

Department of Social Systems and Management
Discussion Paper Series

No. 1212

Bankruptcy Dynamics in Japan

by

Nobuyuki HARADA and Noriyuki KAGEYAMA

June 2008

UNIVERSITY OF TSUKUBA
Tsukuba, Ibaraki 305-8573
JAPAN

Bankruptcy Dynamics in Japan^{*}

Nobuyuki HARADA

Graduate School of Systems and Information Engineering

University of Tsukuba

1-1-1 Tennodai, Tsukuba, Ibaraki, 305-8573, Japan

E-mail: harada@sk.tsukuba.ac.jp

Noriyuki KAGEYAMA

Ministry of Economy, Trade and Industry

1-3-1, Kasumigaseki, Chiyoda-ku, Tokyo, 100-8901, Japan

Abstract

This paper investigates aggregate bankruptcies in Japan, with a particular focus on revealing the dynamic characteristics of the series. For this purpose, we estimate a vector autoregression comprised of five economic variables and the bankruptcy rate, and construct its impulse responses. The estimation results show expected and consistent relationships between economic shocks and aggregate bankruptcies: in particular, a positive shock in the call rate clearly raises the bankruptcy rate. Our results further imply that changes in the bankruptcy rate reflect the accumulated impact of various shocks in the present and past, to which it has a distinct response structure.

JEL classification: C32, E32, G33

Keywords: bankruptcy, bankruptcy rate, vector autoregression, impulse response, Japan

^{*} Earlier versions of the paper were presented at the 2008 Spring Meeting of the Japanese Economic Association, the Gifu Conference, the Yamaguchi Conference, and the 51st (2007) Annual Meeting of the International Society for the System Sciences. We would like to thank the participants for helpful comments and suggestions. We especially thank Kazumi Asako, Tsutomu Miyagawa, Hideaki Murase, Kazuo Ogawa, Masaya Sakuragawa and Tomoyoshi Yabu for insightful discussions. This research was supported in part by a Grant-in-Aid for Scientific Research (17730200, 18103001 and 20730176). Any views expressed herein are those of the authors and not necessarily those of the organizations with which they are affiliated.

1. Introduction

The number of bankruptcies fluctuates greatly over time. In the case of Japan, the number has varied from about 6,500 to 21,000 per year since 1975 (Figure 1). Intuitively, the fluctuations have often been associated with economic conditions. Economic essays, debates and newspaper articles that are based on such an association, a priori, are quite common. However, the actual structure of the relationship between aggregate bankruptcies and economic conditions is still unclear and ambiguous (Economic Planning Agency, 2000, Ch. 1).

In the international academic literature, since Altman's (1968) famous work applying discriminant analysis, bankruptcy studies based on micro data have been numerous (e.g., Ohlson, 1980; Shumway, 2001; Hillegeist et al., 2004; and Hwang et al., 2007). They basically sought to find relationships between financial indicators of individual firms and the probability of bankruptcy. In other words, they attempted to predict bankruptcies based on the financial condition of the firm, such as their costs, profit, debt, assets, and/or market value. In a study of Japanese firms, Shirata (2003) proposed a bankruptcy prediction model comprising four financial indicators of each firm using discriminant analysis of medium- and large-sized enterprises. The Small and Medium Enterprise Agency (2002, Ch. 3) estimated probit models of the probability of bankruptcy of small- and medium-sized enterprises in which the probability was explained by the firm's and manager's characteristics in addition to five financial indicators of the firm. Fukuda et al. (2008) estimated probit models for medium-sized enterprises that explained the borrower's probability of bankruptcy by four financial indicators of the firm and measures of bank health.

Studies have also emerged on the macro aspects of bankruptcies. This is partly because the aggregate bankruptcy rate can be considered a prevalent indicator of the amount of credit risk of the economy (Koopman and Lucas, 2005). Altman (1983) estimated a distributed lag model for the US in which changes in the business failure rate are explained by the growth rates of real GNP, the S&P Stock Index, the money supply (M2), and new firm formation. The results

found that the first three factors negatively affect the business failure rate, and the last factor positively affects it. Since this study, a number of analyses on the rate of corporate bankruptcies, failures and liquidations have been published. First, researchers have estimated distributed lag models or simple multiple regression models (Wadhvani, 1986; Hudson 1986; Turner et al., 1992; Platt and Platt, 1994; Young, 1995; Vlieghe, 2001; and Dewaelheyns and Hulle, 2008). In general, they have used the current and/or lagged interest rate, price level, aggregate output, wage rate, new firm formation rate, and profits and banking conditions of the corporate sector as explanatory factors.

Second, sophisticated variations of time series techniques have been applied to the rate of bankruptcy, failure and liquidation (Liu, 2004; Liu and Pang, 2005; Fabling and Grimes, 2005; Gaffeo and Santoro, 2006; Drehmann et al., 2006; Dewaelheyns and Van Hulle, 2007). These studies estimated economic systems using vector autoregression or error-correction models, and investigated the relationships and behaviors of key variables in the estimated system. Similar to the first approach, these studies have used the interest rate, price level, aggregate output, new firm formation rate, and/or profits and banking conditions of the corporate sector as main variables in the estimated economic system coupled with the bankruptcy/failure/liquidation rate.

However, for Japan's economy, there are only a few studies on the macro aspects of bankruptcies. Ohta (1996) and the Small and Medium Enterprise Agency (2002, Ch. 3) estimated multiple regression models. The former, based on annual data from 1968 to 1993, examined various combinations of economic variables linked to macroeconomic fluctuations, conditions in financial markets and the corporate sector to explain the bankruptcy rate, partly by industry and partly by firm size. The latter, based on quarterly data from 1981 to 2001, used the ordinary profit rate, liquidity in the corporate sector, the real land price, and the real call rate as cardinal factors to explain the logarithm of the number of bankruptcies. The Economic Planning Agency (2000, Ch. 1), using quarterly data from 1977 to 2000, estimated a distributed lag model

of the bankruptcy rate of the small- and medium-sized enterprise sector, explained by retained earnings in the sector, interest rate on short-term loans, the real land price, and an institutional dummy. They found significant relationships between these factors and aggregate bankruptcies; however, the characteristics of aggregate bankruptcies are not well known because of the lack of ample empirical evidence.

This paper attempts to enhance understanding of the macro aspects of bankruptcies in Japan. That is, we formally investigate the aggregate bankruptcy rate, with a particular focus on examining the dynamic features of the series. For this purpose, we estimate a vector autoregression comprising economic variables and the bankruptcy rate, and construct its impulse responses. This method belongs to the second approach mentioned above, and to the authors' knowledge, this approach has not been previously used for Japan's economy. We apply a standard framework to the model and construction of impulse responses to provide a clear foundation for further studies, and to enable us to compare the results with those of numerous studies of the Japanese economy using vector autoregressions (see the next section). We use five economic variables in the model: the policy interest rate, price level, output of the economy, and profit and liquidity of the corporate sector. In summary, this paper has two contributions. First, it contributes as a new study on aggregate bankruptcy in Japan. Second, it contributes as a straightforward extension of vector autoregression analyses of the Japanese economy.

The remainder of the paper is organized as follows. Section 2 describes the methodology and variables to be analyzed. Section 3 estimates the model and constructs impulse responses. Section 4 extends the model through an industry-level analysis and constructs impulse responses for the manufacturing, construction, and wholesale and retail trade sectors. Section 5 offers concluding remarks.

***** Figure 1 *****

2. Methodology and Variables

The vector autoregression has been popular in economic analysis since the seminal work of Sims (1980). The most standard (reduced-form) expression of the vector autoregression is written as:

$$x_t = \Gamma(L)x_{t-1} + u_t,$$

where x_t is an $(n \times 1)$ vector of time series variables, $\Gamma(L)$ is a polynomial matrix in the q -th order lag operator, and u_t is an $(n \times 1)$ vector of nonautocorrelated disturbances. All components of the matrix $\Gamma(L)$ can be estimated by ordinary least squares equation-by-equation with consistency (Sims et al., 1990).

