the cause, the degree of the differentiation of goods may lead to the cross-industry difference in the estimation results for the parameter α_{FP}. While products of machinery industry such as electrical machinery, transportation machinery and precision machinery are

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[20] Many previous studies suggest that, in Japan, the adjustment speed of wages and labor in small firms is faster than in large firms. They also suggest that changes in cash flow have a significant effect on the fixed investment of small firms rather than that of large firms, because small firms are likely to be liquidity constrained. See, for example, Hanasaki and Tran (2002), Shinotsuka (1979), Muramatsu (1995), Ohtake (1988), Small and Medium Enterprise Agency (1999).

[21] We also estimate the equation by using SUR (seemingly unrelated regression). If the disturbances for a given industry are correlated across the equations, there is an efficiency gain from using SUR rather than OLS separately for each equation. Although we omit the estimation results because of limited space, we confirm that the alternative estimation methodology does not change our main results.

differentiated, those of petroleum & coal products, nonferrous metals, and chemicals are relatively simple and homogenous across firms. The parameter α_{FP} is negative and statistically significant in the former industries, but not in the latter industries.

As Gottfries (1991) suggests, customer markets theory can be applied only to the industries that produce differentiated goods. In those industries, customers respond slowly to price changes, because price comparisons are more difficult and a change of supplier is costly. In the industries whose products are relatively simple, however, a change of supplier is likely to be less costly and customer response is likely to be faster, because price comparisons are easier. For example, it should be easier to compare prices for a standard quality of gasoline than to compare prices and qualities of advanced machinery. This may explain why a statistically significant negative effect of financial constraints on prices is only found in industries that produce differentiated goods.

The above interpretation is supported by Figure 6, which shows a negative cross-industry correlation between the parameter α_{FP} and the parameter α_{SD}. In the industries whose parameter α_{SD} is larger, the impacts of financial constraints on output prices are larger and more significant. The parameter α_{SD} reflects the degree of competitiveness of the market. As the market becomes less competitive because of the higher degree of differentiation of goods, the pricing power of firms becomes strong, and hence firms can shift the change in the marginal costs caused by the fluctuations in excess demand onto output prices. Therefore, the less competitive the market because of the higher degree of differentiation of goods, the larger the parameter α_{SD}. Customer market theory suggests that firms who have pricing powers because of the imperfect competitiveness of the market can compete more intensely for customers and try to expand market shares by charging low prices, while they raise output prices for the locked-in customers when they face financial constraints. This leads to the negative cross-industry correlation between α_{FP} and α_{SD}.

4. Impact of Financial Constraints on Aggregate Prices

Although customer market theory is not applied to all the industries in the manufacturing sector, we find that financial constraints affect large firms' pricing behavior in eight industries, including machinery industries whose sales share in the manufacturing sector is very large. In the following, from the macroeconomic perspective, we show the impact of the financial constraints of large firms on aggregate prices.

According to equation 1, the cumulative effect of financial positions on large firms' DI of changes in output prices is $\alpha_{FP}/(1-\alpha_{OP})$, which is calculated to be -0.37 using the estimation results of Table 3. The increase in the share of firms whose financial position is tight by 1 percent, ceteris paribus, leads to an increase in the share of firms that raise output prices by 0.37 percent in the long run.

Now, we convert the above effect on the DI into the effect on CGPI inflation, using the estimation results of Table 1. The linear regression of CGPI inflation on the DI of changes in output prices indicates that the slope of the regression line is 0.27; that is, a change in DI by 1 percent leads to a change in CGPI inflation by 0.27 percent. Then, the cumulative effect of financial positions on CGPI is $0.27 \times \alpha_{FP}/(1-\alpha_{OP})$, which is calculated to be -0.10. Put differently, the increase in the percentage share of large firms whose financial position is tight by 1 percent, ceteris paribus, leads to an increase in CGPI inflation by 0.1 percent in the long run.

Next, we decompose the CGPI inflation into three factors: the cumulative effect of input prices, that of supply and demand conditions, and that of financial positions. To do this, we rearrange equation 1 as follows:

$$\begin{aligned} OP_t &= \alpha_{OP} OP_{t-1} + \alpha_{IP} IP_t + \alpha_{\Delta IP} \Delta IP_t + \alpha_{SD} SD_t + \alpha_{\Delta SD} \Delta SD_t + \alpha_{FP} FP_{t-1} + c + \varepsilon_t \\ &= \lim_{n\to\infty} \sum_{j=0}^{n} (\alpha_{OP})^j (\alpha_{IP} IP_{t-j} + \alpha_{\Delta IP} \Delta IP_{t-j} + \alpha_{SD} SD_{t-j} + \alpha_{\Delta SD} \Delta SD_{t-j} + \alpha_{FP} FP_{t-j} + c + \varepsilon_{t-j}). \end{aligned} \tag{2}$$

