Idiosyncratic Risk and Creative Destruction in Japan

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Abstract

The dramatic rise and fall of the Japanese equity market provides us with a unique opportunity to examine market-and firm-specific risks over different market conditions. Contrary to the U.S. experience, we document a surprising fall in firm-level volatility and turnover in Japanese stocks after the market crash. Accordingly, correlations among individual stocks have increased and the number of stocks needed to achieve a given level of diversification has declined. As a consequence, we suggest that it has become more difficult over the past decade for both investors and managers to separate high-quality from low-quality firms, making the Japanese market less efficient. Moreover, changes in firm-level volatilities are positively related to corporate bankruptcies, indicating that improvements in information efficiency occur when regulations on corporate bankruptcies are relaxed. These results suggest that the sharp fall in firm-level volatility during the 1990-1996 period could be due to a lack of corporate restructuring. This is more evident for firms with business group and main bank affiliations, whose firm-level volatility is less dependent on economic conditions than that of firms with no affiliations. Thus, we argue that a lack of "creative destruction" may have led to Japanese market inefficiency and a vicious cycle of capital misallocation.

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> It was the best of times, it was the worst of times, it was the age of wisdom, it was the age of foolishness, it was the spring of hope, it was the winter of despair, we had everything before us, we had nothing before us, we were all going direct to Heaven, we were all going direct the other way. –Charles Dickens, "A Tale of Two Cities"

The chronic stagnation of the Japanese economy is a huge puzzle. Once a shining light for both developing and industrialized nations, it has now become a basket case for bubble economies. Eleven years after its stock market bubble burst, a great country - an economy with a strong labor force, huge capital endowment, advanced technology, and stable government - is still operating far below its potential productive capacity. While numerous arguments have been advanced to explain the recent plight of the Japanese economy, most have focused on lack of consumer demand, collapsing asset values, and non-performing loans.[2] This paper offers a unique perspective by studying the roles of Japanese equity markets. In particular, we document a sharp fall in firm-level volatility and turnover and a noticeable increase in Japanese stock market volatility following the crash. We explore the possible causes of these events as they relate to information efficiency and the lack of corporate restructuring after the crash.

Campbell, Lettau, Malkiel, and Xu (2001) were the first to provide a comprehensive study of idiosyncratic risk for U.S. stocks. During the period from 1962 to 1997, they discovered a noticeable increase in firm-level volatility relative to market volatility. Accordingly, correlations among individual stocks and the explanatory power of the market model for a typical stock declined. Moreover, they found that all volatility measures (market, industry, and firm) move together counter-cyclically in the U.S. In other words, firm-level volatility tends to *increase* during a recession. Contrary to U.S.

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[2] See for example, Krugman (1999).

results, this paper finds a sharp *reduction* in firm-level volatility relative to market volatility immediately following the Japanese market crash. Accordingly, correlations among individual stocks have increased. As a result, there is a reduction in market information efficiency using the R^2 measure developed by Durnev, Morck, and Yeung (2001). In addition, we find that while market-wide volatility has increased, there is a significant drop in the variation of systematic risk across firms.

In order to understand the abnormal behavior of idiosyncratic risk in Japan, we examine the impact of Japanese bankruptcy as well as business group affiliation on firm-level volatility. If idiosyncratic volatility conveys signals about asset reallocation,[3] an increase in corporate bankruptcies should improve information efficiency. In fact, we discover a positive correlation between changes in aggregate firm-level volatility and corporate bankruptcies. There is also some evidence that increasing bankruptcies after 1997 have led to higher firm-level volatility. These results suggest that the sharp fall in firm-level volatility during the 1990-1996 period could be due to a lack of corporate restructuring.

By comparing firm-level volatility of *keiretsu* (group-affiliated) firms and non-*keiretsu* firms, we find that a decrease in industrial production growth tends to increase the difference of firm-level volatility between non-*keiretsu* and *keiretsu* firms. That is, the lower the growth, the higher the firm-level volatility of non-*keiretsu* firms compared to *keiretsu* firms. This means that during the recession period in Japan, there was a greater disparity of stock performance among non-*keiretsu* firms, indicating the presence of protection among group-affiliated firms. We find similar results when comparing the firm-level volatility between firms with main banks and firms without main banks. Thus,

[3] See Wurgler (2000) and Durnev, Morck, Yeung , and Zarowin (2002).

idiosyncratic volatility for firms with business group and main bank affiliations is much less responsive to economic conditions than that of firms without such affiliations, suggesting that weak firms with business group and main bank affiliations may have been protected during most of the 1990s.

This anomalous behavior of firm-level volatility may help us understand the poor performance of the Japanese economy over the last decade since disaggregated volatility measures could impact aggregate output in several ways.

First, macroeconomic models of "cleansing recessions," such as those described by Caballero and Hammour (1994), Eden and Jovanovic (1994), emphasize the impact of firm-level volatility on resource allocation during recession. A recession may increase the arrival rate of information about management quality and thus increase resource reallocation from low-quality to high-quality firms. Such resource reallocation is enhanced in the U.S. because firm-level volatility moves counter-cyclically. To the extent that Japanese market downturns are accompanied by a *reduction* in firm-level volatility, and thus a reduction in the arrival of firm information, it is more difficult for investors to distinguish low-quality from high-quality firms, thereby reducing the effectiveness of the cleansing mechanism. This view is consistent with recent empirical studies conducted by Durnev, Morck, and Yeung (2001), who find that firms in industries with greater firm-specific return variation exhibit a higher quality of capital budgeting, in that their profitability indices (marginal Q ratios) are closer to one (or to a tax-adjusted benchmark).

Second, a reduction in firm-level volatility as well as in the variation of systematic risk among firms leads to a more homogeneous firm valuation, implying that

Japanese stocks were treated much less discriminatingly after the crash. Thus, both low-quality and high-quality firms had a similar cost of capital. As a result, high-quality firms were unable to leverage their advantage in obtaining low-cost capital as long as low-quality firms continued to have similar access to equity capital. In short, the bad firms were not held accountable, and the good firms were not rewarded. The "creative destruction" observed in the U.S cannot take hold in Japan. This is consistent with a recent study by Wurgler (2000), showing that countries with stock markets that impound more firm-specific information into individual stock prices exhibit a better allocation of capital. Wurgler suggests that efficient secondary information market prices can help investors and managers distinguish good investments from bad ones.[4]

The reduction in firm-level volatility may also explain the increasing trend in market-wide volatility. When idiosyncratic volatility drops, firms face increasing difficulty in raising additional financing from banks and securities markets, because it becomes harder to distinguish the good from the bad firms. As a result, more and more companies are treated like "lemons" in financial markets, weakening their ability to sustain any economy-wide shocks. Such increasing vulnerability of firms to economic shocks induces higher market volatility.

This paper builds on the growing literature exploring the relationship between financial markets and economic growth.[5] While it is based on the methodology developed by Campbell, Lettau, Malkiel, and Xu (2001), we have introduced a number of

[4] See also Morck, Yeung, and Yu (2000) and Durnev, Morck, Yeung, and Zarowin (2002).

[5] King and Levine (1993), Levine (1998), Levine and Zervos (1998), Beck, Levine, and Loayza (1999), Demirguc-Kunt and Maksimovic (1998) demonstrate that firms in financially developed countries grow faster. Rajan and Zingales (1998) show that industries that are externally financed grow faster in financially developed countries. Jayaratne and Strahan (1996) discover that economic growth increases in states that have less stringent intrastate banking restrictions.

methodological innovations. First, we employ a duo-factor model of Lo and Wang (2001) to gain a more accurate measure of firm-level volatility and trading volume in a multifactor setting. Second, we use a recently developed consistent statistic by Xu (2001) to determine the number of factors in the duo-factor model.

The paper is organized as follows. Section I provides a brief description of the data and the various specifications for estimating firm-specific volatilities, including a simple market model, the Fama and French (1993) three factor-model, the Xu and Malkiel (2001) approach, as well as a multi-factor APT model. Section III presents our empirical results. Section IV studies the relationship between aggregate firm volatility and Japanese business cycle variables as well as some unique firm-level volatility behavior of Japanese business groups. It also suggests some factors that may have influenced the apparent decrease in idiosyncratic volatility and its potential impact on the Japanese economy. Section V presents concluding comments.

I. Measuring Idiosyncratic Volatility

A. Data and Background

Much of modern finance theory strives to establish a quantitative relationship between risk and return. In some sense, the success of each theory hinges on measuring risk. In general, there are two types of risks for individual securities: systematic risk, which is determined by common risk factors; and idiosyncratic risk, which is the residual risk. Since idiosyncratic risk can be diversified in standard finance theory, its role has been largely ignored. Campbell, Lettau, Malkiel, and Xu (2001) suggest that idiosyncratic volatility has increased substantially over the past decade due to the trading behavior of institutional investors and the pursuit of growth objectives by many individual companies (see also Xu and Malkiel, 2001). The rise in idiosyncratic risk makes it more difficult for individual investors trying to diversify the risk. In this paper, we take a new look at idiosyncratic risk from the perspective of Japanese corporate restructuring and use it as a proxy for measuring "creative destruction."

We examine all stocks listed on the First and Second Sections of the Tokyo Stock Exchange (TSE). The data used in this paper come from different sources. Monthly individual stock returns and volume, and annual financial statements (for book value of equity) data are from the PACAP Japan database. Short-term interest rates are from updates of the database presented in Hamao (1991). GDP and industrial production data are from the Ministry of Economy, Trade, and Industry. Bankruptcy data are provided by the Nomura Research Institute and Tokyo Shoko Research.