Based on the estimated parameters, we can construct impulse response functions, which are defined as the response of an element of x_t at time $t + s$ ($s = 0, 1, 2, \dots$) to a one-time shock in the element of x_t at time t . Plotting impulse responses is a practical way to visually show and examine dynamic behaviors of time series variables in response to the various shocks. Here, we suppose the disturbances are rewritten as the combination of fundamental shocks by $A_0 u_t = e_t$, where e_t is a vector of fundamental (uncorrelated) shocks, and A_0 is an $(n \times n)$ invertible matrix. A standard way to identify the system and extract the effects of fundamental shocks is to impose a recursive structure on the matrix A_0 ; that is, to assume A_0 as a lower triangular matrix with unit diagonal elements. This paper follows this Cholesky decomposition approach, though it requires us to define the ordering of variables.

The core advantage of the vector autoregression is that all variables are (potentially) treated as endogenous variables, and the relationships between them are unrestricted before estimation. Sims (1980) proposed the model as a potent alternative to large-scale macroeconomic models, and since then it has been a key methodology in macroeconomic analysis. Furthermore, the framework has evolved in diverse directions (e.g., Litterman, 1986; Blanchard and Quah, 1989; Bernanke et al., 2005; and Uhlig, 2005). For Japan's economy, there are a lot of studies that applied these original or modified vector autoregressions (e.g., Shioji,

2000; Miyao, 2000 and 2002; Hosono et al., 2001; Ogawa, 2000 and 2002; Ford et al., 2003; Braun and Shioji, 2004; Fujiwara, 2006; Nakashima, 2006; Shibamoto, 2007; and Inoue and Okimoto, 2008: see also a survey by Teruyama (2001) for earlier studies). An important objective of these studies has been to identify the effects of monetary policy shocks (representatively expressed by shocks in the call rate) on the macroeconomy. This paper partly pursues this objective. There is no consensus on which methodology is fundamentally superior, and this paper focuses on the standard methodology above.¹

For estimation of the model, we use three macroeconomic variables, two financial variables of the corporate sector, and the bankruptcy rate, all of which are quarterly data from the first quarter of 1975 to the first quarter of 2005 (121 quarters in total). First, the bankruptcy rate is defined as [the number of bankruptcies of corporations in the period]/[the number of corporations at the end of the previous period] \times 100 (percent). Because the number of corporations varied (increased) in Japan, we evaluate the number of bankruptcies in comparison with the total number of corporations. The data on the number of corporations are obtained from the *National Tax Agency Annual Statistics Reports*, which is published by the National Tax Agency.²

As a measure of the number of bankruptcies, this paper uses data from the *Bankruptcy Reports* published by Teikoku Databank, Ltd., which is a well-known bankruptcy survey in Japan. Teikoku Databank defines “bankruptcy” as a company in any one of the following six situations: (1) Drawing unpaid notes twice and transactions with banks are suspended; (2) Dissolution of the company (when the representative admits being bankrupt); (3) Applying for

¹ Furthermore, Engle and Granger (1987) and other scholars have proposed the error-correction model as another possible specification of the macroeconomy. However, for Japan’s economy, most studies have applied vector autoregressions (an exception is Jang and Ogaki, 2003), and thus this paper also uses the vector autoregression methodology.

² Because the National Tax Agency only provides annual data, we linearly interpolate these data for the quarterly analysis.

the application of the Corporate Rehabilitation Law to the court; (4) Applying for the commencement of the procedure based on the Civil Rehabilitation Law to the court (since April 2000, the enforcement date of the law); (5) Applying for liquidation to the court; (6) Applying for the commencement of special liquidation to the court.³ The survey covers bankrupt companies with liabilities of 10 million yen or more.⁴ Furthermore, we exclude individual proprietorships from the data set, mainly because we use the results of the survey of corporations as outlined below.⁵ We seasonally adjusted the number of bankruptcies variable using the Census X12 procedure. Figure 2 shows the bankruptcy rate.⁶ It indicates the bankruptcy rate rapidly fell from 1987 to 1990 during the “bubble economy” period, increased in the following year, and remains relatively stable.

***** Figure 2 *****

The macroeconomic variables we use to represent the general economic environment are real GDP as the level of output, the GDP deflator as the price level, and the call rate. For real GDP and the GDP deflator, we use the official seasonally adjusted series of the 93SNA (fixed-based, base year = 1995). From 1975 to 1979, we link the old-version official seasonally adjusted series of the 68SNA (base year = 1990) based on the quarterly growth rate, because of

³ Moreover, “bankruptcy” based on the Composition Law (which was abrogated on March 2000) and based on a specific procedure (*Kaisha Seiri*) provided by the Commercial Law (which was abrogated on May 2006) was covered in the survey. Our long-term data set includes both of these cases.

⁴ From May 2005, the *Bankruptcy Reports* begin to cover only the cases corresponding from (3) to (6), which are classified as “legal” liquidation. We decided to limit our analysis up to the first quarter of 2005 because of the discontinuity.

⁵ Individual proprietorships account for about 22% of the total number of bankruptcies on average in the sample period. They are included in Figure 1.

⁶ The shadows in Figures 2, 3 and 5 indicate recession periods, which are officially published by the Economic and Social Research Institute, Cabinet Office.

the lack of the data in the 93SNA for the period. For the call rate, we use the collateralized overnight rate (percent per annum) as a proxy of the policy interest rate, which is obtained from the Bank of Japan's official statistics for the entire estimation period.⁷ To our knowledge, the vector autoregression comprising aggregate output, price level, and policy interest rate is a core choice for standard modeling (see the literature mentioned above). This paper follows this approach.^{8,9}

To represent business conditions in the corporate sector, we use two financial variables in the model: the ordinary profit rate and the quick assets ratio. Both are constructed from the results of the *Financial Statements Statistics of Corporations by Industry, Quarterly* (hereafter, FSSC), published by the Ministry of Finance. It surveys quarterly financial statements of nonfinancial corporations and publishes the aggregate results. It is an authorized and official series of statistics on the corporate sector in Japan, and widely used for economic analyses. Although the FSSC covers corporations, the paid-up capital of which is greater than or equal to 10 million yen, we assume the results of the survey as a proxy for the entire corporate sector. The discontinuity in the survey because of the annual renewal of sampled firms has been raised as an issue and attempts have been made to overcome the problem (cf., Ogawa et al., 1994; Ogawa, 2000 and 2002; and Miyagawa et al., 2006). However, this paper does not make any adjustment because we use ratio variables, the numerator and denominator of which are constructed from the FSSC results surveyed in the same period, and thus the discontinuity seems to be less problematic.

The ordinary profit rate is adopted to represent the profitability of the corporations. It

⁷ Meanwhile, the uncollateralized rate can be obtained only from June 1985 (at the establishment of the market).

⁸ To be exact, a larger number of the previous studies use monthly data. However, this paper uses quarterly data because we intend to use the results of the FSSC, which is published quarterly.

⁹ A possible alternative for modeling is to add a variable for the money supply or the outstanding amount of bank loans. However, we omit it for the model because we use a more direct measure of the monetary policy (call rate) and of the liquidity of the corporate sector (quick assets ratio).

is defined as $[\text{ordinary profit/sales}] \times 100$ (percent), with a high ratio corresponding to high profitability of the sector. The indicator combining profit and sales is also selected as a variable that compresses financial information on the profit-and-loss statement of the business. The quick assets ratio represents financial soundness and solvency in the immediate or short term. A high ratio indicates that there is adequate capacity to pay, which is associated with the soundness of the sector. It is defined as $[\text{quick assets/liquid liabilities}] \times 100$ (percent): the quick assets = cash and deposits + bills and accounts receivable + short-term securities; and the liquid liabilities = bills and accounts payable + short-term borrowings + allowance + other liquid liabilities.¹⁰ The indicator compresses financial information on the balance sheet of the business for both assets and liabilities. We seasonally adjusted the two variables using the Census X12 procedure. Figure 3 shows the results of the two variables; the ordinary profit rate and the quick assets ratio.