By multiplying equation 2 by the conversion parameter 0.27, we obtain the following three cumulative effects on CGPI inflation.

$$\begin{pmatrix}\text{Cummulative effect of}\\ \text{change in input prices}\\ \text{on CGPI inflation}\end{pmatrix} = \lim_{n\to\infty} 0.27\sum_{j=0}^{n}(\alpha_{OP})^{j}(\alpha_{IP}IP_{t-j} + \alpha_{\Delta IP}\Delta IP_{t-j})$$

$$\begin{pmatrix}\text{Cummulative effect of}\\ \text{supply and demand conditions}\\ \text{on CGPI inflation}\end{pmatrix} = \lim_{n\to\infty} 0.27\sum_{j=0}^{n}(\alpha_{OP})^{j}(\alpha_{SD}SD_{t-j} + \alpha_{\Delta SD}\Delta SD_{t-j})$$

$$\begin{pmatrix}\text{Cummulative effect of}\\ \text{financial position}\\ \text{on CGPI inflation}\end{pmatrix} = \lim_{n\to\infty} 0.27\sum_{j=0}^{n}(\alpha_{OP})^{j}(\alpha_{FP}FP_{t-j})$$

In Figure 7, we show these three effects by setting n=20. Note that $(\alpha_{OP})^{20}$ can be approximated to be zero because $\alpha_{OP} = 0.665$. This figure indicates that the periods when the cumulative effect of supply and demand conditions on inflation is negative nearly corresponds to the recession in Japan, and that the cumulative effect of financial position is negatively correlated with that of supply and demand conditions. Put differently, the impact of financial position on CGPI inflation is counter-cyclical, which makes aggregate prices appear to be unaffected by short-run variations in demand. During the bubble economy, i.e., in the year 1988-1990, the easy financial position contributed to a decline in CGPI inflation by around 2 percent, while the excess demand contributed to a rise in CGPI inflation by around 3 percent. On the other hand, after the bursting of the bubble economy, i.e., in the year 1992-1995, the tight financial position contributed to a rise in CGPI inflation by around 1 percent, while the excess supply contributed to a decline in CGPI inflation by around 2 percent. As these examples show, the change in large firms' financial positions leads to price rigidities in Japan.

5. Conclusion

We found that financial positions affect the pricing behavior of large firms, but not that of small firms. The impact of financial positions on large firms' prices is counter-cyclical, and this characteristic is clearly observed in the industries that

produce differentiated goods such as advanced machinery. In the bubble era, i.e., the latter half of the 1980s, liquidity-abundant large firms invested in the customer stock by charging low prices without raising prices, while they did not cut their prices for locked-in customers who remained loyal in the lost decade. We found that such large firms' pricing behavior made aggregate prices rigid.

Our findings provide a new implication to understand Japan's business cycles. Many previous studies show that investment behavior and the adjustment speed of labor differ according to firm size, and our empirical results imply that such differences in investment and labor adjustment are closely related to the difference in firms' pricing behavior. Because large firms' prices are more rigid than small firms' prices and their markups are more counter-cyclical, their cash flow falls less in recessions. This contributes to avoiding a significant decrease in investment and labor for large firms. In contrast, small firms' prices are less rigid and likely to fall relatively fast in recessions, because they produce less-differentiated goods and they do not have strong negotiating powers for customers (i.e., mainly large firms). This leads to a significant decrease in small firms' cash flow, and therefore small firms need to reduce investment and labor more sharply.

Finally, although our paper focused on Japan's economy in the bubble era and the lost decade, we believe our empirical findings provided some insights on the key common element of financial crises in the world. As Bank of Japan Governor Shirakawa (2009) points out, many financial crises were preceded by low inflation coupled with high growth for an extended period of time. Such seemingly stable macro-economic environments play an important role in fostering bullish sentiment. Risk perception becomes optimistic and risk tolerance is elevated under benign economic conditions. Why are financial crises preceded by low inflation? Customer market theory and our empirical results imply that abundant liquidity in booms makes firms invest more in the customer stock by charging low prices, which leads to low inflation. If this is the case and central bank focuses narrowly on price inflation alone, especially in the short run, it may have the unintended effect of assisting the creation of bubbles when low inflation coexists with an excessive boom in economic and financial activity, which ultimately leads to financial crisis.

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Table 1. Regression of CGPI Inflation on DIs of change in Output Prices

Manufacturing

Sample period 1976:1-2003:4

Independent variables				
DI of large firms	DI of medium-sized firms	DI of small firms	$\overline{R}^2$	S.E.
0.277^{***} (0.030)			0.763	1.974
	0.229^{***} (0.036)		0.614	2.524
		0.201^{***} (0.036)	0.547	2.732
0.459^{***} (0.063)	-0.108 (0.093)	-0.076 (0.060)	0.798	1.824

Notes. Numbers in parentheses are White heteroskedasticity-consistent standard errors.
***/**/* denotes significance at the 1/5/10 percent level.