The period covered in this study is from 1975 to 1999. The entire sample period is divided into five 5-year periods. The first two periods (1975-1979 and 1980-1984) are before the bubble; the third (1985-1989) is the bubble period, and the last two periods (1990-1994 and 1995-1999) correspond to the post-crash era. The numbers of stocks in each sub-period are 1174, 1275, 1368, 1521, and 1607, respectively.

While a thorough account of Japanese economic history during this sample period is beyond the scope of this paper, we provide a brief summary of events as background information.

After a post-World War II high growth period (1956-1973, average annual GDP growth rate of 9.2%), Japan entered a lower growth period, triggered by the oil crises. Average annual GDP growth rate during the period from 1974 to 1990 was 3.8%. Our sample period starts in 1975, which is around the beginning of this medium-growth period. In the latter period of our sample, Japan's growth rate dropped further to an average of 1.3% (1991-2000). This low- or no-growth period corresponds with the aftermath of the crash of the financial market bubble.

Soon after the Plaza Accord of 1985, the value of the yen rapidly appreciated against the U.S. dollar from 250yen/$ in May 1985 to 170yen/$ in May 1986, and then to 144yen/$ in May 1987. Facing such currency appreciation, Japan, traditionally dependent on exports, needed to stimulate domestic demand in order to avoid recession. The Bank of Japan took a decidedly low interest rate policy. The official discount rate was lowered to 2.5% in February 1987 and was not raised until 1989. In addition to the expansive monetary policy, credit in general was easy to obtain. This was because commercial banks were losing traditional clients (borrowers) to the now deregulated capital markets. On the other hand, because of the slow deregulation of the securities business, individuals did not have attractive alternative financial products and a substantial portion (more than 50%) of individual financial assets was still held as bank deposits. Banks, therefore, were actively seeking new clients who typically borrowed using their land and stock holdings as collateral and often invested further in land and stocks. Banks were heavily protected by the Ministry of Finance through the so-called "convoy system," which essentially guaranteed that no bank would fail. Given this implicit government guarantee and the loose corporate governance which resulted from cross-shareholding, the Japanese banking system landed itself in a huge case of moral hazard. Banks and their affiliated financial institutions easily funded stock and land speculators as well as businesses with optimistic expansion plans. Stock and land prices soared, but the general price level remained stable.

Interest rates were finally raised in 1989 and 1990 in order to contain the bubble. The market started to crash in 1990, and bank balance sheets deteriorated with bad loans. Since then Japan has been slow in dealing with the problems that arose in the aftermath of the collapse of bubble. Although the banking problem had been well recognized since the early 1990s, it was not publicly acknowledged until the first failure of a major bank (Hokkaido Takushoku Bank, in November 1997). In late 1998, two more major banks (Long-Term Credit Bank and Nippon Credit Bank) ultimately failed and were nationalized. In March 1998, 15 major banks reluctantly received injections of tax money totaling 7.45 trillion yen. The bad loan problem has not improved much since then, as the economy went into another round of recession. Ongoing discussion of the necessity of a second round of bank bailouts continues. The public press often refers to the 1990s as Japan's "lost decade."

B: Model Specification

Since our study focuses on idiosyncratic risk, we use idiosyncratic volatility to measure it directly. Unlike total volatility, uncovering idiosyncratic volatility depends on an asset pricing model. As a start, we use the popular market model to decompose the total return into systematic and idiosyncratic components. That is, we run the following model,

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_{m,i}(R_{M,t} - R_{f,t}) + \varepsilon_{i,t} \quad , \tag{1}$$

where $R_{i,t}$, $R_{M,t}$, $R_{f,t}$ are the individual stock return, the value-weighted market return, and the risk-free rate, respectively. We measure idiosyncratic volatility using the root mean square of residuals, $\varepsilon_{i,t}$.

The market model may be misspecified if we fail to measure the market return or if other risk factors exist, as suggested by the APT model. Despite the fact that we cannot perfectly rationalize the factors used in Fama and French (1993), their three-factor model is considered as "state of art" from an empirical perspective. Furthermore, Chan, Hamao, and Lakonishok (1991) and Daniel, Titman, and Wei (2000) document that size and book-to-market ratio are significant determinants of the cross-section of Japanese stock returns. Therefore, we will also use the three-factor model to decompose the total return as,

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_{m,i}(R_{M,t} - R_{f,t}) + \beta_{SMB,i} R_{SMB,t} + \beta_{HML,i} R_{HML,t} + \varepsilon_{i,t} \quad , \qquad (2)$$

where $R_{SMB,t}$, $R_{HML,t}$, are the return proxies for the size variable and the book-to-market variable, respectively. Again, idiosyncratic volatility is computed as the root mean square of residuals, $\varepsilon_{i,t}$. We have followed the exact procedure of Fama and French (1993) to construct the two proxies for the size and book-to-market variables.

Campbell, Lettau, Malkiel, and Xu (2001) have proposed a model-free decomposition procedure based on daily data. Although this approach only applies to computing the total aggregate idiosyncratic volatility, this measure is the focus of this paper. Since we are using monthly stock returns in this study, we follow a modified approach developed by Xu and Malkiel (2001). Specifically, the total aggregate volatility σ_{TV}^2 is calculated by value weighting an individual stock's total volatility $\sigma_{i,TV}^2$.

The aggregate idiosyncratic volatility σ_{IV}^2 is then computed as the difference between the total aggregate volatility and the market volatility.

Since volatilities in general are unobservable, we apply rolling statistics as used in Xu and Malkiel (2001) to estimate them efficiently. The optimal weights are suggested by Foster and Nelson (1999) with a functional form of $e^{-\alpha t}$, where $\alpha T=\sqrt{3}$. In particular, we choose window length T=12 for our monthly return as suggested in Xu and Malkiel (2001). This approach is applied to estimate both the total volatility and the market volatility.

No matter whether we use the market model or the Fama and French three-factor model, it is still possible that our measurement of idiosyncratic volatility represents other missed factors. Therefore, we extend our analysis by utilizing multi-factor asset pricing models. Recent empirical work by Cremers and Mei (2002) shows a close relationship between idiosyncratic volatility and turnover in the U.S. data. To confirm our results regarding Japanese idiosyncratic volatility, this paper applies the duo-factor model of Lo and Wang (2000) in constructing idiosyncratic volatility and turnover measures.

First, let us summarize the framework we adopt. Assume that asset *i* returns are generated by an approximate *K*-factor model:

$$R_{it} = E_t(R_{it}) + f_{1t}\beta_{i1} + \ldots + f_{Kt}\beta_{iK} + e_{it} \qquad i = 1,\ldots,N; \quad t = 1,\ldots,T \ , \qquad (3)$$

where $f_t' = (f_{1t},\ldots,f_{Kt})$ is a vector of unobservable pervasive shocks, $(\beta_{i1},\ldots, \beta_{iK})$ is a vector of factor loadings which are constant over the sample period, and e_{it} represents an idiosyncratic risk specific to asset *j* at time *t*. We also assume that e_{it} has mean zero and is orthogonal to f_{kt}. As discussed in Chamberlain (1983), the above economy implies the following linear pricing relationship if there exist K well-diversified portfolios:[6]

$$E_t(R_{it}) = r_{ft} + \lambda_{1t}\beta_{i1} + ... + \lambda_{Kt}\beta_{iK}, \quad (4)$$

where $(\lambda_{1t},..., \lambda_{Kt})$ is a vector of risk premiums corresponding to the pervasive shocks $(f_{1t},...,f_{Kt})$, and r_{ft} is the return on a riskless asset.

Parallel to Equation (4), Lo and Wang (2000) derive the proposition that the turnover of each stock also has an approximate K-factor structure under certain regularity conditions. More formally, we have:

$$\tau_{it} = \tau_i + \delta_{i1}g_{1t} + ... + \delta_{iK}g_{Kt} + \xi_{it} \quad (5)$$

Here, δ_{ik} is the exposure of firm i to economy–wide liquidity shocks g_{kt}. g_{kt} could be a function of f_{kt} but it is not specified in the model, and τ_i is a constant. ξ_{it} has mean zero and it is assumed to be orthogonal to g_{kt}. Since both (4) and (5) are both multi-factor models, we will simply call them the duo-factor model for return and volume. While Lo and Wang (2000) also derived the conditions under which the number of actors in (4) and (5) are equalized, our main interest here is to use (4) and (5) to derive measures of idiosyncratic volatility and turnover.

An important issue in measuring idiosyncratic volatility and turnover is the correct identification of the number of factors in (4) and (5). Until now, this crucial parameter is often assumed, rather than determined by the data.[7] A small number of papers in the asset pricing literature have considered the problem of determining the

[6] Connor (1984) derived a similar result under the condition that the asset supplies are well diversified.
[7] Brown and Weinstein (1983) emphasized the importance of obtaining correct estimates on the number of factors. They pointed out that the common practice of using an over-estimate would cause spurious rejection of asset pricing models. They note: "…the rejection of the five and seven factor versions is to be expected if the three factor version is correct."

number of factors in a multifactor model, but the present study differs from them in important ways.[8] This paper introduces a formal statistical procedure that can consistently estimate the number of factors from observed data. This procedure is developed by Xu (2001) under the assumption that both N and T converge to infinity. This extension is of empirical relevance because it fully exploits the advantage of a large panel data set. In addition, our empirical study employs an approximate factor structure for both returns and trading volume. Our results hold under heteroskedasticity in both the time and cross-section dimensions, thus rendering them more general than the results of Connor and Korajczyk (1993) who assume homoskedasticity over time. Our results also hold under weak serial and cross-sectional dependence.