***** Figure 3 *****

3. Estimation and Impulse Responses

Using these economic variables and the bankruptcy rate, we estimate a vector autoregression. The lag order q is set to four because we are undertaking quarterly analysis. Real GDP and the GDP deflator are converted to natural logarithms and multiplied by 100. All variables are used in level, not in difference. To identify the fundamental shocks, as above, we apply the Cholesky decomposition approach. The Cholesky ordering of variables is set as follows: call rate (r), price (p), output (y), profit rate, quick assets ratio, and bankruptcy rate. The ordering is based on the recursive orthogonalization by Sims (1992) and Miyao (2000 and 2002).

¹⁰ All of the terms in the quick assets ratio are constructed by the average of the amount at the end of the period and the one at the end of the previous period, both of which are obtained from the FSSC results surveyed at the same time.

Figure 4 illustrates the estimated impulse responses. It displays the results of the variables, except for responses of the call rate, up to 20 quarters after a one standard deviation shock in each of the six variables. Dotted lines show the one standard error bands (cf. Shioji, 2000; and Miyao, 2000 and 2002), which are calculated by 2,500 Monte Carlo replications. We omit the impulse responses of the call rate to simplify the figure.¹¹

***** Figure 4 *****

In general, the figure shows expected and consistent relationships between economic shocks and each variable. In particular, a positive shock in the call rate depresses total output, ordinary profit rate and quick assets ratio, and most importantly, raises the bankruptcy rate, that is, the aggregate probability of bankruptcy (column 1 of Figure 4). The results indicate that a monetary tightening shock exerts clear negative effects on these variables. Second, positive shocks in total output (column 3), ordinary profit rate (column 4) and quick assets ratio (column 5) show clear positive effects. These shocks stimulate the economic environment, the profitability and liquidity of the corporate sector, and depress the bankruptcy rate. In terms of the responses of the bankruptcy rate, these results indicate that a monetary tightening shock raises the bankruptcy rate, and that shocks in total output, profit rate and quick assets ratio depress it (row 5 of Figure 4).

However, in the figure, we find the appearance of the *price puzzle*; that is, the price level rises after a monetary tightening shock (row 1 of column 1). This is a relatively common result using the standard vector autoregression (Christiano et al., 1999). The price puzzle is not solved in our model even by including additional variables such as an index of commodity prices, oil price, exchange rate, or corporate goods prices, which are incorporated into the previous models to (possibly) reduce it when the price puzzle appears. Furthermore, the

¹¹ The first-period response of the call rate to the shock in the call rate is estimated to be 0.508.

responses to the shock in the price level are unclear (column 2).

We also checked that the results of impulse responses remain almost unchanged if we limit our sample period up to the first quarter of 2001 (i.e., 105 quarters). It means we limit the data period to just before the implementation of the quantitative easing policy by the Bank of Japan; which temporarily changed the target of monetary policy from the policy interest rate to the amount outstanding in the current accounts of financial institutions at the Bank of Japan.

As a supplementary analysis, we estimated a vector autoregression where the total amount of liabilities of bankrupt corporations replaces the bankruptcy rate, and constructed its impulse responses. The amount of liabilities is a possible alternative measure for evaluating the impacts of bankruptcies in relation to the economy. The results are summarized in the appendix, showing similar response structures to those in this and the next section. In that sense, the presented relationships between the economy and aggregate bankruptcies are relatively robust.

4. Extension

This section extends the analysis to the industry level, and we examine differences in the responses among industries. We focus on three sectors: manufacturing, construction, and wholesale and retail trade. On average in the sample period, the number of corporate bankruptcies in manufacturing account for 18% of total corporate bankruptcies, construction 27%, and wholesale and retail trade 38%: the three sector combined account for 82% of the total.¹²

For each sector, we construct the industry-level ordinary profit rate, quick assets ratio, and bankruptcy rate. They are calculated and seasonally adjusted in the same way as the aggregate variables described in Section 2. The ordinary profit rates and quick assets ratios are constructed from the results of the FSSC, and bankruptcy rates from the results of the *Bankruptcy Reports* and the *National Tax Agency Statistics Reports*. Figure 5 shows the

¹² The wholesale and retail trade sector includes eating and drinking places.

bankruptcy rates by industry. The movements are similar across industries, but the level of the construction sector tends to be higher than those of the others.

***** Figure 5 *****

Using these industry-level variables and macroeconomic variables, the call rate, price level and aggregate output, we estimate three types of industry-level vector autoregressions comprised of six variables and with four lags, and construct impulse responses. Figure 6 presents the estimated responses of the three industry-level variables for (a) manufacturing, (b) construction, and (c) wholesale and retail trade. Similar to Figure 4, the figure illustrates impulse responses following a one standard deviation shock in each of the six variables, the dotted lines show the one standard deviation error bands by Monte Carlo simulation, and the Cholesky ordering is the same as in the previous section.

In principle, the industry-level responses are similar to those for the aggregate analysis in Figure 4. For instance, a monetary tightening shock depresses the ordinary profit rate and quick assets ratio, and raises the bankruptcy rate (columns 1 of Figure 6 (a), (b) and (c)). Positive shocks in total output, profit rate and quick assets ratio depress the bankruptcy rate (rows 3). The results indicate the potential similarity and robustness of the estimated structures of the economy, especially relating to the bankruptcy rate.

Meanwhile, for details of the results, the responses of the two financial variables to the shock in the call rate for the manufacturing sector are clear, relative to those for other sectors (rows 1 and 2 of columns 1). The responses of the profit rate differ across industries to a degree (rows 1). The timing of the peak of the response of the bankruptcy rate to the shock in the quick assets ratio for the construction sector is later than those for other sectors (rows 3 of columns 5). In summary, while the basal similarities of sectors are illustrated, the details of the impacts show differences, which are informative.

***** Figure 6 *****

5. Concluding Remarks

This paper highlighted the macro aspects of bankruptcies in Japan, and estimated vector autoregressions comprising five economic variables and the bankruptcy rate. The estimated impulse responses showed dynamic relationships between economic shocks and the bankruptcy rate. In particular, a positive shock in the call rate clearly raises the aggregate probability of bankruptcy, and shocks in total output, ordinary profit rate and quick assets ratio depress it. We also estimated industry-level models for manufacturing, construction, and wholesale and retail trade, which revealed fundamental similarities and showed differences in the details of the economic structure. Our results further imply that the change in the bankruptcy rate reflects the accumulated impact of various shocks in the present and past, to which aggregate bankruptcy has a distinct response structure.

Although the model and results in the paper are relatively simple, we can utilize them as a key benchmark for future studies. The specification and variables for the vector autoregression can be further developed to examine economic behavior from a different angle. It would be useful to incorporate the possibility of structural changes into the analysis (cf. Qu and Perron, 2007). For instance, details of institutional and social systems have been transformed in the long run, and the Japanese economy experienced a prolonged stagnation after the bubble economy burst. Furthermore, our approach will make a contribution to the analysis of the Japanese business cycle.

Finally, a fundamental question remains as to whether or how much we should recognize the (possible) positive effects of bankruptcies in promoting restructuring of the economy (Caballero et al., 2008). In our analysis, related results on this issue are shown in rightmost columns of Figures 4 and 6 in the form of impulse responses of the economic

variables to a shock in the bankruptcy rate. Most of the responses are negative or insignificant, and especially Figure 4 shows that a shock in the bankruptcy rate deepens the deflation and depresses total output even in the long run. Our results therefore present very limited evidence of the positive effect of bankruptcies. However, the question is still open and future research is required before a conclusion can be made.