Table 2. Regression of Large Firms' DI on Quantitative Indices

Regression of DI of change in output prices

Independent variables			
CGPI inflation	Change in exchange rate	$\overline{R}^2$	S.E.
2.667 (0.164)		0.831	5.961
2.582 (0.167)	0.131 (0.066)	0.835	5.887

Notes. Numbers in parentheses are White heteroskedasticity-consistent standard errors.

Regression of DI of financial position

Independent variables					
Ratio of current profits to sales	Call rate	Spread between firms' borrowing rate and government bond rate	Leverage ratio	$\overline{R}^2$	S.E.
7.883 (0.636)				0.569	6.039
7.980 (0.468)	-3.188 (0.214)	-2.279 (0.420)		0.806	4.044
6.964 (0.568)	-2.531 (0.235)		-33.183 (6.055)	0.813	3.979

Notes. Numbers in parentheses are White heteroskedasticity-consistent standard errors. Sample period is 1980:1Q-2003:4Q, because of data availability of the leverage ratio.

Regression of DI of change in input prices

Independent variables			
Import price index inflation: petroleum, coal & natural gas	Overall wholesale price index inflation: raw materials (domestic products & imports)	$\overline{R}^2$	S.E.
0.303 (0.046)		0.536	12.245
	0.643 (0.063)	0.592	11.489

Notes. Numbers in parentheses are White heteroskedasticity-consistent standard errors.

Regression of DI of supply and demand conditions for products

Independent variable		
Index of operating ratio	$\overline{R}^2$	S.E.
2.913 (0.122)	0.843	6.337

Notes. Numbers in parentheses are White heteroskedasticity-consistent standard errors.

Table 3. Estimation Results of Manufacturing

$$OP_t = \alpha_{OP} OP_{t-1} + \alpha_{IP} IP_t + \alpha_{\Delta IP} \Delta IP_t + \alpha_{SD} SD_t + \alpha_{\Delta SD} \Delta SD_t + \alpha_{FP} FP_{t-1} + c + \varepsilon_t$$

	α_{OP}	α_{IP}	$\alpha_{\Delta IP}$	α_{SD}	$\alpha_{\Delta SD}$	α_{FP}	$\bar{R}^2$	S.E.
Large firms	0.665^{***} (0.069)	0.168^{***} (0.040)	0.314^{***} (0.057)	0.131^{***} (0.029)	0.252^{***} (0.058)	-0.124^{***} (0.036)	0.975	2.339
Medium-sized firms	0.681^{***} (0.066)	0.165^{***} (0.039)	0.270^{***} (0.064)	0.143^{***} (0.040)	0.135^{*} (0.071)	-0.069 (0.042)	0.974	2.389
Small firms	0.805^{***} (0.052)	0.098^{***} (0.030)	0.376^{***} (0.053)	0.120^{**} (0.049)	0.161^{**} (0.076)	-0.039 (0.068)	0.979	2.179

Notes. Numbers in parentheses are White heteroskedasticity-consistent standard errors.
***/**/* denotes significance at the 1/5/10 percent level.
As an explanatory variable, exchange rate is included because changes in output prices may reflect yen-based prices for exports.
Sample period is 1976:1-2003:4.

Table 4. Lag Exclusion Tests

Dependent variable: DI of change in output prices (OP)

Independent variable	p-value for lag exclusion tests		
	Large firms	Medium-sized firms	Small firms
Change in input prices (IP)	0.110	0.002	0.428
Supply-demand condition (SD)	0.001	0.002	0.000
Financial position (FP)	0.038	0.027	0.728

Notes. Regression includes four lags of exchange rate. Sample period is 1976:1-2003:4.

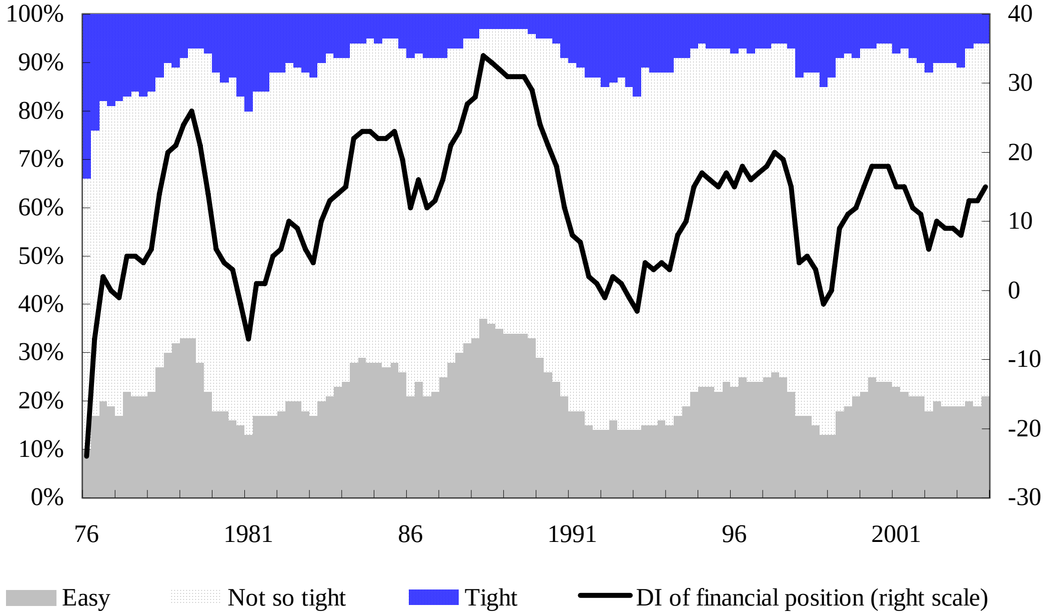
Table 5. Estimation Results of Large Firms by Industry Level (OLS)