III. Time-Varying Market Volatility and Idiosyncratic Volatility

A fascinating fact about the U.S. equity market is that, while the overall market seems relatively calm, idiosyncratic volatility has shown a steady increase over the past decade. Although the financial world has become increasingly integrated, the Japanese equity market has gone through different cycles. It is, therefore, of interest to examine this issue with respect to the Japanese equity market.

A. Examining the Overall Market

We first plot aggregate returns and trading volume of the Tokyo Stock Exchange. As Figure 1 illustrates, the market experienced a rapid run-up after 1985, and it peaked in

[8] Roll and Ross (1980), for example, employ a likelihood ratio test using an exact factor model with normality assumptions. Connor and Korajczyk (1993) develop a test for the number of factors in asset returns under sequential limit asymptotics. Mei (1993) proposes a semi-autoregressive approach to determine the number of factors.

December 1989. This period, now widely known as the "bubble period," was followed by a rapid decline of the market and a consequent series of ups and downs. For simplicity, we will call the 1990-1994 period "the crash period" and the 1995-1999 period "the post-crash period." In the 1990s, the index value stayed between ½ to 2/3 of its peak and there was a sharp fall in trading volume.

In order to better understand our data, we show summary statistics in Table 1. The first item reported in Table 1 is the mean and standard deviation of the value-weighted market return (R_M). The mean market return is positive in the first three periods, with a high 2.8% per month return in the 1985-1989 period. In the last two periods, however, the market on average earned negative returns. The standard deviation of market return shows a rising trend. Next, we report the cross-sectional median, mean, and standard deviation of individual stock returns averaged over time ($\bar{R}_i$). The mean and median of $\bar{R}_i$ show a similar pattern to that of the market return, but the standard deviation does not have a clear-cut trend as the market index does.

The results of the market model estimation for individual stocks are reported in the next three columns. We first notice a significant reduction in the cross-sectional variation of firm betas, $\beta_{i,CAPM}$, from 0.447 to 0.321 from the bubble period to the crash period. We also note a remarkable change in the R^2 of the market model. On average it is 13% and 10% in the earlier, pre-bubble periods, but increases to 17% during the bubble period, and jumps dramatically to 51% in the period immediately following the market peak. Although it decreases somewhat in the last period, the market model explains on average 39% of the variation of individual stocks.

One might suspect that the market "bubble" caused stocks to move in the same direction, as investors in general may have expected similar returns on stocks with different characteristics. But the further increased explanatory power of the value-weighted index after the burst of the bubble indicates that Japanese stocks started to move together with the whole market, even when the market started to decline and the economy suffered from recession. In these years, individual stocks lost much of their contribution of idiosyncratic risk to total risk. This is in contrast to results obtained in the U.S. as reported by Campbell, Lettau, Malkiel, and Xu (2001). They find that firm-level volatility is *higher* in NBER-dated recessions.

The sixth column shows the cross-sectional distribution of the idiosyncratic component of volatility ($\sigma_{i,IV}$), as measured by the mean square of residuals. We note a slightly increased idiosyncratic volatility in the bubble period (0.106), followed by a sharp fall to 0.080 in the crash period, and then a recovery to 0.093 in the post-crash period. In addition, we observe more than a 50% decrease in the variation of $\sigma_{i,IV}$ during the crash period, dropping from 0.039 to 0.024. Total volatility ($\sigma_{i,TV}$) reported in the seventh column is the return volatility of individual stocks measured over each period. While total volatility changed little from the bubble to the post-crash periods, we notice a 25% drop in the variation of $\sigma_{i,TV}$ during the crash period, falling from 0.038 to 0.029.

The table also presents summary statistics for market capitalization and turnover. The size of Japanese companies increased during the first four periods, but decreased in the last period. Average turnover $\overline{\eta_i}$ of stocks was high (0.056) until the collapse of the bubble (1989) and then decreased significantly to 0.027 afterwards. In addition, there is also a significant drop in the variation of $\overline{\eta_i}$, changing from 0.039 in the bubble period to 0.022 in the crash period. The simultaneous fall in $\sigma_{i,IV}$, the variation of $\sigma_{i,TV}$, and the variation of $\overline{\eta_i}$ all suggest a much stronger presence of the market factor in both stock returns and trading volume during the crash period.

To further investigate the significant shift in the characteristics of Japanese firms during the bubble burst period, we performed simple mean tests for levels and F tests for variances for each sub-period in comparison with the bubble burst period. The results of these tests are presented in Table 2. First, as evidenced by the low variation in beta (see third column in Table 2), differences among systematic risk of individual firms appear to have dropped significantly. At the same time, both the level of aggregate idiosyncratic volatility and the differences in idiosyncratic volatilities among different firms have gone down significantly over this period. This suggests that each firm's contribution to market risk and its innovative activities are alike.

B. The Dynamic Behavior of Market and Idiosyncratic Volatility

The summary statistics provide a strong indication of the differences in behavior of the volatility components. Figure 2 shows the 12-month moving average of both the monthly market volatility and the monthly aggregated idiosyncratic volatility in. Through this visual presentation, we can detect a trend of increasing market volatility (the solid line) with a large jump at the time of the crash in 1990/1991. In particular, volatility increased during the bubble period as compared to previous years, and stayed higher during the period of decline market in the 1990s, which is consistent with the summary statistics in Table 1.

While market-wide volatility in Japan appears to have increased after 1985, we also see a decreasing trend in the behavior of idiosyncratic volatility. There is, however, a noticeable jump in the last two years, during the period when the Japanese financial system experienced unprecedented stress and reorganization (e.g., bank failures and government bailouts).[9] Aggregate trading volume was also higher during the boom period, but since then has decreased to the lowest level in the entire sample. These figures are shown in Figure 1 in monthly frequency.

Both market and aggregated idiosyncratic volatilities seem to be quite persistent. The observed trends may be due to persistency in the data, or the volatilities could be non-stationary. Therefore, careful econometrics is necessary for drawing any definite conclusions. Since volatility is non-negative, we test the unit root hypothesis on log volatilities. In particular, the following model is estimated in order to apply the augmented-Dickey-Fuller test:

$$ln(\sigma_t) = \mu + \rho\, ln(\sigma_{t-1}) + \gamma\, t + \alpha_1\, \Delta ln(\sigma_{t-1}) + \ldots + \alpha_6\, \Delta ln(\sigma_{t-6}) + \varepsilon_t \quad . \qquad (6)$$

We first study the whole sample period from 1975 to 1999. Since most of the abnormal behavior in idiosyncratic volatility occurs in the post-bubble era, we also test idiosyncratic volatility for the sub-sample period from 1985 to 1997. All results are reported in Table 3. Apparently the second stock market crash in October 1990 had a larger impact than the first crash in October 1987. This raises the issue of whether this one-time event may be overshadowing the rest of the sample and distorting some of the results. In order to reduce the impact of this outlier, we replace the October 1990 observation with the second largest observation in the data set. This admittedly ad hoc

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[9] Kang and Stulz (2000) document that bank-dependent firms suffered more than others in Japan in early 1990s.

procedure allows us to decrease the influence of the crash while allowing it to remain in the sample as an important event.

For market volatility, the augmented Dickey-Fuller test clearly rejects the unit root hypothesis at a 5% significance level, which means that market volatility is in fact stationary. At the same time, the linear trend is positive and statistically significant at a 1% level. Thus, in contrast, the aggregate idiosyncratic volatility $\ln(\sigma_{IV})$ appears to be non-stationary, with augmented Dickey-Fuller test statistics of -18.75 compared with the critical value of -24.5. In addition, the trend coefficient is not statistically significantly different from zero. This conclusion is robust to different specifications of idiosyncratic volatility measures, such as $\ln(\sigma_{CAPM,IV})$ and $\ln(\sigma_{FF3F,IV})$, as shown in Table 3.

As the graph shows, idiosyncratic volatility has behaved very differently in the post-bubble period. We also report the unit root test for the period. The augmented Dickey-Fuller test strongly rejects the unit root hypothesis. At the same time, there is a statistically significant downward trend in the idiosyncratic volatility. This is also robust to other measures of idiosyncratic volatilities. Therefore, the aggregate stock market volatility in Japan has trended *upwards* over the years, but firm-level volatility *decreased* during the 1990s, except for two short episodes coinciding with the rapid decline of the market in1990/91, and the bank failures in 1998.

C. Implications

Although the evidence on decreasing idiosyncratic volatility and increasing market volatility is strong, we can further examine the issue from the perspective of the explanatory power of the market model, which is the R^2 measure.[10] Apparently, the dispersion between market volatility and idiosyncratic volatility implies an increase in the R^2 for the market model. Recently, there is an increasing application of average R^2 as a measure of market information inefficiency (see Morck, Yeung, and Yu, 2000; Durnev, Morck, Yeung, and Zarowin, 2002; and Wurgler, 2000). Higher R^2 implies that the market is less informationally efficient. These authors have discovered that countries with stock markets that impound more firm-specific information into individual stock prices (low R^2) exhibit a better allocation of capital. They suggest that efficient secondary market prices in terms of information help investors and managers distinguish good investments from bad ones.

In Figure 3a, we show the dynamics of average R^2 statistics from the market model. R^2s for both returns and turnover are reported. At time t, the return R^2 is computed based on estimating the market model using the previous 24 months of monthly data, and the turnover R^2 is computed in a similar way from a single factor model. We can see the return R^2s peaked during 1994-1995 and then declined in the most recent years, but still remain higher than the level of the 1970s and 1980s. This suggests a sharp fall in Japanese market "information efficiency" during the post-bubble period and a slight improvement in more recent years.

