Article

Financial Anxieties of Large, Medium and Small Enterprises in Japan

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Abstract

In our previous article (2005), we investigated financial anxieties over the economy of Japan by treating the conditional variances of TARCH model as the financial anxieties. However we did not distinguish between large enterprises and small enterprises, though we differentiated the financial anxieties between all enterprises and small enterprises. The reason was that we implicitly assumed that the financial anxieties of large firms were smaller than those of small firms in the period of financial distress, since large firms could access the credit markets directly through stock and bond market. Small firms which were more dependent of bank loans were supposed to have much more financial anxieties in the financial panic than large firms.

In this article, we have quantified the financial anxieties for four different categories of enterprises: large enterprises, medium enterprises, small enterprises and adding altogether (viz., large + medium + small) as all enterprises. Also another new aspect is that we have used EGARCH model instead of TARCH, because in this model there is no need for non-negative constraints on the parameters and more importantly, it also allows for asymmetries in the variance equation. Then we have compared and explained financial anxieties for all categories through the line of history of the deflationary economy of Japan.

Our findings show the opposite results that was expected. That is to say, large firms respond to financial distress more strongly than small firms.

Keywords: Financial anxiety, precautionary demand, unit roots, EGARCH

Introduction

Kimura and Fujita (1999) proposed a new variable to capture the financial shocks as psychological change of people due to financial anxieties. They used the Corporate Financial Position Diffusion Indexes issued quarterly by the Bank of Japan known as TANKAN in order to quantify the unobservable variable over the period 1976Q2 to 1999Q3. They employed two nonstationary TANKAN indexes in TARCH (Threshold

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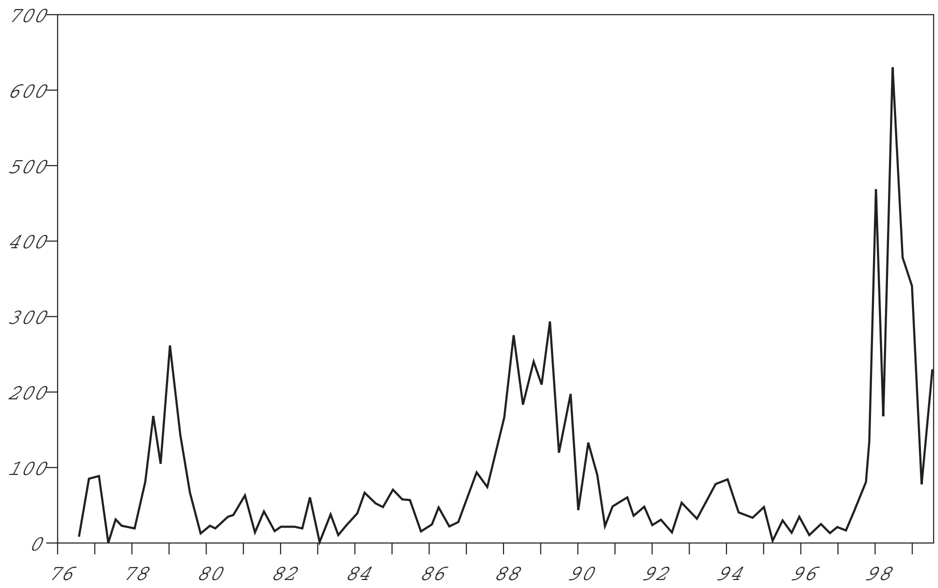

Figure 1. Financial anxieties over 1976-1999 shown by Kimura *et al* (1999)