$$OP_t = \alpha_{OP} OP_{t-1} + \alpha_{IP} IP_t + \alpha_{\Delta IP} \Delta IP_t + \alpha_{SD} SD_t + \alpha_{\Delta SD} \Delta SD_t + \alpha_{FP} FP_{t-1} + c + \varepsilon_t$$

OLS	α_{OP}	α_{IP}	$\alpha_{\Delta IP}$	α_{SD}	$\alpha_{\Delta SD}$	α_{FP}	$\bar{R}^2$	S.E.
Textiles	0.437*** (0.065)	0.191*** (0.050)	0.239*** (0.080)	0.258*** (0.089)	0.449*** (0.120)	-0.111* (0.057)	0.774	9.339
Lumber & wood	0.154 (0.100)	0.321*** (0.089)	0.023 (0.063)	0.315*** (0.094)	0.167 (0.109)	-0.212** (0.094)	0.513	23.225
Pulp & paper	0.503*** (0.074)	0.420*** (0.085)	0.078 (0.094)	0.104 (0.077)	0.458*** (0.126)	-0.126 (0.094)	0.770	16.073
Chemicals	0.377*** (0.099)	0.478*** (0.086)	0.097 (0.082)	0.091 (0.070)	0.480*** (0.103)	-0.071 (0.067)	0.891	6.731
Petroleum & coal products	0.102 (0.120)	0.852*** (0.113)	-0.234** (0.114)	0.253*** (0.092)	0.126 (0.144)	-0.130 (0.184)	0.674	31.071
Ceramics	0.447*** (0.073)	0.333*** (0.046)	-0.066 (0.071)	0.160*** (0.052)	-0.041 (0.097)	-0.192*** (0.066)	0.875	8.306
Iron & steel	0.526*** (0.076)	0.324*** (0.060)	0.089 (0.071)	0.232** (0.092)	0.268** (0.116)	-0.225** (0.108)	0.870	10.892
Nonferrous metals	0.228*** (0.066)	0.657*** (0.063)	0.116 (0.074)	0.039 (0.030)	0.075 (0.076)	0.000 (0.063)	0.912	8.426
Food & beverages	0.459*** (0.111)	0.257*** (0.088)	0.188** (0.085)	0.051 (0.118)	0.093 (0.124)	0.022 (0.074)	0.745	6.029
Processed metals	0.602*** (0.075)	0.254*** (0.058)	-0.046 (0.062)	0.114*** (0.043)	0.051 (0.074)	-0.008 (0.063)	0.853	7.318
Industrial machinery	0.590*** (0.041)	0.198*** (0.025)	0.098 (0.057)	0.152*** (0.023)	0.233*** (0.050)	-0.132*** (0.042)	0.895	4.945
Electrical machinery	0.600*** (0.087)	0.208*** (0.063)	0.228*** (0.085)	0.106*** (0.030)	0.096* (0.050)	-0.108** (0.050)	0.925	4.165
Transportation machinery	0.713*** (0.085)	0.169*** (0.037)	0.224*** (0.063)	0.087** (0.023)	-0.032 (0.100)	-0.099** (0.048)	0.905	4.433
Precision machinery	0.512*** (0.076)	0.166** (0.081)	0.046 (0.086)	0.214*** (0.066)	-0.046 (0.067)	-0.124** (0.053)	0.820	6.439
Other manufacturing	0.486*** (0.076)	0.243** (0.046)	-0.018 (0.066)	0.227*** (0.060)	-0.071 (0.079)	-0.029 (0.063)	0.890	5.993