Perhaps it is more interesting to examine the changing volatility issue from the correlation perspective. If market volatility reflects the average covariance among individual stock returns, the observed phenomenon of decreasing idiosyncratic volatility could only happen when the average correlation increases. We present correlations

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[10] R^2 = 1-(idiosyncratic volatility)/(total volatility). Morck, Yeung, and Yu (2000) use average R^2 across firms to measure market information efficiency.

among individual stock excess returns and volume in Figure 3b. At any time t, we compute the average of pair-wise correlations using the previous 24 months of monthly data. As the figure shows, we find a clear pattern in the evolution of return and volume correlations: approximately 0.10 for returns and 0.05 for volume in the 1970s and 1980s. But in the 1990s, after the collapse of the bubble, the correlations increase significantly, to as high as 0.50 for returns, and 0.20 for volume.

The correlation picture uncovers important characteristics about the Japanese market. During the decline of the market and the contraction of the economy, stocks in the Japanese market lost their individuality and started to move together. Since the correlations among stocks significantly increased, the number of stocks needed to diversify idiosyncratic risk should have significantly decreased. Although this is good news for individual investors in terms of lowering their investment costs in achieving a certain level of diversification, it is bad from the point of view of stock selection. It becomes harder to tell the good from the bad firms when idiosyncratic volatility drops. Since Japanese investors were faced with stocks that were not very distinguishable from each other, more and more companies were treated like “lemons” in the financial markets. As a result, capital was prevented from flowing into good companies to support innovations and continued competitiveness, and weakening their ability to sustain economy-wide shocks. This increase in vulnerability of firms to economic shocks induces higher overall market volatility. Therefore, in the 1990s, Japanese investors have faced rising aggregate market risk, even though diversification was achievable through investment in a smaller number of stocks.

D. Idiosyncratic Risk and R^2 in a Multi-Factor Model

We now confirm the above results by explicitly testing the duo-factor model using monthly returns and turnover data for TSE securities from 1975 to 1999. Table 4 provides the results of the test across a number of factors in excess return and turnover, including incremental R^2 from the k-th factor of the return and turnover for models for 1 to 10 factors. The first principal component of returns explains 14% and 11% of the normalized excess returns in the 1975-1979 and 1980-1984 periods, which increases to 18% during the bubble period, followed by dramatic increases in the post-bubble periods, to 52% (1990-1994) and 39% (1995-1999). These findings indicate that during a period of market decline, excess returns are largely driven by a single systematic factor, and are consistent with our previous results showing rising market risk during the post-bubble period.[11]

The last column of Table 4 shows the average R^2 of regressing individual stock returns and turnover on their corresponding systematic factors for each period. In the first period, a three-factor model explains on average 25% of variation of stock returns and a four-factor model explains 31% of variation of turnovers. These R^2s go up slightly for the 1985-1989 period, suggesting a small rise in commonality in time-series variations of both stock returns and volumes. However, we find a significant increase in average R^2s in the 1990-1994 and 1995-1999 periods for both returns and turnovers. This indicates that during the post-bubble period, there is a sharp decrease in contribution

[11] Table 4 also reports the number of factors in excess returns and turnover, determined by using a loss function suggested by Xu (2001). Our results show that there are 3 factors in excess returns in Japan, except for the 1990-94 period where there are 4 factors. The number of factors in excess returns remains relatively stable, whereas for turnover, it varies between 3 and 6. However, our main interest here is to derive measures of idiosyncratic volatility and not to provide a test of the hypothesis that there are the same number of factors in return and turnover in the duo-factor model.

of idiosyncratic risk in stock returns and trading volume. This finding further confirms our previous results.

Cremers and Mei (2002) report a close relationship between idiosyncratic volatility and idiosyncratic turnover, based on the rationale that idiosyncratic volatility tends to be driven by firm-specific information on firm cash flows and risk, which also drives firm-specific trading volume. To the extent that Japanese idiosyncratic turnover displays a similar reduction during the crash period, our results showing a surprising decrease in firm-level volatility during the same time period are further strengthened. The decrease that we find in firm-level information in the Japanese equity market during the post-bubble period indicates a reduced level of market information efficiency as measured by R^2.

In summary, by examining the Japanese stock market over three periods (pre-bubble, bubble and post-crash), we have documented different levels of total and idiosyncratic volatility over time. Total volatility increased after the collapse of the bubble, but, at the same time, idiosyncratic components significantly decreased. This stands in sharp contrast with the U.S. market where market-level volatility does not show significant change over time, although firm-level volatility increases over time, especially during recessions (Campbell, Lettau, Malkiel, and Xu (2001). Using a multifactor model, we again confirmed that the contribution of idiosyncratic risk to total risk decreased during the recent periods of market decline.

IV. Why Did Idiosyncratic Volatility Fall after 1990?

We have documented increased market-wide volatility, decreased firm-level volatility, and the deterioration of information efficiency measures in the Japanese market in the 1990s. In this section, we relate these findings to the economic environment of Japan, and particularly to some institutional factors that may be driving these phenomena.

A: An Introduction to Japanese-Style Capitalism

The post-WWII Japanese economic system was centered on a "main bank" system in which major banks played an important, and *quasi*-public-sector role in supplying much needed capital for building the economy after the devastation and destruction of the war. Thus, major banks were at the core of all Japanese industrial groups (*keiretsu*). Main banks not only made loans to the *keiretsu* group, but also owned up to 10% (5% after 1977) of client firms (many of them in the *keiretsu* group). Furthermore, main banks often sent directors to borrowing firms, especially when they were experiencing financial difficulties, and the monitoring capability of banks was believed to be effective (Aoki, Patrick, and Sheard, 1994). Main banks also provided much-needed liquidity for financially distressed firms, thus reducing the cost of financial distress (Hoshi, Kashyap, and Scharfstein, 1990). In addition, since bankruptcy procedures in Japan were quite time-consuming and expensive, and once filed, conferred immediate control to court-appointed trustees, managers had a strong incentive not to resort to them. As a result, as shown later, there were very few cases of bankruptcies of large, publicly traded firms in Japan.

While the Japanese model appeared to function well through the high-growth period, one can argue that it was not able to meet the challenges of the changing environment in the 1990s. Instead, the system created an excuse for staying with the status quo rather than implementing timely reforms. After the collapse of the bubble, many corporations faced problems, such as high leverage resulting from overly optimistic expansion plans during the bubble period, decreased collateral value owing to the decline in land values, and decline in revenues due to economic slowdown. However, corporate managers did not address these issues quickly. It is possible that their previous strong ties with main banks led them to believe that negotiated financial support, rather than legal bankruptcy procedure, would be possible and desirable.[12]

Financial regulators were also slow to reveal the problem of non-performing loans. Rather than facing the issue, they chose to use "easy" criteria for classifying non-performing loans in their published statistics, delaying immediate and necessary reforms. Since banks were not directly writing off the non-performing loans, troubled borrowers were not forced to go bankrupt. Even firms that are widely recognized to be in serious financial distress for more than five years (e.g., large construction companies and some retail concerns) are still receiving support from banks. The practice of lifetime employment in large corporations is another element that has made it difficult for the skilled labor force to move from inefficient to more productive sectors.

B. The Relationship between Bankruptcy and Idiosyncratic Risk

[12] Nissan Motor, for example, asked for help from their main bank (Industrial Bank of Japan) over several years until at the end, in 1999, the French automaker Renault bought a substantial share of Nissan and sent a CEO to initiate a drastic restructuring. At the time of this transaction, analysts widely agreed that Nissan was actually insolvent.

Protection among *keiretsu* affiliated firms and the lack of reform in Japan's corporate sector may have led to a lack of "creative destruction" in the Japanese economy. Figures 4a and 4b compare bankruptcies of all firms in the economy and those of the Tokyo Stock Exchange listed firms.[13] As the figures reveal, the number of bankruptcies for firms listed on the Tokyo Stock Exchange is much smaller than the number for the entire economy. Among the former, there were only one to three bankruptcies per year from 1975 to 1996, with the exception of 1984 when there were five bankruptcies. In many years there were no bankruptcies at all. Indeed, from 1987 to 1991 (from the boom period to the beginning of the declining period), for five consecutive years, there were no bankruptcies. This low bankruptcy phenomenon continued until 1996, well into the period of economic downturn. It was only after 1997 that the number of bankruptcies started to increase, but even then the number remained below ten per year. This is in sharp contrast with the U.S., where in 2000 (2001), there were 176 (257) bankruptcy filings of publicly traded companies.[14] Bankruptcies of listed firms in Japan are particularly low since such firms are considered to have social and economic importance, and all parties involved (banks, other businesses, and regulators) deem them to be "too large to fail."

The Japanese stock market mirrored this period of procrastination. Since immediate restructuring of corporations and banks was not forthcoming, investors may have come to expect a prolonged period of corporate "bailouts and rescues" where cash flows from good firms are diverted to save weak firms in the same business group and to

[13] For the economy as a whole, the number of bankruptcies increased gradually from 1975 to 1984, but decreased during the "bubble" boom period (1985-1990). The number started to increase again after the collapse of the bubble.
[14] See http://www.bankruptcydata.com/

converge economic risk. Thus, we should observe a convergence of stock market returns and a reduction in firm-level volatility. This implies a positive relation between number of bankruptcies and idiosyncratic risk, and a negative relation between number of bankruptcies and information efficiency measures of the market.