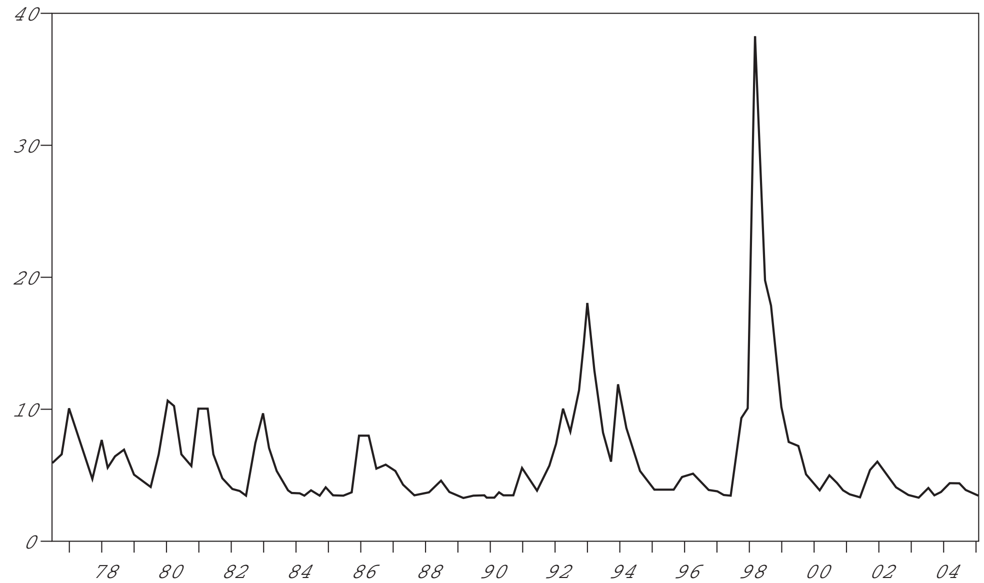

Fig 2. Financial anxieties over the period 1976-2005 by Rahman *et al* (2005)

Autoregressive Conditional Heteroscedasticity) model and treated the conditional variances as financial anxieties. However, due to rough treatment of nonstationary data, their model had been affected by unexpected parameter values and sign problems and hence couldn't explain the asymmetric properties properly. As a result, their model showed financial anxieties in the period of bubble as well as after the bust of the bubble economy, which could not be explained in economic views.

To get rid of this problem, In Rahman, Miyagawa, and Morita (2005), we improved the anxiety variable using the growth rate model for the same data but over the period 1976Q2 to 2000Q1 in TARCH and our results show financial anxieties only after the bust of the bubble. The magnitude and non-negativity conditions in estimating our TARCH model are valid in statistical sense and our estimation can exhibit the financial anxieties explicitly over the economy, which is consistent with economic views. Figure 1 shows financial anxieties by Kimura *et al* (1999) while our case is depicted in Figure 2 using TARCH model.

However, in our article the financial anxieties for all enterprises and small enterprises were only considered and the conditional variances of TARCH model was treated as the financial anxieties as well. No doubt about it that for a proper investigation, financial anxieties for different categories of enterprises should be investigated. The reason why we did not distinguish between large and small enterprises in the previous article was that we implicitly assumed that the financial anxieties of large firms were smaller than those of small firms in the period of financial distress, since large firms could access the credit markets directly through stock and bond market. Small firms which were more dependent on bank loans were supposed to have much more financial anxieties in the financial panic than large firms. For this reason, in this article, we quantified the financial anxieties for four different categories of enterprises: large enterprises, medium enterprises, small enterprises and adding altogether (viz., large + medium + small) as all enterprises.

Since TARCH model for large and medium enterprises does not follow the non-negativity condition, therefore, another new aspect is that we have used EGARCH (Exponential Generalized Autoregressive Conditional Heteroscedasticity) model instead of TARCH, because in this model there is no need for non-negative constraints on the parameters and more importantly, it also allows for asymmetries in the variance equation. Then we have compared and explained financial anxieties for all categories through the line of history of the deflationary economy of Japan.