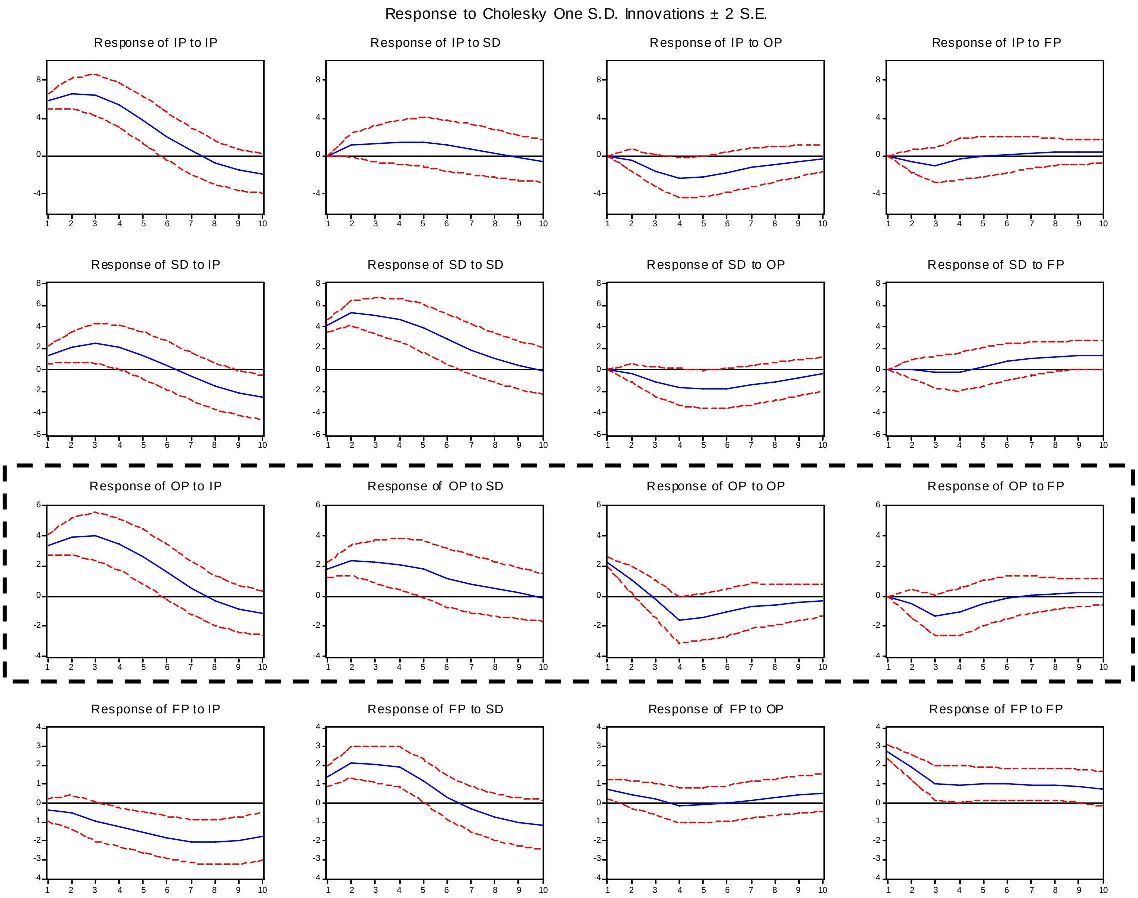
Notes. Numbers in parentheses are White heteroskedasticity-consistent standard errors.
***/**/* denotes significance at the 1/5/10 percent level. As an explanatory variable, exchange rate is included because changes in output prices may reflect yen-based prices for exports. Sample period is 1976:1-2003:4.