To confirm the above conjecture, we regress changes in firm-level volatility on the number of corporate bankruptcies of TSE listed firms and the annual growth rate of GDP. We use annual data for this regression and report the results in Table 5. Changes in annual aggregate idiosyncratic risk are computed as changes in the 12-month average of the cross-sectional mean of idiosyncratic volatility obtained from the market model. For the full sample period, we find a weak positive relation between changes in firm-level volatility and corporate bankruptcies; the higher number of bankruptcies is related to higher idiosyncratic volatility. We also regress changes in information efficiency measures (average R^2 and average pair-wise correlations) on the number of corporate bankruptcies of TSE firms and GDP growth. Generally we find a negative relation between number of bankruptcies and changes in information efficiency measures; an increase in number of corporate bankruptcies tends to improve information efficiency. Number of bankruptcies is significantly negatively related to changes in average R^2. However, the relation between information efficiency measures and GDP growth is mixed.

We also run these regressions for the 1990-1999 sub-period. The coefficients show a pattern consistent with the full sample. Of four information efficiency measures, three have a significantly negative relation with the number of bankruptcies. This suggests that the sharp fall in firm-level volatility (and rise in average R^2 and correlations) during the 1990-1999 period may be due to the low occurrence of bankruptcies, or a lack of corporate restructuring.

As shown in Figures 2 and 3, firm-level volatility increased after 1997. Although the small number of observations does not allow us to conduct a statistical test, it appears that the increase in firm-level volatility is related to the recent increase in number of bankruptcies and discussions in the Japanese parliament on the adoption of a new bankruptcy law.[15] Moreover, there is some anecdotal evidence that the market in fact looks forward to bankruptcy filing of failing firms, rather than prolonged rescue negotiation involving banks.[16] On the other hand, when Daiei, a large retail chain, and its banks agreed on a rescue plan including a 400 trillion yen debt-equity swap on January 15, 2002, the Nikkei average went down by 1% and "the rumor (of the rescue) pushed down bank stocks by 7% over the previous week."[17]

C: The Impact of Business Group Affiliation on Idiosyncratic Risk

We have argued that a lack of creative destruction (bankruptcies) may have caused Japanese firm-level volatility to decrease during the 1990s. We now turn our attention to differences in the behavior of idiosyncratic volatility of *keiretsu* and *non-keiretsu* firms, and firms with and without main banks. Our purpose is to examine

[15] In April 2000, another bankruptcy procedure under a new law (*minji-saisei-hou*) was introduced. This procedure requires fewer legal steps, and once bankruptcy is filed, managers can stay during the restructuring. Although the number of filings is still low, there were six (seven) cases out of ten (nine) bankruptcies in 2000 (2001). This may contribute to the improvement of information efficiency measure in the Japanese market in the future.

[16] For example, when Mycal, a large supermarket chain, filed for *minji-saisei-hou* bankruptcy on September 17, 2001, with 74 trillion yen in debt, the Nikkei average went *up* by 4% because of "the expectation in the market that the disposition of bad debts by banks would accelerate (*Nihon Keizai Shinbun* (*Japan Economic Journal*), September 17, 2001). A similar market reaction was observed when a construction company, Sato Kogyo, filed for bankruptcy on March 4, 2002, with a total debt amount of 560 trillion yen, and the Nikkei average went up by 5%.

[17] *Nihon Keizai Shinbun* (*Japan Economic Journal*), January 15, 2002.

whether these unique Japanese institutional features play a role in determining the firm-level components of volatility and volume.

We first divide our sample into firms that belong to the six major *keiretsu* groups (Fuji, Mitsui, Mitsubishi, Daiichi-Kangyo, Sumitomo, and Sanwa), and firms that do not. We also divide the sample into firms that have a main bank affiliation and firms that do not. The classification is based on 1998 data in Kigyo Keiretsu Soran (1999), published by Toyo Keizai Shinpo Sha.

We compute individual idiosyncratic components of return volatility and volume of these firms, and average them across firms within each category (*keiretsu* firms and non-*keiretsu* firms; and firms with main banks and firms without main banks) to obtain aggregate idiosyncratic components.[18] We then regress the difference in aggregate idiosyncratic components between non-*keiretsu* firms and *keiretsu* firms on the monthly growth rate of industrial production (IP).

Table 6 reports regression results for the difference in idiosyncratic components of return volatility and volume between non-*keiretsu* firms and *keiretsu* firms (Panel A), and between firms with main banks and firms without main banks (Panel B). We report results for before the collapse of the bubble (high- and medium-economic growth periods), and the post-bubble (low-growth period). Noting that there is a reversal in the pattern of idiosyncratic risk around 1997, we report results for the 1990-1996 period.

The results for the 1977-1989 period in Panel A show a generally positive relation between IP growth and the difference in idiosyncratic components; an increase in IP growth tends to increase the difference of firm-level volatility between non-*keiretsu* and

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[18] We have also used other single- and multi-factor models to compute idiosyncratic components. The results are quite similar and available upon request from the authors.

keiretsu firms. A higher growth rate of the IP implies higher firm-level volatility and volume of non-*keiretsu* firms compared to *keiretsu* firms. This means that, in this sub-period, when economic growth is at a high rate, there tends to be greater disparity of stock performance among non-*keiretsu* firms. Less disparity among the performance of stocks of *keiretsu* firms during the high-growth period implies the presence of sharing resources among these firms, whereas independent firms who do not share resources experience higher degree of disparity in volatility. Panel B shows that the same results hold for firms without main banks versus firms with main banks, and all coefficients are significant.

When we run the same regressions for the 1990-1996 (post-crash period), the sign of the coefficients flips to negative, and they are all significant except for one case. In this sub-period, a decrease in IP growth tends to increase the difference of firm-level components between non-*keiretsu* and *keiretsu* firms (Panel A) and between firms without main banks and firms with main banks (Panel B). The lower the IP growth, the higher the firm-level components of non-*keiretsu* firms (firms without main banks) compared to *keiretsu* firms (firms with main banks). This means that, in this sub-period, when the rate of economic growth is low, there tends to be greater disparity of stock performance among non-*keiretsu* firms and firms without main banks, compared to their counterparts. This suggests that *keiretsu* firms and firms with main banks are less sensitive to negative economic conditions compared to independent firms, indicating the presence of protection of weak firms by *keiretsu* groups or main banks.

D: A Vicious Cycle in Capital Allocation

Our analysis in this section has demonstrated that misallocation of capital by Japanese *keiretsu* or main bank groups in the form of lack of corporate bankruptcy and the presence of group protection may have contributed to a reduction in Japanese equity market efficiency. The role of equity markets, however, is not just a *passive* reflection of misallocation of capital in the Japanese economy.

Numerous theoretical and empirical studies have demonstrated that equity markets help improve the capital allocation process, and thus contribute to economic growth. One theory is that efficient secondary market prices help investors identify good investments from bad ones through a mechanism like Tobin's Q. Another is that lenders and intermediaries use book-to-market ratios to screen out bad credits (Altman, 2002). Agency theories argue that pressure from external investors, or managerial ownership, encourages managers to pursue value-maximizing investment policies (Jensen, 1986).[19] Recent empirical work by Wurgler (2000) demonstrates that equity markets actually do improve the allocation of capital. Using a sample consisting of 65 countries, he shows that countries with stock markets that impound more firm-specific information into individual stock prices – in other words, those that have a smaller R^2– do exhibit a better allocation of capital, …"which appears to be particularly useful for limiting investment in declining industries." Durnev, Morck, and Yeung (2001) also find that firms in industries in which firm-specific return variation is larger exhibit a better quality of capital budgeting, in the sense that their profitability indices (marginal Q ratios) are closer to one.

[19] La Porta, Lopez-de-Silanes, Shleifer, and Vishny (1997) show that effective laws against misuse of minority investors' funds are a key determinant of their supply of finance to good projects.

All of these results suggest that equity markets also play an active role in the allocation of capital itself. While misallocation of capital by major banks and *keiretsu* may cause a decrease in equity market information efficiency, this in turn could lead to further misallocation of capital by firms and investors. As we discussed in section III, a reduction in market information efficiency makes it difficult for investors to distinguish good from bad firms. As a result, some healthy firms will find it difficult to raise financing and stay competitive. This in turn will lead to more "rescues and bailouts" by business groups, which will trigger further reductions in firm-level volatility and market efficiency, thus leading to a vicious cycle of capital misallocation.

We believe this vicious cycle of capital misallocation may help explain the long stagnation of the Japanese economy. Fundamentally, the strength of an economy can be measured by whether it allocates its scarce capital efficiently. Capital should be invested in firms that are expected to have high returns, and withdrawn from firms with poorer prospects. To the extent the Japanese economy continues to misallocate large amounts of scarce capital, its recovery will remain illusive, despite its large capital endowment. While Japanese corporations and government recently have taken steps to address the issue of corporate reorganization with an eye toward improving equity market efficiency, our empirical results indicate that firm-level volatility in Japan is still too low (and R^2 is too high) compared to other developed countries, indicating that Japan's corporate restructuring may still have a long way to go.[20]

[20] At the end of 1999, the average R^2 of the Japanese market was 0.25, still much higher than that of the U.S. (about 0.08 over the 1993-1998 period) and its own pre-crash historical level.

V. Conclusion

This paper documents an abnormal *reduction* in firm-level volatility after the Japanese stock market crash. We find a significant drop in the variation of systematic risk across firms and a sharp reduction in market information efficiency. In order to understand the abnormal behavior of idiosyncratic risk in Japan, we examine the impact of Japanese bankruptcy as well as business group affiliation on firm-level volatility. We discover that the sharp fall in firm-level volatility during the 1990-1996 period could be due to a lack of corporate restructuring in Japan. A further comparison of firm-level volatility between various Japanese business groups shows that, idiosyncratic volatility for firms with business group and main bank affiliations responds much less to economic conditions compared to those of firms with no affiliations. This indicates the presence of group protection of weak firms during most of the 1990s.