Appendix: Impulse responses in the total-liabilities model

The main part of the paper focused on the behavior of the bankruptcy rate, according to the research stream denoted in Section 1. However, the bankruptcy rate is not the sole measure of bankruptcies. In addition, the total amount of liabilities when companies go bankrupt could be considered another important factor for evaluating the interactive and dynamic structures between aggregate bankruptcies and the economy.

In this appendix, we investigate a different specification of the model where the total liabilities of bankrupt corporations replace the bankruptcy rate. The total liabilities data are obtained from the *Bankruptcy Reports*. The methodology, the five variables other than total liabilities and the estimation periods are the same as in the main part of the paper. Total liabilities are seasonally adjusted, in natural logarithms and multiplied by 100. We first estimate the model for the total economy, as in Section 3, and subsequently the industry-level models for (a) manufacturing, (b) construction and (c) wholesale and retail trade as in Section 4.

The estimated impulse responses are displayed as Figures A1 and A2. The figures show similar response structures to Figures 4 and 6, respectively. In general, a monetary tightening shock depresses total output, the profit rate and the quick assets ratio, and raises the total liabilities of bankrupt corporations (column 1). Positive shocks in total output, the profit rate and the quick assets ratio tend to depress total liabilities (row 5 of Figure A1 and rows 3 of Figure A2 (a), (b) and (c)). Furthermore, the rightmost columns of the figures show very limited evidence of the (possible) positive effects of bankruptcies. A shock in total liabilities depresses

the price level and the output of the economy (Figure A1). In principle, the results presented in the main part of the paper are also supported by the alternative specification.

***** Figure A1 *****

***** Figure A2 *****

References

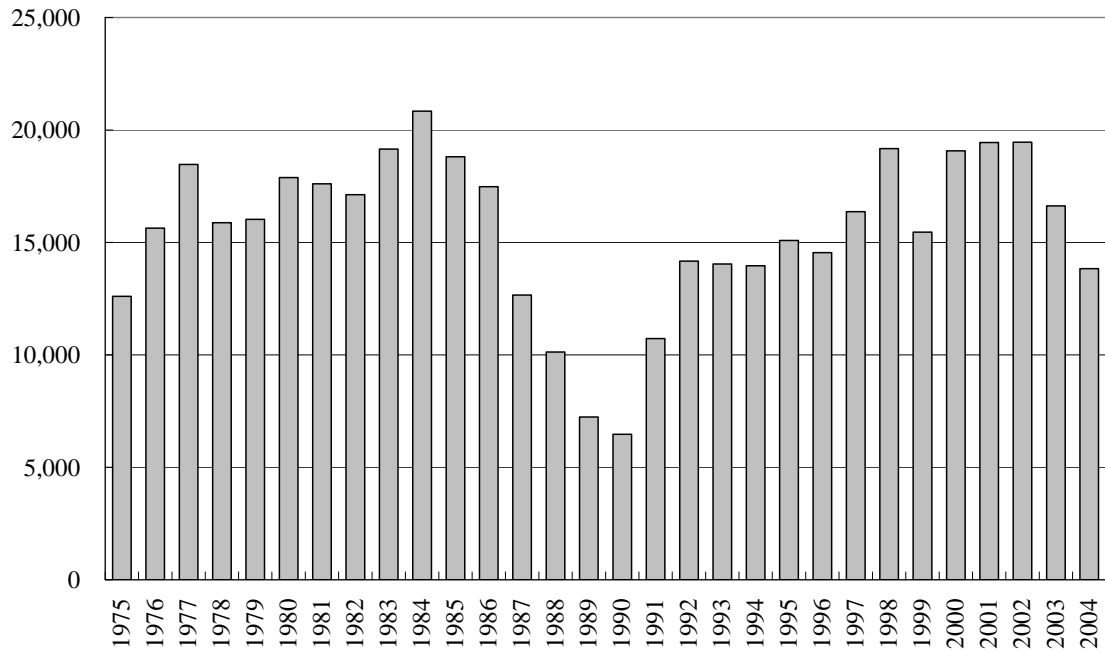
- Altman, E. I., 1968. Financial ratios, discriminant analysis and the prediction of corporate bankruptcy. *Journal of Finance* 23, 589-609.
- Altman, E. I., 1983. Why business fail. *Journal of Business Strategy* 3, 15-21.
- Bernanke, B. S., Boivin, J., Elias, P., 2005. Measuring the effects of monetary policy: a factor-augmented vector autoregressive (FAVAR) approach. *Quarterly Journal of Economics* 120, 387-422.
- Blanchard, O. J., Quah, D., 1989. The dynamic effects of aggregate demand and supply disturbances. *American Economic Review* 79, 655-673.
- Braun, R. A., Shioji, E. 2004. Nihon ni okeru gijyututeki shokku to souroudo jikan [Technology shocks and aggregate work hours – evidence from Japan]. *Keizai Kenkyu* 55, 289-298 (in Japanese).
- Caballero, R. J., Hoshi, T., Kashyap, A. K., 2008. Zombie lending and depressed restructuring in Japan. *American Economic Review*, forthcoming.
- Christiano, L. J., Eichenbaum, M., Evans, C. L., 1999. Monetary policy shocks. what have we learned and to what end? In Taylor, J. B., Woodford, M. (Eds.). *Handbook of Macroeconomics*, Vol. 1, Amsterdam: North-Holland, 65–148.
- Dewaelheyns, N., Van Hulle, C., 2007. Aggregate bankruptcy rates and the macroeconomic environment: forecasting systematic probabilities of default. mimeo.
- Dewaelheyns, N., Van Hulle, C., 2008. Legal reform and aggregate small and micro business

- bankruptcy rates: evidence from the 1997 Belgian bankruptcy code. *Small Business Economics*, forthcoming.
- Drehmann, M. Patton, A. J., Sorensen, S., 2006. Corporate defaults and macroeconomic shocks: non-linearities and uncertainty. mimeo.
- Economic Planning Agency, 2000. *Keizai Hakusyo 2000* [Economic Survey of Japan 1999-2000]. Printing Bureau, Ministry of Finance.
- Engle, R. F., Granger, C. W. J., 1987. Co-integration and error correction: representation, estimation, and testing. *Econometrica* 55, 251-276.
- Fabling, R., Grimes, A., 2005. Insolvency and economic development: regional variation and adjustment. *Journal of Economics and Business* 57, 339-359.
- Ford, J. L., Agung, J., Ahmed, S., Santoso, B., 2003. Bank behaviour and the channel of monetary policy in Japan, 1965–1999. *Japanese Economic Review* 54, 275–99.
- Fujiwara, I., 2006. Evaluating monetary policy when nominal interest rates are almost zero. *Journal of Japanese and International Economies* 20, 434-453.
- Fukuda S., Kasuya, M., Akashi K., 2008. Impaired bank health and default risk. *Pacific Basin Finance Journal*, forthcoming.
- Gaffeo, E., Santoro, E., 2006. Macroeconomic conditions and business failures in Italy: a panel cointegration approach. mimeo.
- Hillegeist, S. A., Keating, E. K., Cram, D. P., Lundstedt, K. G., 2004. Assessing the probability of bankruptcy. *Review of Accounting Studies* 9, 5-34.
- Hosono, K., Sugihara, S., Mihira, T., 2001. *Kinyu Seisaku no Yukousei to Genkai* [The Effectiveness and Limits of Monetary Policy]. Toyo Kenai Shinpousha (in Japanese).
- Hudson, J., 1986. An analysis of company liquidations. *Applied Economics* 18, 219-235.
- Hwang, R-C., Cheng, K. F., Lee, J. C., 2007. A semiparametric method for predicting bankruptcy. *Journal of Forecasting* 26, 317-342.
- Inoue, T., Okimoto, T., 2008. Were there structural breaks in the effects of Japanese monetary