Figure 1. DI of Financial Position in Large Firms



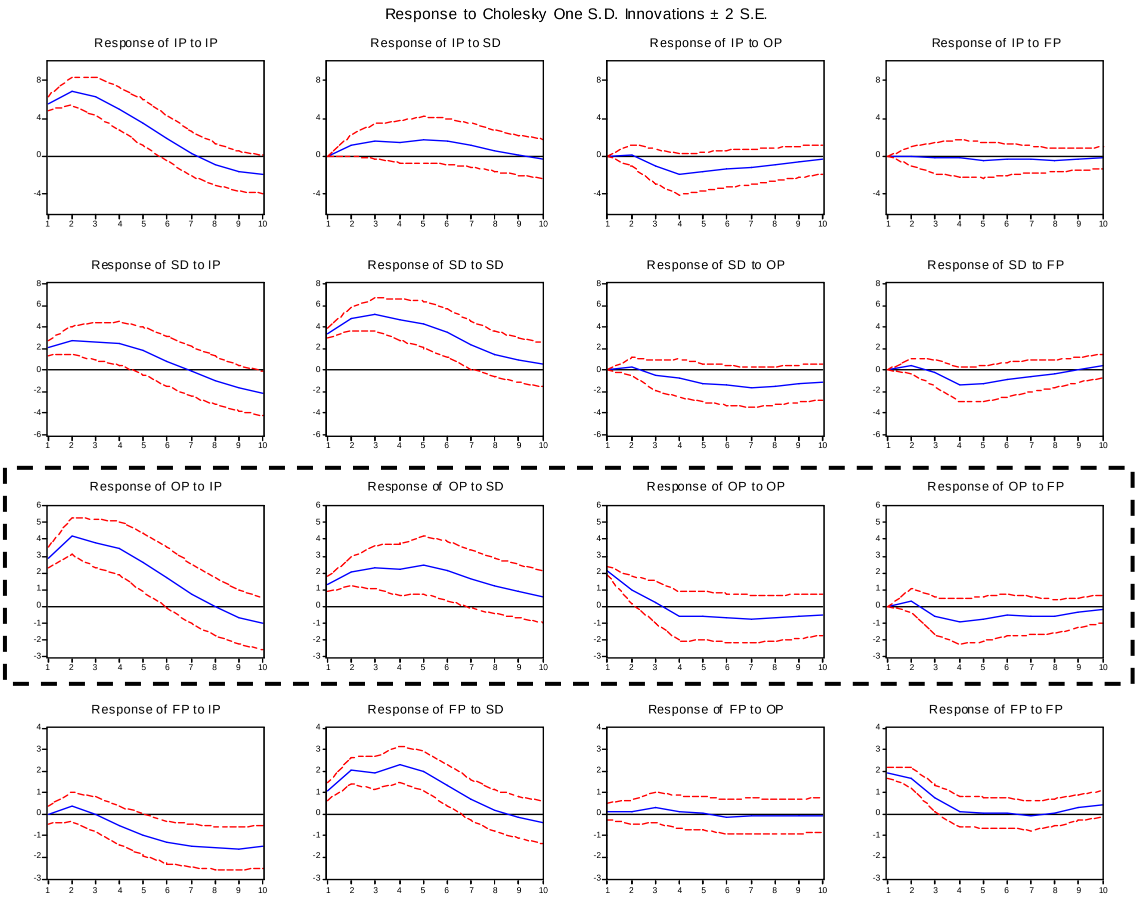
Source: Bank of Japan, *Tankan*

Figure 2. VAR Results of Large Firms



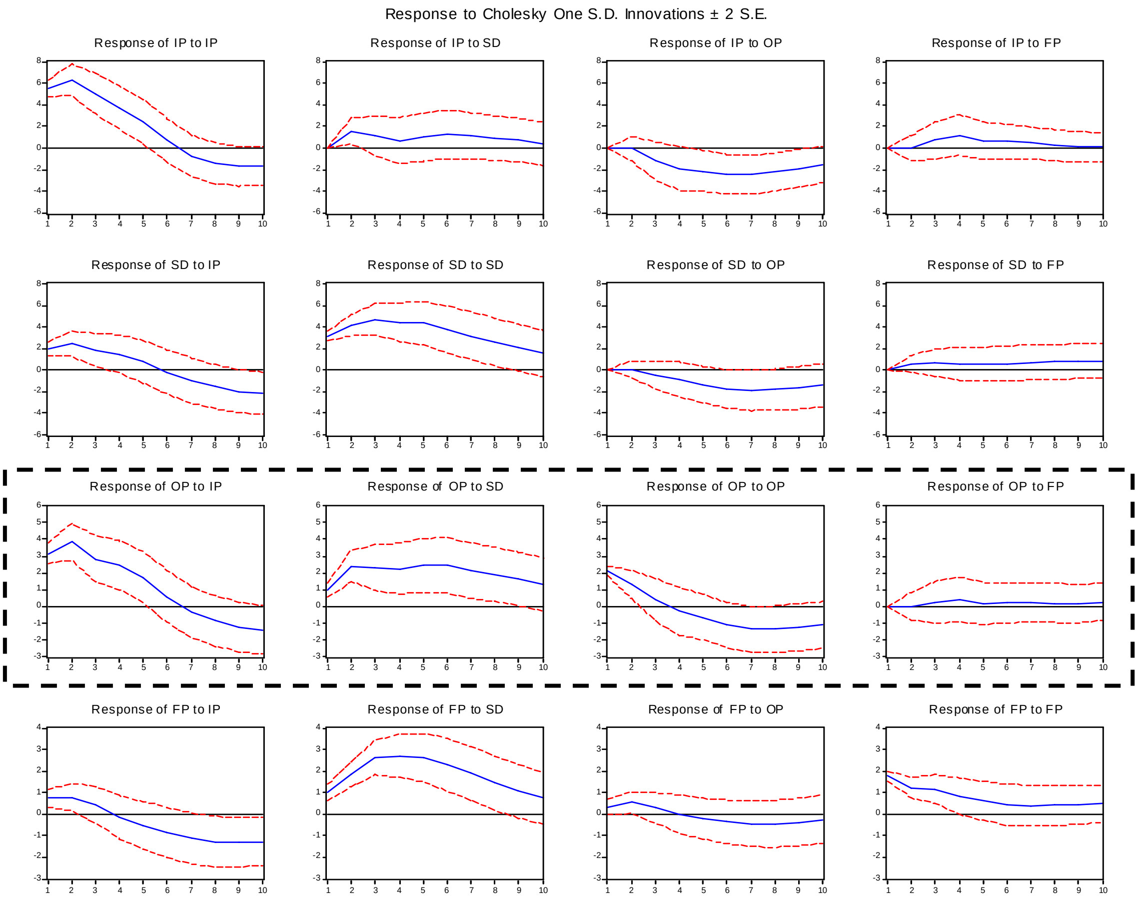
Source: Author's calculation based on the Bank of Japan's *Tankan*.