2. Data Description

Using the same notations by Kimura and Fujita, two kinds of TANKAN diffusion indexes are used:

$DI=$<easy>minus<tight>
$\Delta rate=$<rise>minus<fall>

where DI is a rate of financial position such that <easy> (<tight>) means the percentage with which company feels financial position as easy (tight) respectively, and where $\Delta rate$ is change of interest rate with which a company borrows money from bank such that <rise> (<fall>) means the percentage with which company feels interest rate as rise (fall) respectively. The sample in TANKAN is taken from about 700 companies listed in stock exchange. For example, DI for the financial position is made as follows: Companies are asked to choose one out of three answers, 1 tight, 2 not so tight, 3 easy. The percentage share of those which answered 1 is subtracted from those which answered 3. Kimura and Fujita define a new variable $rate(t)$ as an interest rate by accumulating $\Delta rate(t)$:

$$rate(t)=\Delta rate(1)+\Delta rate(2)+\cdots+\Delta rate(t).$$

In our article, we have used the above two kinds of TANKAN diffusion indexes, DI and $\Delta rate$, for three categories of enterprises (viz., large, medium and small) over the period 1983q1 to 2004q4 and adding these three categories altogether as all enterprises for the same period.

2.1 Time Series Properties of the Variables

Time series can be characterized in many ways. In checking the time series properties, we focus on the presence or absence of unit roots or stochastic trends in each variable used in this article. In order to form a statistically adequate model, the variable should first be checked as to whether they could be considered stationary. The tests carried out are the asymptotically most powerful DF-GLS test for the null of unit root of Elliott, Rothenberg, and Stock (1996), the Kwiatkowski *et al.* (1992) LM test for the null of stationarity (KPSS) as well as the PP test of Philips and Perron (1988) for the null of unit root. A common strategy is to present results of both ADF/PP and KPSS tests, and show that the results are consistent (e.g., that the former reject the null while the latter fails to do so, or vice -versa). The lag length is selected by the Akaike Information Criteria (AIC). The results are shown in Table.1.

For financial position of all enterprises, DI_all, both the DF-GLS and PP tests are unable to reject the null hypothesis of unit root while KPSS test contradicts with this result

Table 1. Unit Root Tests

Variableslegs	lags	DF-GLS	KPSS	PP
DI_all	5	−0.106600	0.237033	−2.649835
DI_large	7	−1.724134	0.358388*	−2.188446
DI_medium	6	−1.576244	0.535899**	−1.841774
DI_small	6	−1.345984	0.508292**	−1.88296
$rate\_all$	9	0.123617	1.089169***	−2.073389
$rate\_large$	4	−2.282786	0.80669***	−1.964025
$rate\_medium$	4	−0.779368	0.778815***	−2.017522
$rate\_small$	2	−2.5799341	0.863183***	−1.794751

Note: Rejection of the null hypothesis at 1, 5 and 10 percent level of significance are denoted by ***,** and * respectively.

by accepting the null of stationarity. However, there is no strong evidence against the nonstationarity of DI_all, so we consider this variable as nonstationary process. Other DI variables for large, medium and small enterprises are to be detected as nonstationary. The same conclusion can be made for rate variable for all categories of enterprises. The first difference form of the both variables, that is ΔDI and $\Delta rate$, does not contain unit roots, which implies stationarity (not shown) according to all test procedures used in Table 1 for all categories of enterprises.

It should be mentioned that Kimura *et al* (1999) used nonstationary DI and *rate* variables for all enterprises in TARCH model for quantifying financial anxieties as conditional variances while Rahman *et al* (2005) used the same variables in differenced form for all and small enterprises.

3. Modeling Financial Time Series

Modeling financial time series is not an easy task because they possess some special characteristics (see Ruey S. Tasy (2002)). They often exhibit volatility clustering (i.e. large changes tend to be followed by large changes and small changes by small changes), often exhibit leptokurtosis (i.e., the distribution of their returns is fat tailed) and often show leverage effect (i.e. changes in stock prices tend to be negatively correlated with changes in volatility which implies volatility is higher after negative shocks than after positive shocks of the same magnitude). In order to capture the first two characteristics of financial time series, Engle (1982) propose to model time-varying conditional variance with the Auto-Regressive Conditional Heteroskedasticity (ARCH) processes that use past disturbances to model the variance of the series. Early empirical evidence shows that high ARCH order has to be selected in order to catch the dynamic of the conditional variance. The Generalized ARCH (GARCH) model of Bollerslev (1986) is an answer to this issue. It is based on an infinite ARCH specification and it allows reducing the number of estimated parameters from ∞ to only 2. Both models allow taking the first two characteristics into account, but their distributions are symmetric and therefore fail to model the third stylized fact, namely the "leverage effect". To solve this problem, many nonlinear extensions of the GARCH model have been proposed. Among the most widely spread are the Exponential GARCH (EGARCH) of Nelson (1991), the so-called GJR of Glosten, Jagannathan, and Runkle (1993). Note that the TARCH model of Zakoian (1994) is very similar to GJR but models the conditional standard deviation instead of the conditional variance.