- policy? Re-evaluating policy effects of the lost decade. *Journal of Japanese and International Economies*, forthcoming.
- Jang, K., Ogaki, M., 2003. The effects of Japanese monetary policy shocks on exchange rates: a structural vector error correction model approach. *Monetary and Economic Studies* 21, 1–34.
- Koopman, S. J., Lucas, A., 2005. Business and default cycles for credit risk. *Journal of Applied Econometrics* 20, 311-323.
- Litterman, R. B., 1986. Forecasting with Bayesian vector autoregressions: five years of experience. *Journal of Business and Economic Statistics* 4, 25-38.
- Liu, J., 2004. Macroeconomic determinants of corporate failures: evidence from the UK. *Applied Economics* 36, 939-945.
- Liu, J., Pang, D., 2005. Business failures and macroeconomic factors in the UK. *European Financial Management Association 2005 Annual Meetings*.
- Miyagawa, T., Sakuragawa, Y., Takizawa, M., 2006. The impact of technology shocks on the Japanese business cycle – an empirical analysis based on Japanese industry data. *Japan and the World Economy* 18, 401-417.
- Miyao, R., 2000. The role of monetary policy in Japan: a break in the 1990s? *Journal of the Japanese and International Economies* 14, 366–384.
- Miyao, R., 2002. The effects of monetary policy in Japan. *Journal of Money, Credit, and Banking* 34, 376–392.
- Nakashima, K., 2006. The bank of Japan's operating procedures and the identification of monetary policy shocks: a reexamination using the Bernanke-Mihov approach. *Journal of Japanese and International Economies* 20, 406-433.
- Ogawa, K., 2000. Monetary policy, credit, and real activity: evidence from the balance sheet of Japanese firms. *Journal of the Japanese and International Economies* 14, 385–407.
- Ogawa, K., 2002. Monetary transmission and inventory: evidence from Japanese balance-sheet data by firm size. *Japanese Economic Review* 53, 425–43.

- Ogawa, K., Kitasaka, S., Watanabe, T., Maruyama, T., Yamaoka, H., Iwata, Y., 1994. Asset Markets and Business Fluctuations in Japan. Economic Analysis 136. Economic Research Institute, Economic Planning Agency.
- Ohlson, J. A., 1980. Financial ratios and the probabilistic prediction of bankruptcy. *Journal of Accounting Research* 18, 109-131.
- Ohta, S., 1996. Kigyo Tosan no Kenkyu [Study on Bankruptcies]. Dobunkan (in Japanese).
- Platt, H. D., Platt, M. B., 1994. Business cycle effects on state corporate failure rates. *Journal of Economics and Business* 46, 113-127.
- Qu, Z., Perron, P., 2007. Estimation and testing structural changes in multivariate regressions. *Econometrica* 75, 459-502.
- Shibamoto, M., 2007. An analysis of monetary policy shocks in Japan: a factor augmented vector autoregressive approach. *Japanese Economic Review* 58, 484-503.
- Shioji, E., 2000. Identifying monetary policy shocks in Japan. *Journal of the Japanese and International Economies* 14, 22-42.
- Shirata, Y., 2003. Kigyo Tosan Yochi Moderu [Bankruptcy Prediction Model]. Chuokeizai-sha (in Japanese).
- Shumway, T., 2001. Forecasting bankruptcy more accurately: a simple hazard model. *Journal of Business* 74, 101-124.
- Sims, C. A., 1980. Macroeconomics and reality. *Econometrica* 48, 1-48.
- Sims, C. A., Stock, J. H., Watson, M. W., 1990. Inference in linear time series models with some unit roots. *Econometrica* 58, 113-144.
- Sims, C. A., 1992. Interpreting the macroeconomic time series facts: the effects of monetary policy. *European Economic Review* 36, 975-1000.
- Small and Medium Enterprise Agency, 2002. Chusyo Kigyo Hakusyo 2002 [White Paper on Small and Medium Enterprises in Japan 2002]. Japan Small Business Research Institute.
- Teruyama, H., 2001. VAR ni yoru kinyuuseisaku no bunseki: Tenbou [Analysis of Monetary

- Policy using VAR: A perspective]. *Financial Review* 59, 74-140 (in Japanese).
- Turner, P., Coutts, A., and Bowdwen, S., 1992. The effects of the Thatcher government on company liquidations: an econometric study. *Applied Economics* 24, 935-943.
- Uhlig, H., 2005. What are the effects of monetary policy on output? Results from an agnostic identification procedure. *Journal of Monetary Economics* 52, 381-419.
- Vlieghe, G. W., 2001. Indicators of fragility in the UK corporate sector. Bank of England Working Paper.
- Wadhvani, S. B., 1986. Inflation, bankruptcy, default premia and the stock market. *Economic Journal* 96, 120-138.
- Young, G., 1995. Company liquidations, interest rates and debt. *Manchester School* 63, 57-69.



Source: Teikoku Databank, Ltd., *Bankruptcy Report*.

Figure 1. Number of bankruptcies in Japan

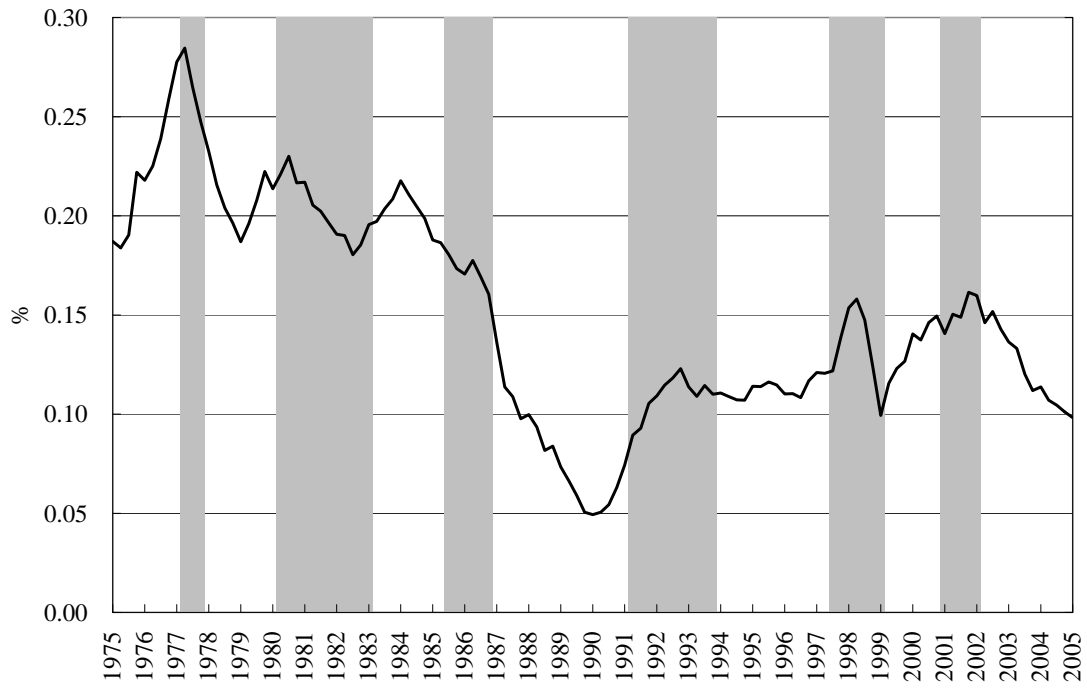


Figure 2. Bankruptcy rate (quarterly)