Figure 3. VAR Results of Medium-sized Firms



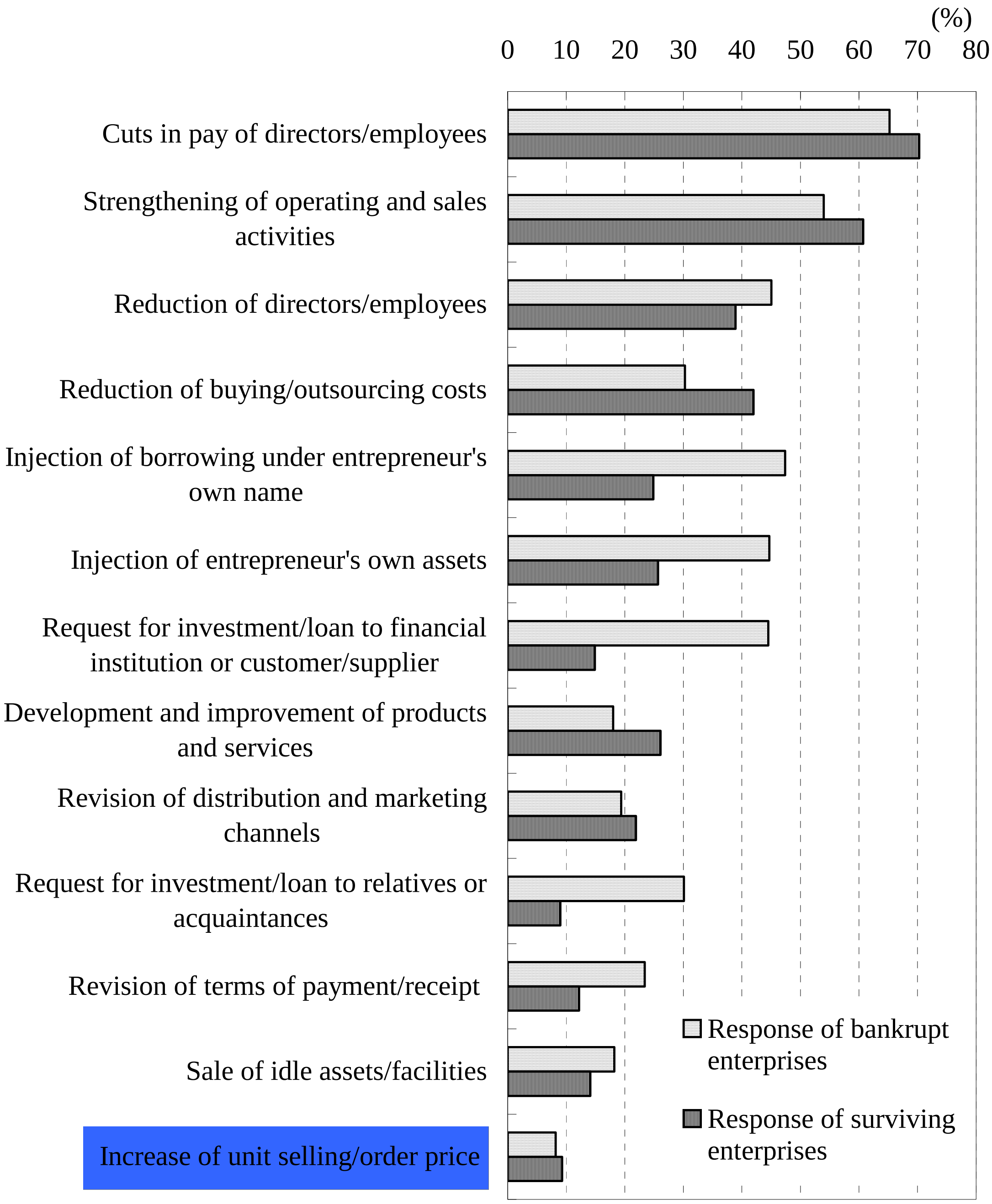
Source: Author's calculation based on the Bank of Japan's *Tankan.*

Figure 4. VAR Results of Small Firms



Source: Author's calculation based on the Bank of Japan's *Tankan*.