In this article, we have used EGARCH of Nelson (1991) to model our financial time series, because in this model there is no need for non-negative constraints on the parameters and more importantly, it allows for asymmetries in the variance equation. We have used two types of TANKAN diffusion index ΔDI and $\Delta rate$ as a growth rate model as follows:

$$\Delta DI_t = \phi_0 + \phi_1 \Delta rate_t + \phi_2 \Delta rate_{t-1} + \varepsilon_t \tag{1}$$

where ε_t a random error with mean 0 and $Var_{t-1}(\varepsilon_t) = \sigma_t^2$ with $Var_{t-1}(\cdot)$ denoting the variance conditional on the information at time $t-1$ and taking the form of $\varepsilon_t = z_t \sigma_t$, where $z_t \sim$ *iid* (0, 1). Then the conditional variance is described by EGARCH(1, 1) model as:

$$h_t = a_0 + a_1 \frac{|\varepsilon_{t-1}| + \gamma \varepsilon_{t-1}}{\sigma_{t-1}} + b h_{t-1} \tag{2}$$

where $h_t = \log \sigma_t^2$. Note that when ε_{t-1} is positive or there is “good news”, the total effect of ε_{t-1} is $(1+\gamma)|\varepsilon_{t-1}|$; in contrast, when ε_{t-1} is negative or there is “bad news”, the total effect of ε_{t-1} is $(1-\gamma)|\varepsilon_{t-1}|$. Bad news can have a larger effect on volatility, and the value of γ would be expected to be negative $(\gamma < 0)$. The impact is asymmetric if $\gamma \neq 0$. Also note that the left hand side is the log of the conditional variance. This implies that forecasts of the conditional variance are guaranteed to be nonnegative for any sign of the parameters.

The basic idea in our analysis is to regard the conditional variance σ_t^2 as financial anxieties, that is, if there is a bad news or negative shock $(\varepsilon_{t-1} < 0)$ inputted to financial position at $(t-1)$-period, then σ_t^2 becomes larger at t-period than in the case of good news or positive shock $(\varepsilon_{t-1} > 0)$. This asymmetric property seems to produce larger uncertainties when a big and negative shock as financial anxieties is added to the economic system, and in such a case, an increase of precautionary demand will be expected so that many companies will keep cash in themselves against a credit crunch in a near future, while precautionary demand is not increased for a good news $(\varepsilon_{t-1} > 0)$.

3.1 Densities Assumptions

The EGARCH model is estimated using a maximum likelihood (ML) methodology. The logic of ML is to interpret the density as a function of the parameters set, conditional on a set of sample outcomes. This function is called the likelihood function.

Failure to capture fat-tails property of financial time series has led to the use of non-normal distributions to better model excessive third and fourth moments. The most commonly used are the normal (Gaussian) distribution, Student-t distribution, Skewed student-t distribution and the Generalized Error Distribution (GED). Since it may be expected that excess kurtosis and skewness displayed by the residuals of conditional heteroscedasticity models will be reduced when a more appropriate distribution is used, we consider the Student-t (including a “tail” parameter) in this study.

For the student's t-distribution, the contribution for to the log-likelihood for observation t is of the form:

$$l_t = -\frac{1}{2}\log\left(\frac{\pi(\nu-2)\Gamma(\nu/2)^2}{\Gamma((\nu+1)/2)^2}\right) - \frac{2}{1}\log\sigma_t^2 - \frac{(\nu+1)}{2}\log\left(1+\frac{z_t^2}{(\nu-2)}\right)$$

where the degree of freedom $\nu > 2$ controls the tail behavior. The t-distribution approaches to normal as $\nu \to \infty$.