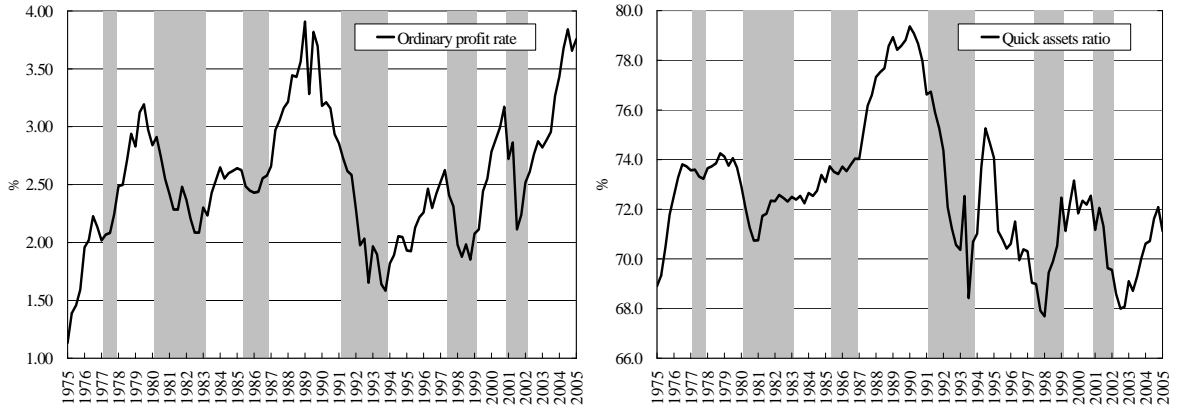


Figure 3. Ordinary profit rate and quick assets ratio

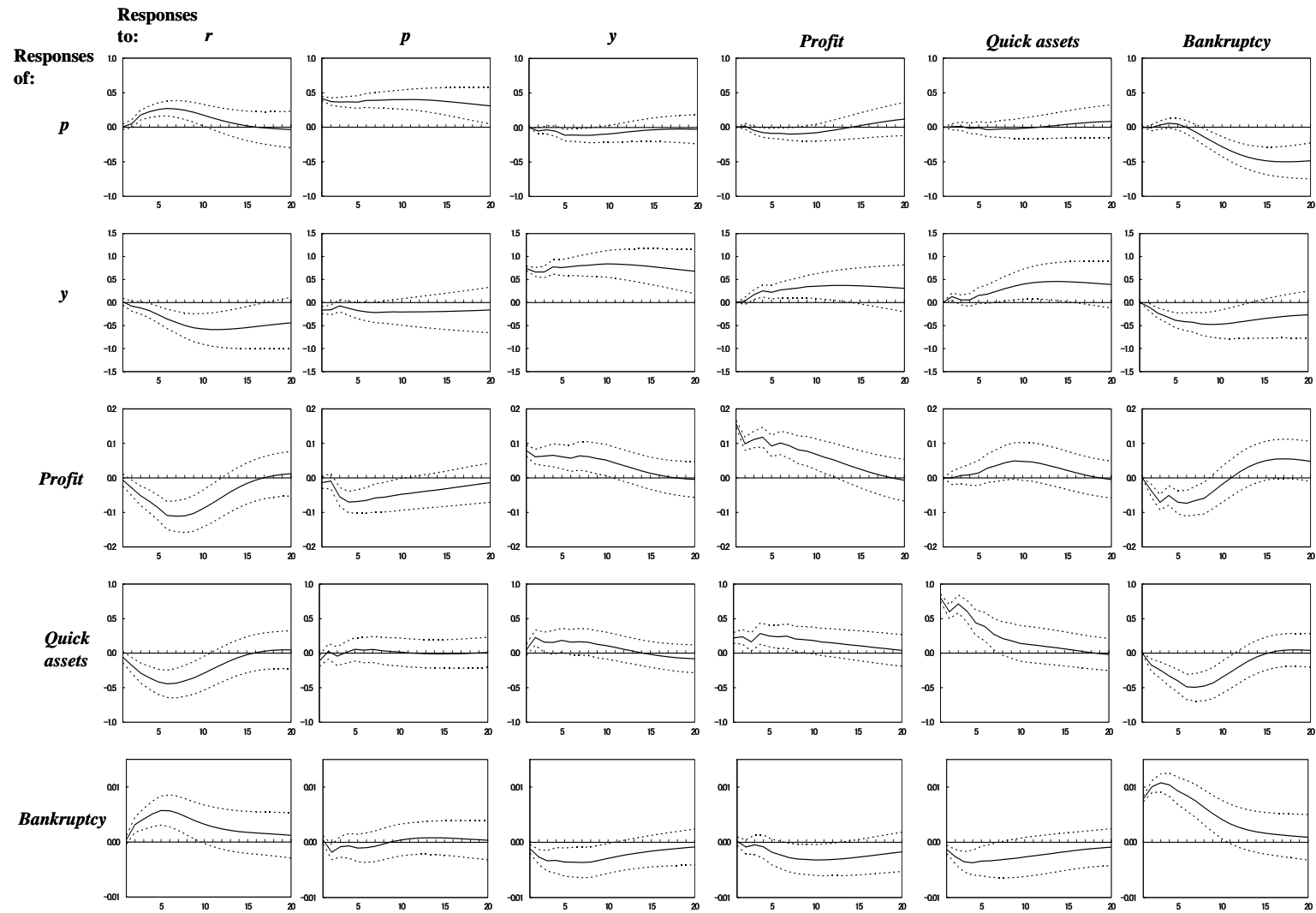


Figure 4. Impulse responses

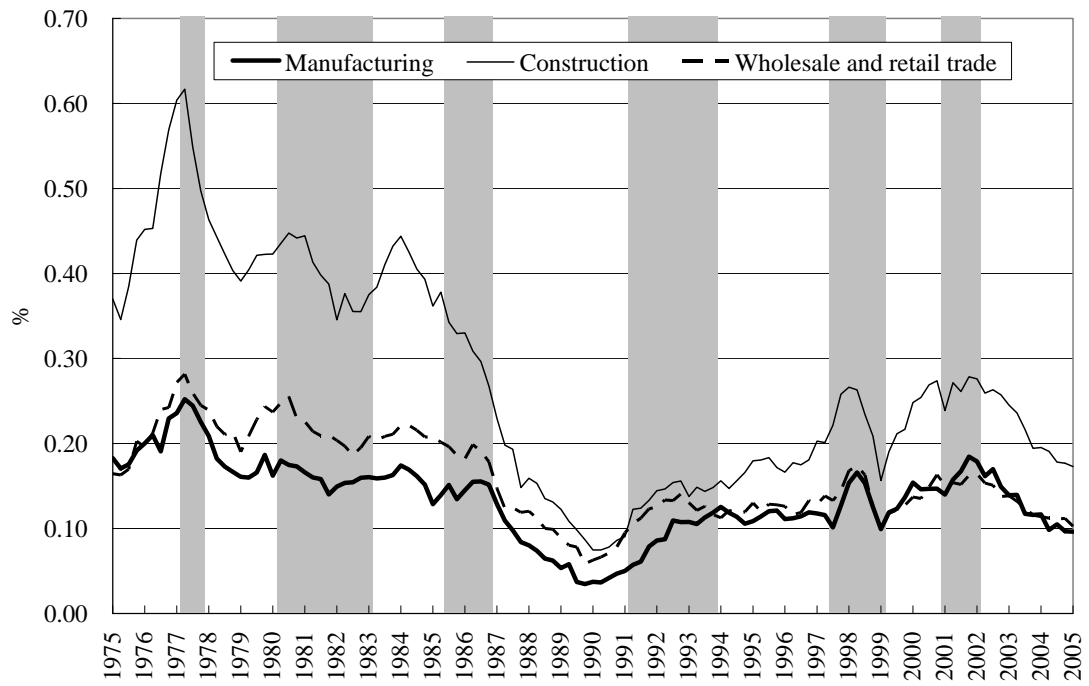
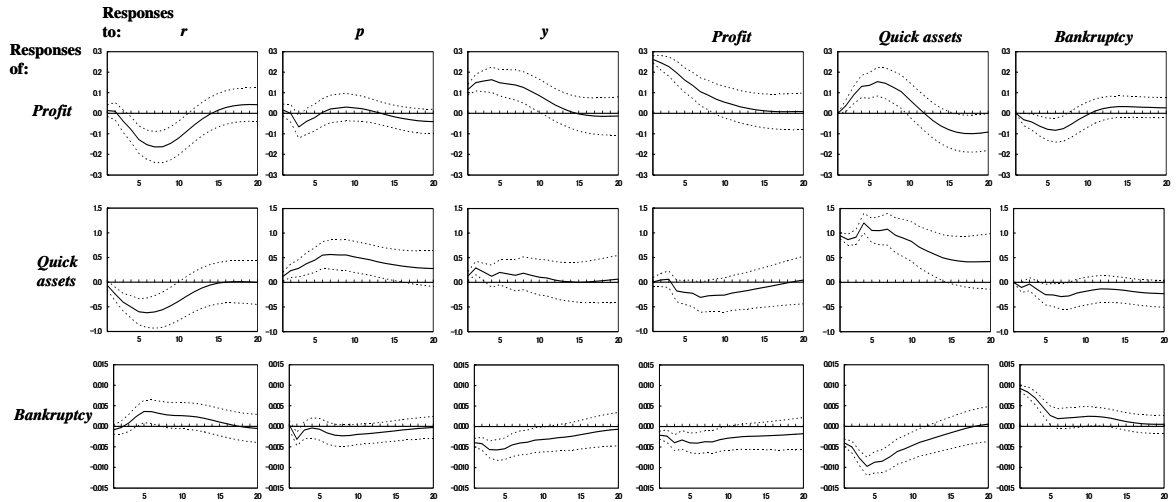
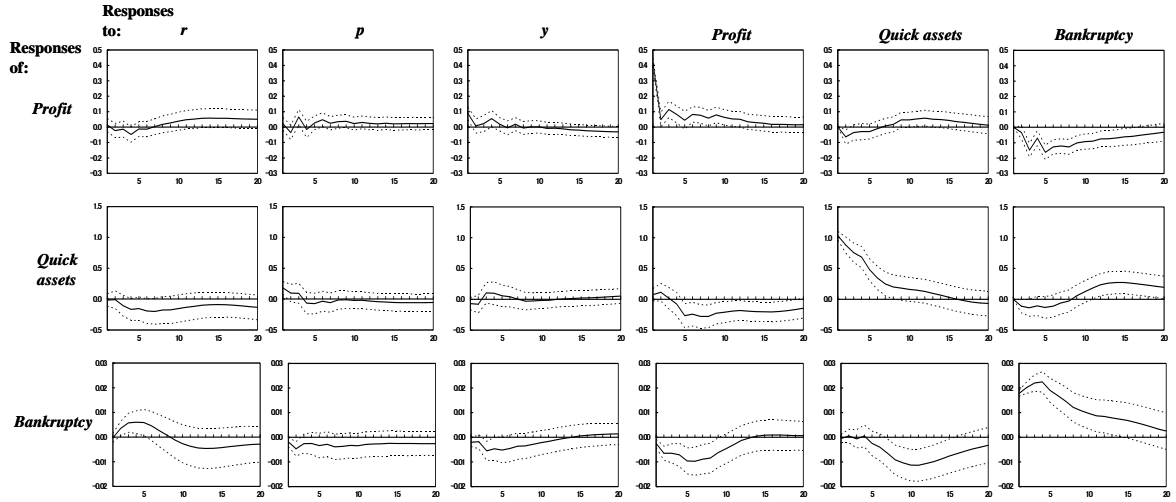