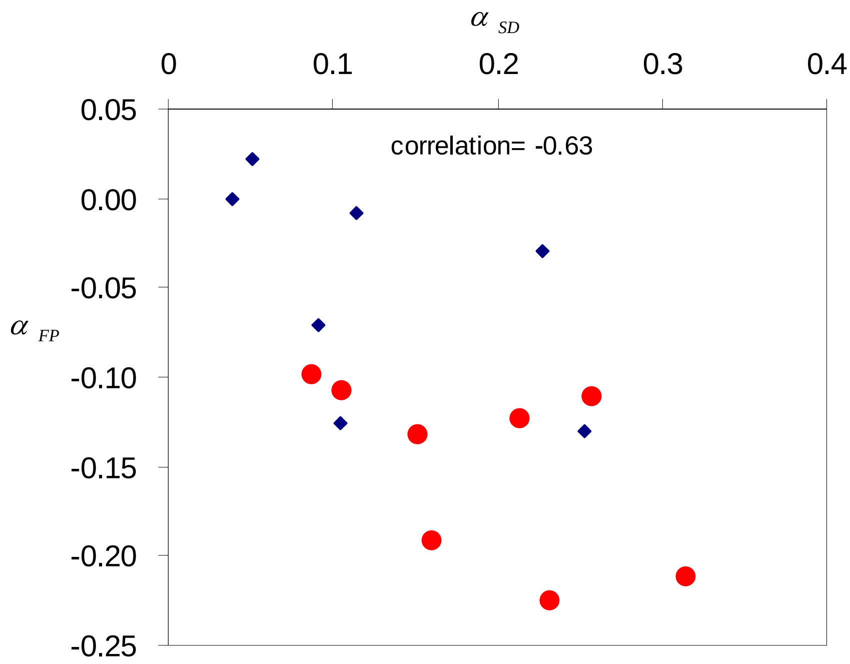
Figure 5. Bankruptcy Avoidance Measures of Small Firms (Bankrupt and Surviving Enterprises)



Notes. Proportion of entrepreneurs giving valid responses who adopted each measures. Surviving enterprises include only enterprises that responded that their sense of crisis "continues and similarly concerned". Totals exceed 100 because of multiple responses.

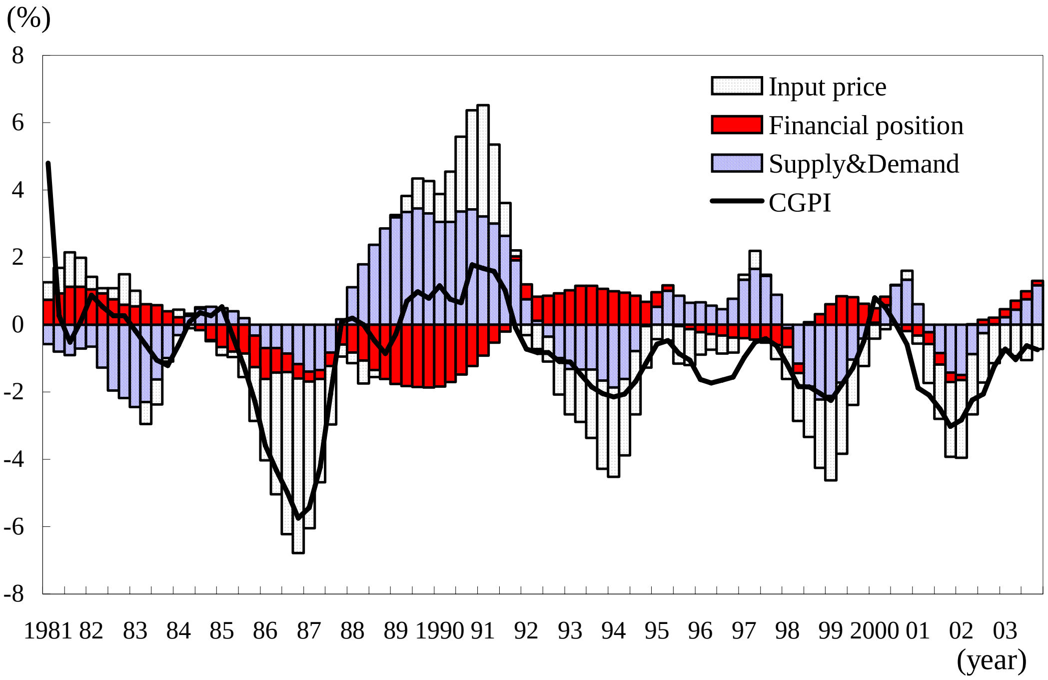
Sources: Small Business Institute Japan, Fact-finding Survey of Business Rechallenge (2002), Fact-finding Survey on Overcoming Difficulties (2002).

Figure 6. Cross-industry Correlation between α_{FP} and α_{SD}



Note: Circles in the figure indicate that the parameter α_{FP} is statistically significant.

Figure 7. Impact of Financial Position on CGPI



Source: Author’s calculation.