This evidence suggests that the lack of "creative destruction" may have contributed to a reduction in Japanese market information efficiency and triggered a vicious cycle of capital misallocation. These results may help explain the poor performance of the Japanese economy over the last decade.

To obtain a more accurate measure of idiosyncratic risk, this paper has made a number of methodological innovations. First, we have introduced volume into our asset pricing studies. Because of the close relationship between idiosyncratic risk and idiosyncratic volume, examining the time-variation of idiosyncratic volume gives us a better grasp of firm-level volatility in the Japanese equity market. Second, as a robustness check, we employ the duo-factor model of Lo and Wang (2001), which provides an alternative measure of firm-level volatility and trading volume in a multifactor setting. Third, we use a recently developed consistent statistic by Xu (2001) to determine the number of factors in the duo-factor model. This provides a more accurate measure of idiosyncratic volatility in a multifactor model.

This paper raises many interesting research questions. First, while our results indicate a reduction in Japanese equity market information efficiency and a possible negative impact on Japanese capital allocation, it would be interesting to examine whether this reduction actually leads to reduced efficiency in Japanese firms' capital budgeting. Second, our results indicate that a reduction in idiosyncratic volatility is accompanied by rising overall market volatility. It would be interesting to examine whether changes in idiosyncratic risk have affected asset pricing.[21] We leave these topics for future research.

[21] Goyal and Santa-Clara (2002), for example, have examined the issue of whether idiosyncratic risk has affected asset pricing in the U.S.

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Table 1: Summary Statistics

This table shows some of the summary statistics for Japanese equity markets over different episodes. Except for "R_M", which is based on the value-weighted market index return, all the statistics are computed based on the statistics of individual stocks in the specified period. In particular, $\sigma_{i,IV}$ is the root mean squared residuals from the same CAPM that computes $\beta_{i,CAPM}$ and R^2_{CAPM}. $\sigma_{i,TV}$ is the return volatility of individual stocks. $\overline{\eta_i}$ denotes the average turnover over time of individual stocks, while $log(\overline{ME_i})$ is the average market capitalization for individual stocks.

	R_M	$\overline{R_i}$	$\beta_{i,CAPM}$	R^2_{CAPM}	$\sigma_{i,IV}$	$\sigma_{i,TV}$	$log(\overline{ME_i})$	$\overline{\eta_i}$
				1975-79				
Median		0.015	0.997	0.117	0.085	0.093	9.523	0.037
Mean	0.016	0.016	0.999	0.132	0.090	0.096	9.586	0.050
S.D.	0.033	0.010	0.580	0.095	0.036	0.037	1.422	0.049
				1980-84				
Median		0.012	0.951	0.086	0.081	0.085	9.919	0.027
Mean	0.013	0.014	0.996	0.103	0.087	0.091	10.010	0.040
S.D.	0.026	0.011	0.653	0.083	0.040	0.041	1.473	0.040
				1985-89				
Median		0.028	1.027	0.157	0.097	0.107	10.889	0.049
Mean	0.027	0.028	1.024	0.172	0.106	0.115	11.036	0.056
S.D.	0.041	0.012	0.447	0.113	0.039	0.038	1.440	0.039
				1990-94				
Median		-0.004	1.016	0.538	0.076	0.116	11.147	0.022
Mean	-0.004	-0.004	1.011	0.513	0.080	0.117	11.270	0.027
S.D.	0.083	0.007	0.321	0.168	0.024	0.029	1.373	0.022
				1995-99				
Median		-0.007	0.983	0.407	0.085	0.115	10.573	0.021
Mean	-0.004	-0.005	1.006	0.387	0.093	0.122	10.777	0.027
S.D.	0.075	0.012	0.519	0.188	0.039	0.049	1.507	0.024

Table 2: Significance Test

This table provides the significant test of selected statistics of 1990-1994 against other time periods. This comparison period has 1521 stocks. Test statistics for the hypothesis of equal standard deviation is computed based on an F test, while that of equal mean is based on a t test. In particular, $\sigma_{i,IV}$ is the root mean squared residuals from the same CAPM that computes $\beta_{i,CAPM}$ and R^2_{CAPM}. $\overline{\eta_i}$ denotes the average turnover over time of individual stocks.

	No.	$\beta_{i,CAPM}$	R^2_{CAPM}	$\sigma_{i,IV}$	$\sigma_{i,IV}$	$\overline{\eta_i}$	$\overline{\eta_i}$
	Obs.	S.D.	Mean	Mean	S.D.	Mean	S.D.
				1975-79			
Statistic	1174	3.268	-69.56	8.498	2.165	16.28	5.171
P-value		0.000	0.000	0.000	0.000	0.000	0.000
				1980-84			
Statistic	1275	4.152	-79.29	5.037	2.710	11.36	3.505
P-value		0.000	0.000	0.000	0.000	0.000	0.000
				1985-89			
Statistic	1352	1.942	-62.91	20.87	2.648	24.94	3.288
P-value		0.000	0.000	0.000	0.000	0.000	0.000
				1995-99			
Statistic	1606	2.624	-19.71	10.86	2.668	-0.167	1.220
P-value		0.000	0.000	0.000	0.000	0.566	0.000

Table 3: Time Series Test for Market and Aggregate Idiosyncratic Volatility

This table provides the significant tests for stochastic trend vs. time trend in both market volatility and idiosyncratic volatility over the entire sample period from 1975-1999. Similar test statistics are also given for the post Plaza Accord subsample period from 1985-1999. All monthly volatilities are computed using rolling statistics. Three measures of idiosyncratic volatilities are used. They are σ_{IV} according to Xu and Malkiel (2001), the root mean square of the CAPM residuals $\sigma_{CAPM, IV}$, and residuals from three factor models of Fama and French (1993) $\sigma_{FF3,IV}$.

Model: $ln(\sigma_t) = \mu + \rho\, ln(\sigma_{t-1}) + \gamma\, t + \alpha_1 \Delta ln(\sigma_{t-1}) + \ldots + \alpha_6 \Delta ln(\sigma_{t-6}) + \varepsilon_t$

	Entire Sample Period: 1975-1999				Sub Sample Period: 1985-1999			
	μ	γ	ρ	R^2	μ	γ	ρ	R^2
				Market Volatility				
Estimates	-.1728	.00016	.8948	0.901				
t	-3.63	2.44	31.67					
ADF T(ρ-1)			-37.38					
				Idiosyncratic Volatility (σ_{IV})				
Estimates	-.0486	.00001	.9560	.937	-.0975	-.00018	.8958	.950
t	-2.68	0.54	58.3		-2.98	-2.12	25.2	
ADF T(ρ-1)			-18.75				-35.92	
				Idiosyncratic Volatility ($\sigma_{CAPM,IV}$)				
Estimates	-.0438	.00001	.9596	.949	-.1078	-.00023	.8803	.948
t	-2.75	0.46	65.9		-3.32	-2.42	24.1	
ADF T(ρ-1)			-19.96				-46.84	
				Idiosyncratic Volatility ($\sigma_{FF3F,IV}$)				
Estimates	-.0351	.00001	.9699	.963	-.1194	-.00023	.8782	.966
t	-2.44	0.58	78.0		-3.58	-2.78	25.4	
ADF T(ρ-1)			-16.01				-74.82	

Table 4: Test of Number of Factors in the Excess Return and Turnover Models for Balanced Panels

This table reports the average incremental coefficient of determination from regressing individual stock returns (or turnover) on each statistical factor extracted using the "MEC" approach of Xu (2001). The number of factors is determined based on the test statistics suggested by Xu (2001).

Period	ΔR^2_1	ΔR^2_2	ΔR^2_3	ΔR^2_4	ΔR^2_5	ΔR^2_6	ΔR^2_7	ΔR^2_8	ΔR^2_9	ΔR^2_{10}	# factors	$R^2_{1,\ldots,10}$
						Returns						
1975-79	0.135	0.060	0.052	0.044	0.028	0.026	0.024	0.022	0.021	0.021	3	0.247
1980-84	0.107	0.066	0.048	0.035	0.031	0.028	0.027	0.025	0.023	0.022	3	0.222
1985-89	0.176	0.095	0.042	0.034	0.031	0.025	0.023	0.021	0.020	0.019	3	0.313
1990-94	0.515	0.049	0.030	0.024	0.022	0.018	0.014	0.014	0.013	0.013	4	0.619
1995-99	0.389	0.048	0.030	0.026	0.026	0.025	0.020	0.019	0.019	0.018	3	0.467
						Turnover						
1975-79	0.123	0.076	0.057	0.048	0.039	0.031	0.031	0.027	0.025	0.024	4	0.305
1980-84	0.101	0.062	0.052	0.042	0.040	0.035	0.033	0.030	0.028	0.026	3	0.215
1985-89	0.103	0.067	0.055	0.053	0.044	0.036	0.035	0.029	0.027	0.026	5	0.322
1990-94	0.208	0.074	0.061	0.058	0.038	0.037	0.031	0.028	0.025	0.022	6	0.476
1995-99	0.137	0.117	0.053	0.045	0.041	0.035	0.031	0.028	0.026	0.024	5	0.391

Table 5: Regression of Changes in Equity Market Information Efficiency Proxies on Bankruptcy and GDP growth (1977-1999)
Changes in annual aggregate idiosyncratic risk are computed as changes in the 12-month average of the cross-sectional mean of idiosyncratic volatility from the market model. Equity market information efficiency proxies used are average R^2 for excess returns using the market model, average R^2 for turnover using the market model, average correlation for excess returns among stocks, and average correlation for turnovers among stocks. The first line provides parameter estimates. The second line gives the t-statistics.