Figure 5. Bankruptcy rates by industry

(a) Manufacturing



(b) Construction



(c) Wholesale and retail trade

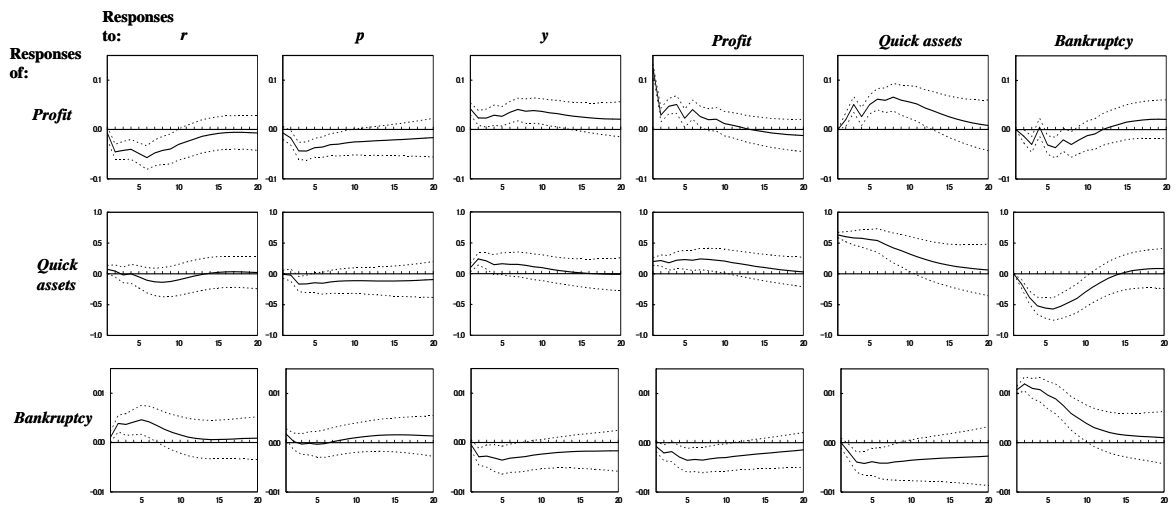


Figure 6. Impulse responses by industry

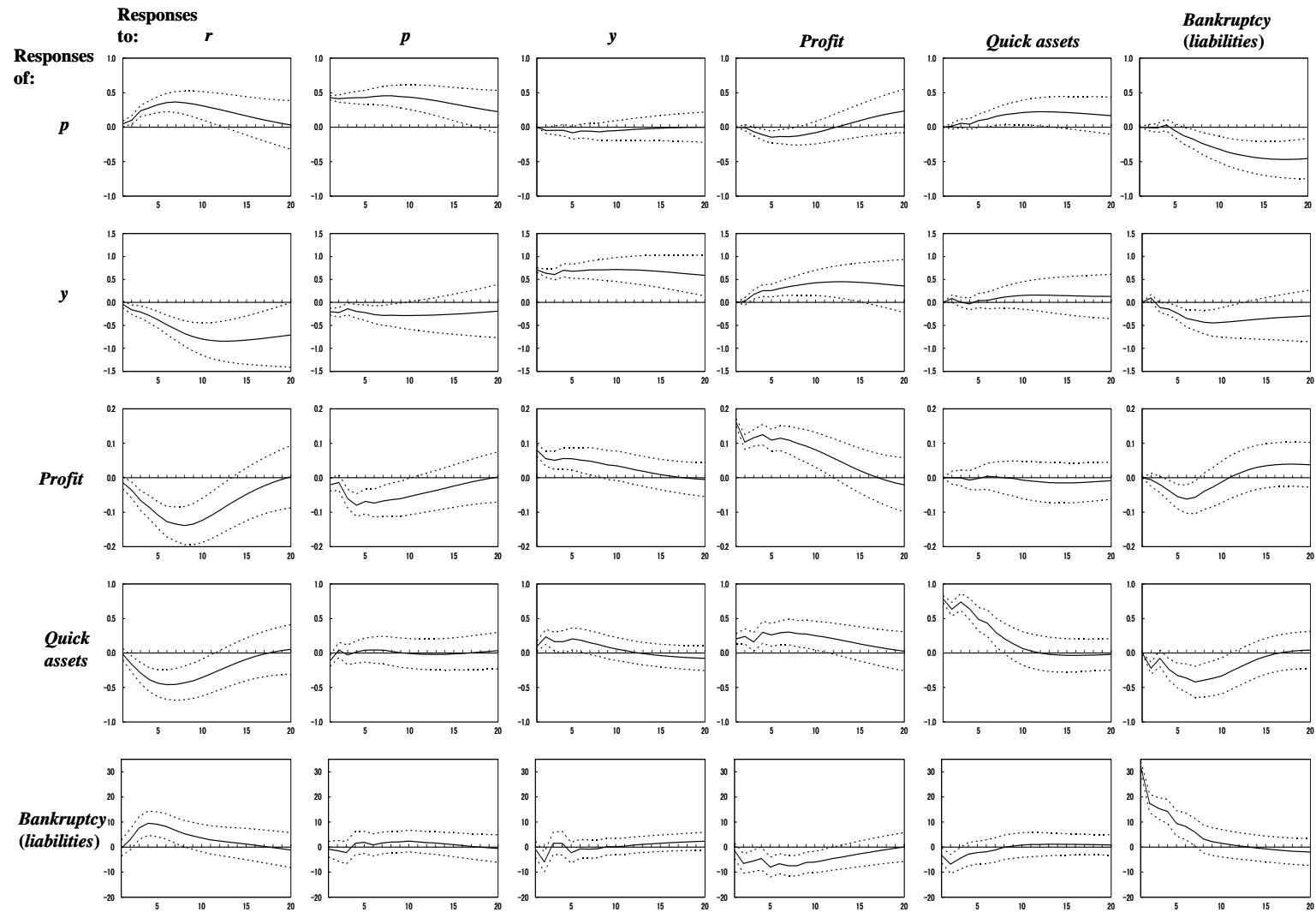
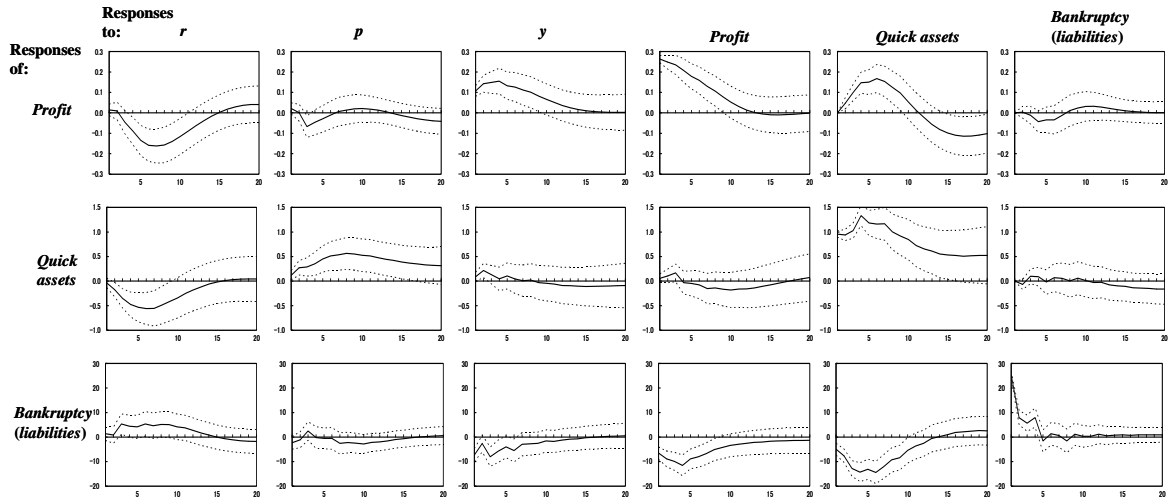