3.2 Pre Estimation Test for ARCH Effects

Before estimating a full EGARCH model for a financial time series, it is usually good practice to test for the presence of autoregressive conditional heteroscedasticity (ARCH) effects in the residuals. If there are no ARCH effects in the residuals, then the EGARCH model is unnecessary and misspecified.

Fortunately, it is easy to test whether the residual ε_t in Equation (1) exhibit time-varying heteroscedasticity without actually having to estimate the EGARCH parameters. Engle (1982) derived the following test based on OLS for observations $t = -m+1, -m+2, \cdots, T$ and the OLS sample residuals $\hat{\varepsilon}_t$ are saved. Next, $\hat{\varepsilon}_t$ is regressed on a constant and m of its own lagged values:

$$\hat{\varepsilon}_t^2 = \alpha_0 + \alpha_1 \hat{\varepsilon}_{t-1}^2 + \alpha_2 \hat{\varepsilon}_{t-2}^2 + \cdots + \alpha_m \hat{\varepsilon}_{t-m}^2 + u_t \quad (3)$$

for $t = 1, 2 \cdots, T$. The sample size T times the uncentered R_u^2 from the regression of Equation (3) then converge in distribution to a chi-square variable with m degrees of freedom under the null hypothesis that $\alpha_1 = \alpha_2 = \cdots = \alpha_m = 0$ (i.e., no ARCH effects). That is, the test statistic is

$$LM = T \cdot R_u^2 \xrightarrow{A} \chi^2(m).$$

We have investigated the ARCH effects in our financial time series up to 5, 10, 15, and 20 lags in Equation (3). Table 2 shows the Engle's test results for four categories of enterprises: large, medium, small and all used in this article. In this case, the p-values for all categories and lags are essentially zero, which are smaller than the conventional 5% level of significance, so reject the null hypothesis that there are no ARCH effects. Hence we can apply our required EGARCH model for our subsequent analysis.

Table 2. Engle's test for the presence of ARCH effects

	Large Enterprises		Medium Enterprises		Small Enterprises		All Enterprises	
lags	Test Statistic	p-value	Test Statistic	p-value	Test Statistic	p-value	Test Statistic	p-value
5	67.747	0	60.371	0	33.796	0	62.077	0
10	64.665	0	59.243	0	33.927	0.002	60.713	0
15	61.516	0	55.664	0	33.998	0.003	56.907	0
20	57.927	0	52.624	0.001	33.017	0.034	54.123	0.001

4. Empirical Results

In the previous section, the unit root tests of two kinds of TANKAN diffusion indexes, financial position (DI_t), and interest rate ($rate_t$) for all categories of enterprises are carried out (Table 1) and it is concluded that DI_t and $rate_t$ are nonstationary and that ΔDI_t ($\equiv DI_t - DI_{t-1}$) and $\Delta rate_t$ are stationary. Since regressing nonstationary DI_t on nonstationary $rate_t$ and $rate_{t-1}$, implies a possibility of spurious regression, we have considered the growth rate model in estimating our EGARCH model in Equations (1) and (2) so that, ΔDI_t is regressed on $\Delta rate_t$ and $\Delta rate_{t-1}$. Table 3 contains the estimation results for large and medium enterprises while Table 4 shows for the small and all

Table 3. Estimation of EGARCH model for large and medium enterprises

	Large Enterprises			Medium Enterprises		
	Coefficient	Std. Error	z-Statistic	Coefficient	Std. Error	z-Statistic
ϕ_0	−0.1762	0.2489	−0.7079	0.20177	0.23579	0.8557
ϕ_1	−0.019942	0.011101	−1.7964	0.00352	0.010347	0.3402
ϕ_2	−0.0027974	0.11318	−0.2472	−0.0085568	0.009618	−0.8897
	Conditional Variancea			Conditional Variancea		
a_0	0.165	0.08078	2.0426	0.24196	0.14815	1.6332
b	0.9104	0.03861	23.5793	0.83945	0.089103	9.4212
a_1	−0.61678	0.24285	−2.5398	−0.73396	0.34529	−2.1256
γ	−0.2066	0.09257	− 2 .2318	−0.28992	0.13842	−2.0945