	Panel A: Full Sample Period				Panel B: 1990-1999			
	Constant	Bankruptcy	GDP	Adj. R^2	Constant	Bankruptcy	GDP	Adj. R^2
ΔIdio. Risk	-0.003	0.001	0.035	0.020	-0.004	0.001	0.035	-0.053
	-0.477	1.526	0.393		-0.471	1.224	0.206	
ΔR^2(Return)	0.023	-0.006	-0.135	0.125	0.007	-0.006	1.389	0.812
	0.943	-2.144	-0.379		0.400	-3.405	3.986	
ΔR^2(Turnover)	0.035	-0.004	-0.511	0.267	0.030	-0.004	-0.166	0.374
	2.565	-2.682	-2.600		1.978	-2.699	-0.590	
ΔCorr(Return)	0.012	-0.003	0.178	0.101	0.001	-0.004	1.338	0.819
	0.595	-1.495	0.636		0.077	-2.520	4.852	
ΔCorr(Turnover)	0.003	-0.002	0.068	0.079	0.007	-0.002	0.249	0.241
	0.307	-1.498	0.443		0.481	-1.589	0.919	

Table 6: Regression of Difference of Information Measures on IP growth (1977-1999)
The first line provides parameter estimates. The second line gives the t-statistics.

	1977-1989 Sample			1990-1996 Sample		
	Constant	IP	Adj. R^2	Constant	IP	Adj. R^2
A: Keiretsu						
Diff. Idio. Risk (nonKeiretsu-Keiretsu)	0.000	0.002	-0.004	0.000	0.000	-0.014
(CAPM)	-1.960	0.527		2.955	-0.138	
Diff. Idio. Risk (nonKeiretsu-Keiretsu)	-0.001	0.002	-0.005	-0.001	-0.008	0.087
(XU)	-2.796	0.405		-9.438	-2.790	
Diff. Idio. Volume (nonKeiretsu-Keiretsu)	-0.002	0.012	0.030	0.000	-0.005	0.103
(CAPM)	-7.151	2.481		0.637	-3.023	
Diff. Idio. Volume (nonKeiretsu-Keiretsu)	-0.003	0.014	0.030	0.000	-0.005	0.090
(XU)	-7.545	2.470		0.177	-2.825	
B. Main Banks						
Diff. Idio. Risk (nonMain Bank-Main Bank)	-0.003	0.019	0.102	-0.002	-0.006	0.163
(CAPM)	-10.16	4.460		-22.43	-3.846	
Diff. Idio. Risk (nonMain Bank-Main Bank)	-0.003	0.019	0.092	-0.003	-0.013	0.094
(XU)	-9.046	4.229		-17.58	-2.894	
Diff. Idio. Volume (nonMain Bank-Main Bank)	-0.003	0.011	0.033	-0.001	-0.006	0.127
(CAPM)	-12.23	2.587		-11.95	-3.365	
Diff. Idio. Volume (nonMain Bank-Main Bank)	-0.004	0.012	0.036	-0.001	-0.008	0.165
(XU)	-13.55	2.700		-11.85	-3.879	

Figure 1. Cumulative Returns and Trading Volume (TSE Value-Weighted Index)

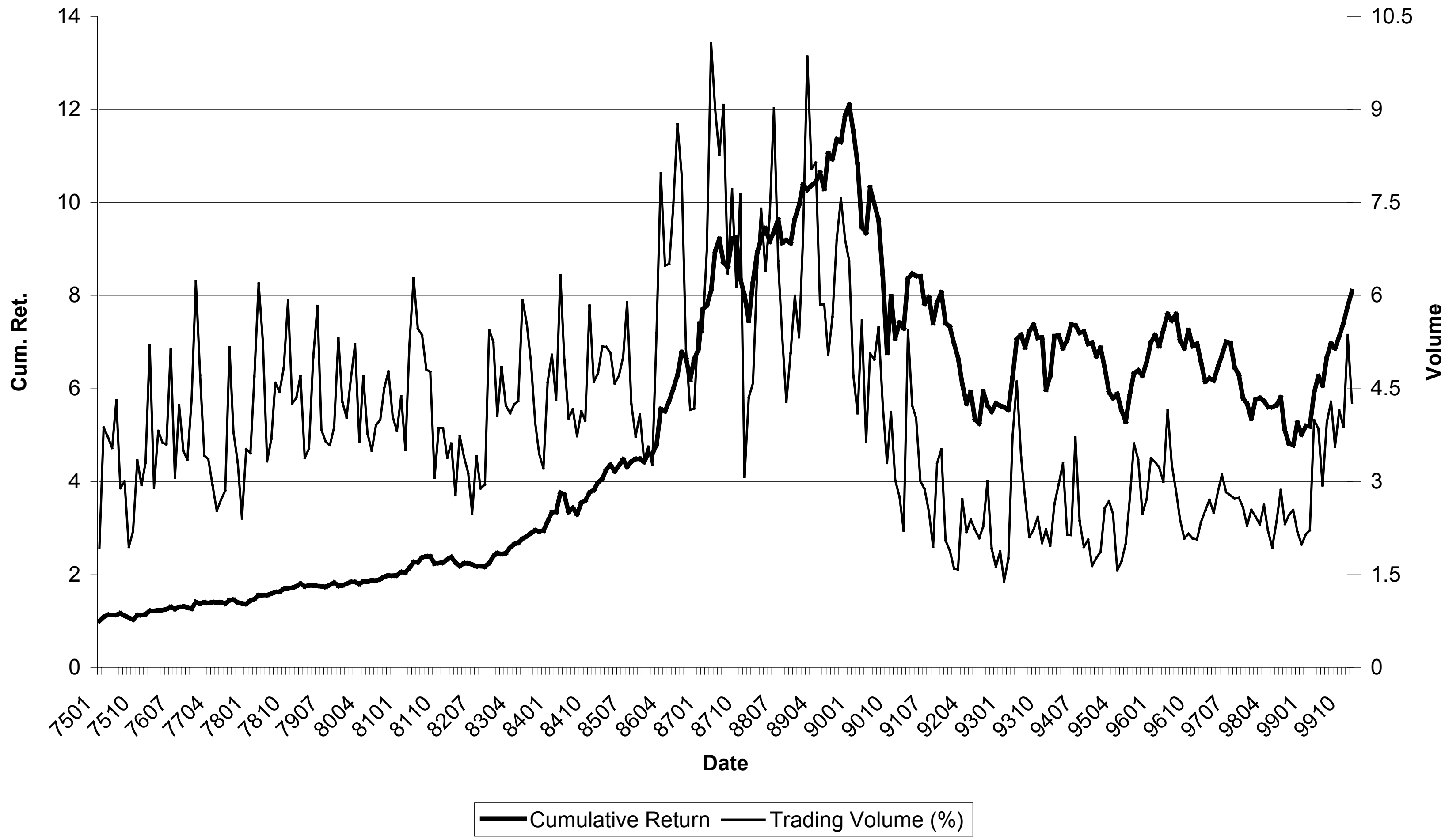

Figure 2. Annualized Market Volatility, Idiosyncratic Volatility, and Trading Volume