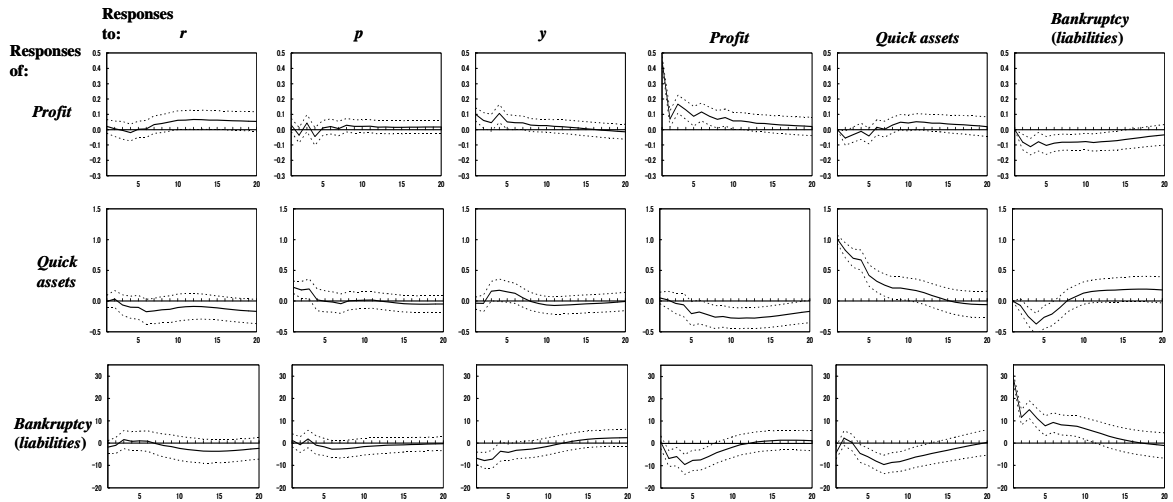


Figure A1. Impulse responses in total-liabilities model

(a) Manufacturing



(b) Construction



(c) Wholesale and retail trade

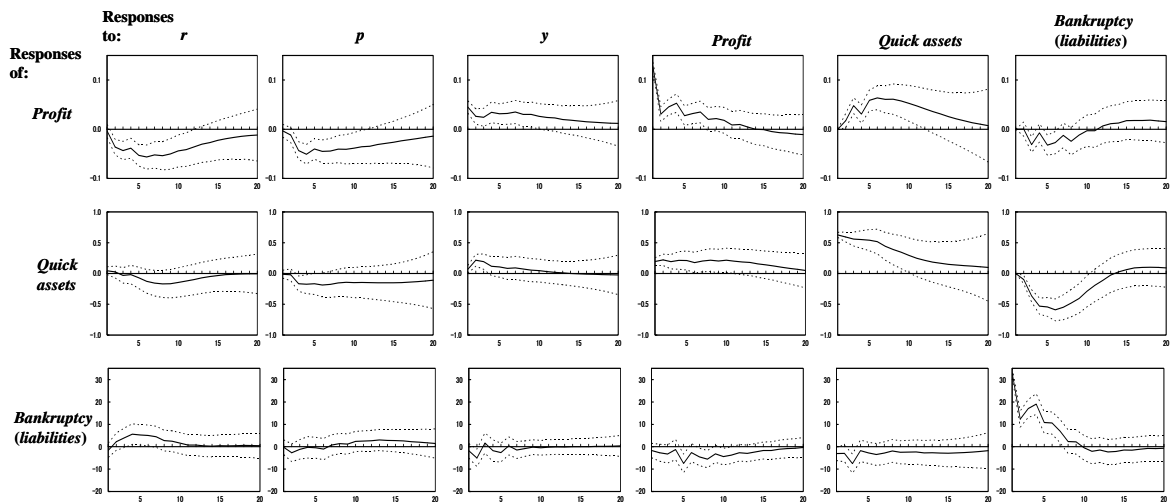


Figure A2. Impulse responses by industry in total-liabilities model