Table 4. Estimation of EGARCH model for small and all enterprises

	Small EnterprisesAll			Enterprises		
	Coefficient	Std. Error	z-Statistic	Coefficient	Std. Error	z-Statistic
ϕ_0	−0.17539	0.225995	0.6747	0.082832	0.1228	0.6745
ϕ_1	0.018033	0.011166	1.6150	−0.012148	0.0079334	−1.5313
ϕ_2	−0.025149	0.01386	−1.8145	−0.0025345	0.008795	−0.2882
	Conditional Variancea			Conditional Variancea		
a_0	0.53791	0.69547	0.9033	0.16479	0.059309	2.7784
b	0.61309	0.43927	1.3957	0.8609	0.048653	17.6945
a_1	0.33101	0.31764	1.0421	−0.77176	0.30741	−2.5105
γ	−0.132	0.1986	−0.6647	−0.30392	0.10984	−2.7668

enterprises for the EGARCH model.

The sign of all parameters seem to be reasonable in economic sense. Since a rise of DI_t implies easy financial position and a rise of $rate_t$ means that of interest rate, in conditional mean equation ($\phi_1+\phi_2$) should take a negative value. The parameter γ in conditional variance equation takes a negative value and hence the conditional variance is shown to exhibit asymmetric property. Z-statistic for estimated parameters in conditional variance are almost significant at a standard level of significance while in the conditional mean equation the significance levels of the estimated parameters are not sufficient.

The conditional variances of the estimated EGARCH model are quantified as the financial anxieties. Figures 3, 4, 5, and 6 depict the financial anxieties for large, medium, small and all enterprises respectively. Also for clarity to compare the magnitudes, the anxiefies of large, medium and small enterprises are depicted in the Figure 7 as well.

Those figures show that financial anxieties for all enterprises rapidly increased in 1997 when the Japanese economy encountered the several adverse shocks including financial consolidation and the East Asian economic crisis. However we find the different amount of anxieties by the size of enterprises. The large enterprises respond much more strongly and promptly to the negative shocks than the medium and small enterprises. This observation is quite different from our assumption. We assumed that the financial anxieties of large enterprises would be smaller and slower than those of small and medium enterprises. Even if banks adopted a stringent attitude toward lending to the enterprises, the large enterprises are generally thought to raise the funds by way of another route except for bank lending. However our results show that even large enterprises are not free from the financial distress from 1997 through 1998. Thus, we might say that the financial panics had very serious affects not only on the small and medium enterprises but on the large enterprises, and rapidly decreased the business fixed investment and caused lots of

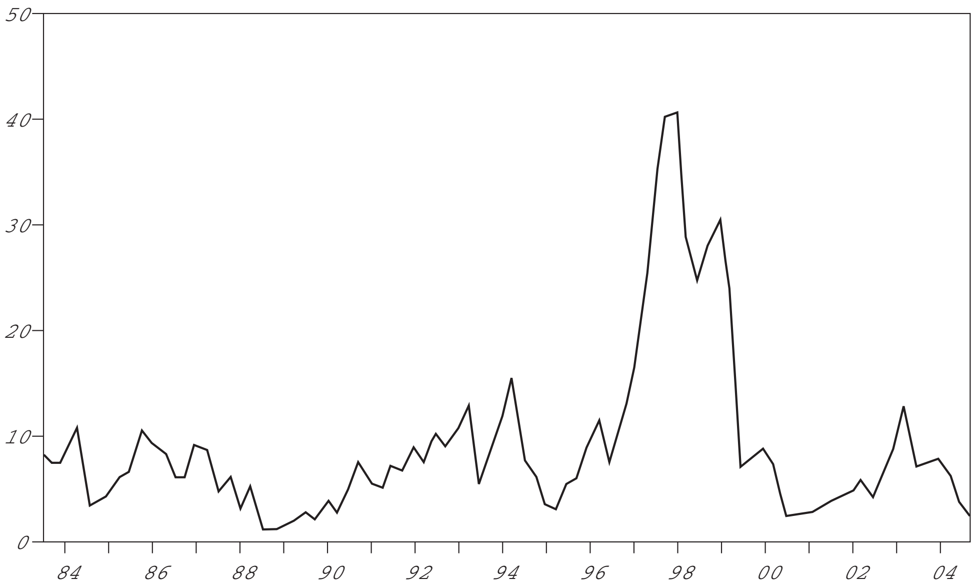

Figure 3. Financial Anxieties for Large Enterprises (1983q1-2004q4)

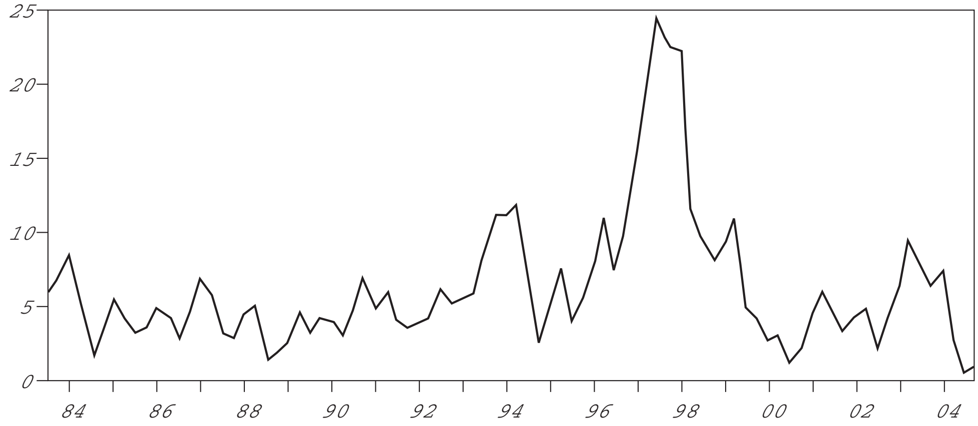

Figure 4. Financial Anxieties for Medium Enterprises (1983q1-2004q4)

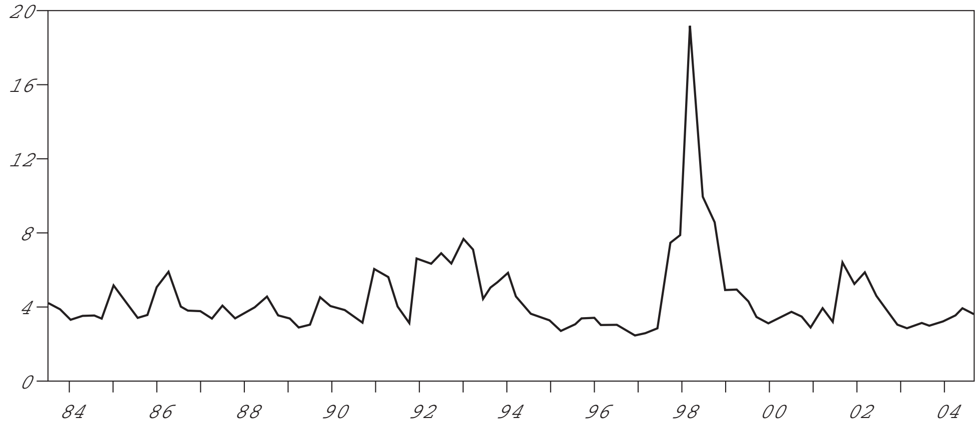

Figure 5. Financial Anxieties for Small Enterprises (1983q1-2004q4)

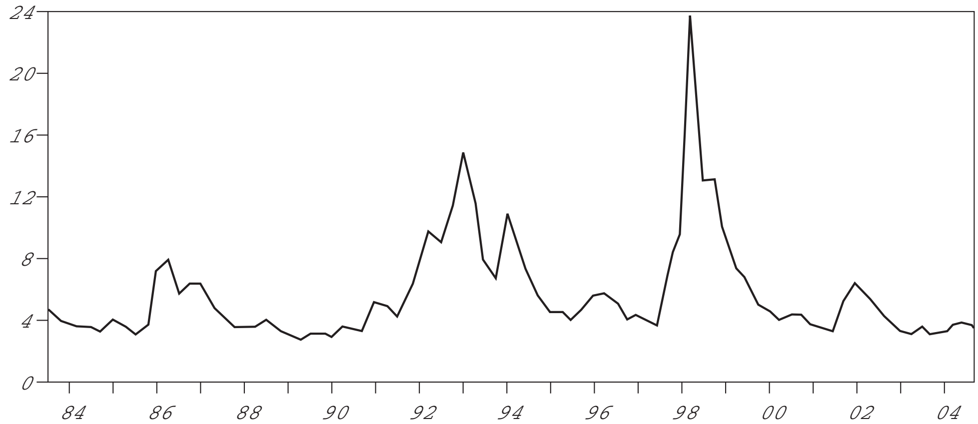

Figure 6. Financial Anxieties for All Enterprises (1983q1-2004q4)

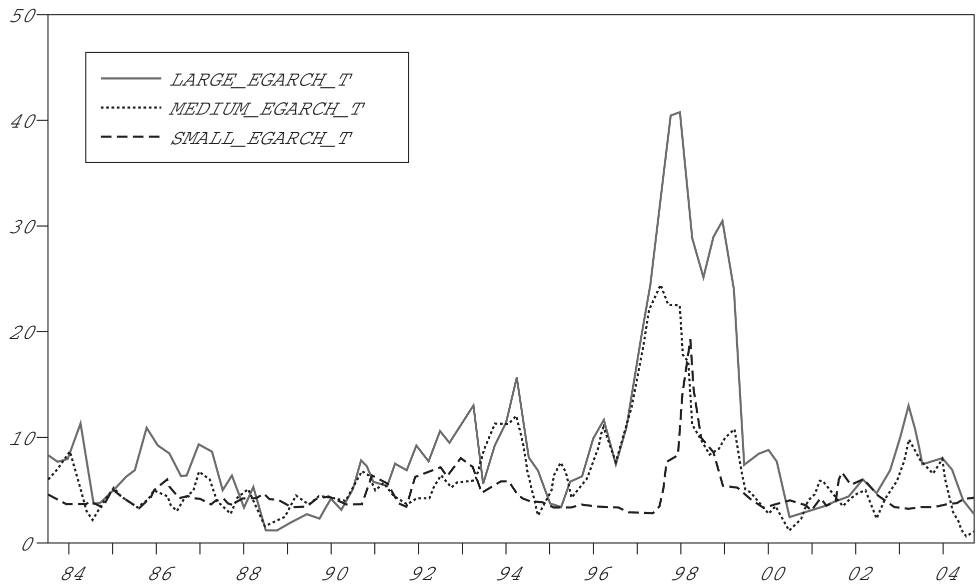

Figure 7. Financial Anxieties for Large, Medium and Small Enterprises

bankruptcies, and deepened the recession.

5. Conclusion

We recalculated the financial anxieties over the Japanese economy especially focusing on the period after the burst of the bubble when banks under pressure to increase their risk adjusted capital ratio to meet the international BIS standard contracted sharply their lending. We improved our previous paper in two points. First point is that we quantified the financial anxieties for four different categories of enterprises: large enterprises, medium enterprises, small enterprises and adding altogether (viz., large + medium + small) as all enterprises. Second point is that we have used EGARCH model instead of TARCH, because in this model there is no need for non-negative constraints on the parameters and more importantly, it also allows for asymmetries in the variance equation.

We could get the results, which are more statistically satisfactory than our previous paper by using EGARCH model. We also found that large, middle and small enterprises differently reacted to financial distress. Our results show that large enterprises feel more financial anxieties than medium and small enterprises in the periods from 1997 through 1998 when several big banks and security companies failed and so called credit crunch occurred in Japan. It is our surprising that large enterprises which can access the credit market directly through stock and bond market feel more financial anxieties than small and medium enterprises which heavily depend on bank loan. The financial distress from 1997 through 1998, thus, would be thought to give very serious negative shock on even large enterprises and pushed down the Japanese economy into very critical situation.

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