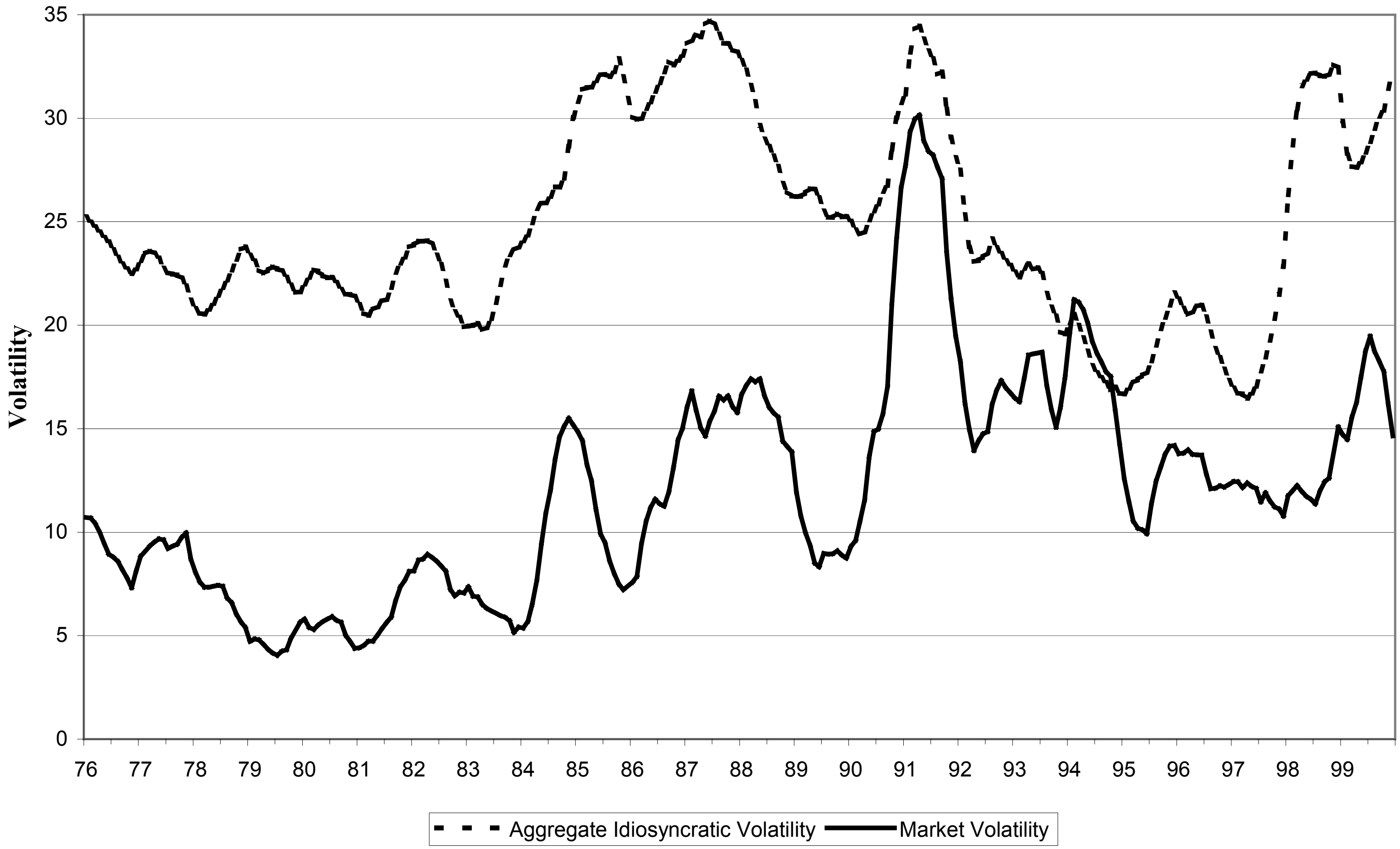

Figure 3a. Average R2 Statistics of Returns and Turnover

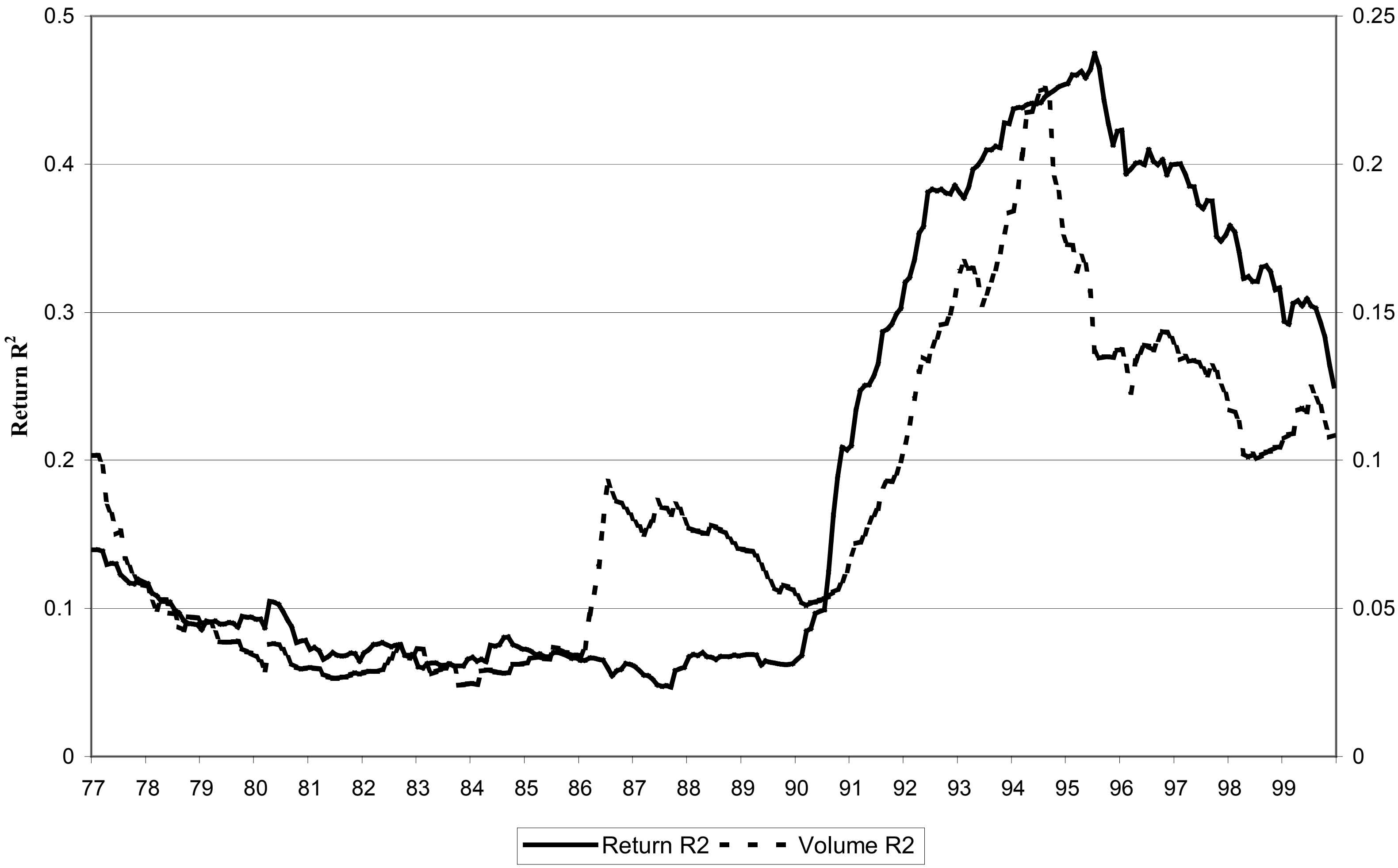

Figure 3b. Return and Volume Correlations among Individual Stocks

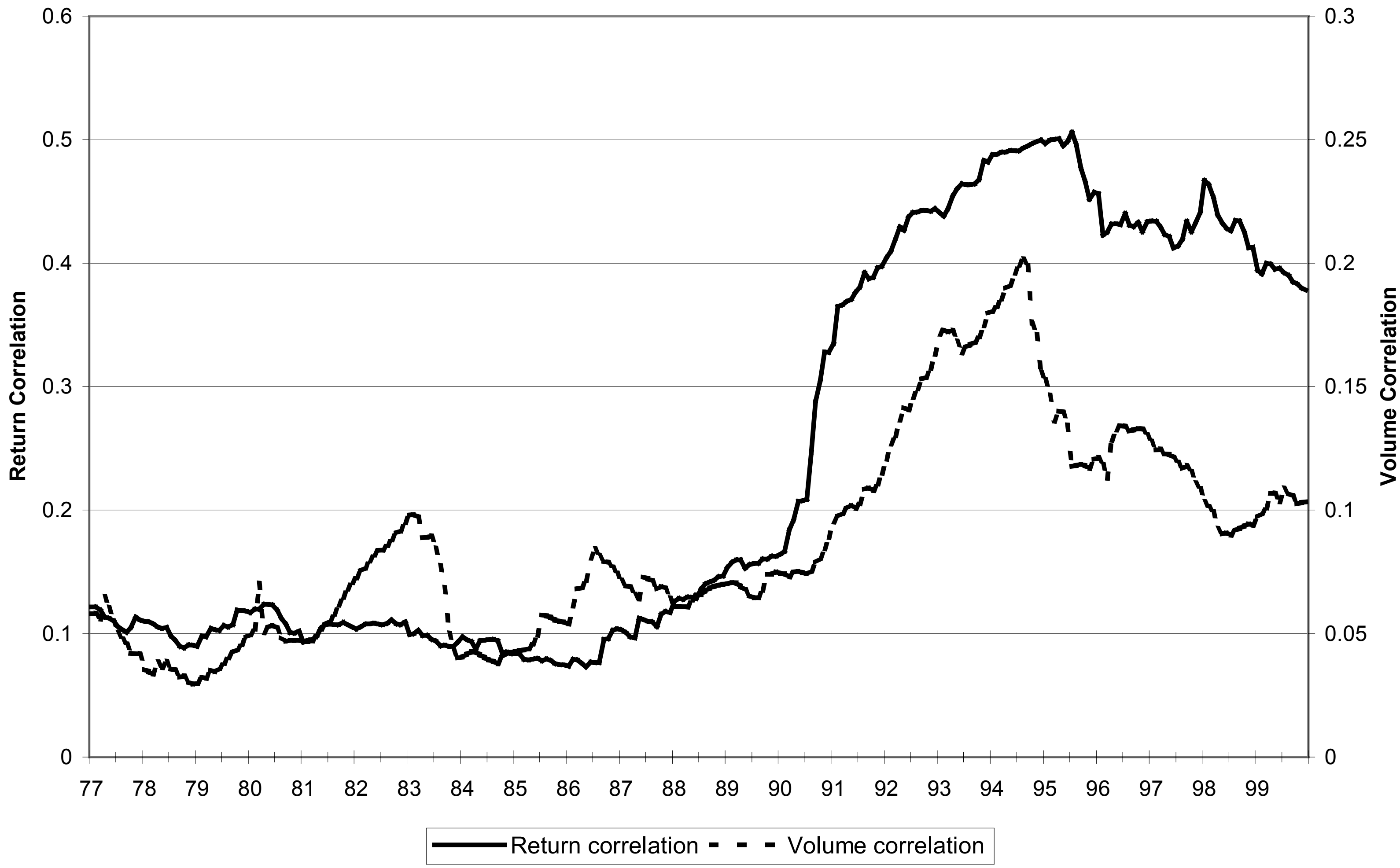

Figure 4a. Bankruptcies in Japan

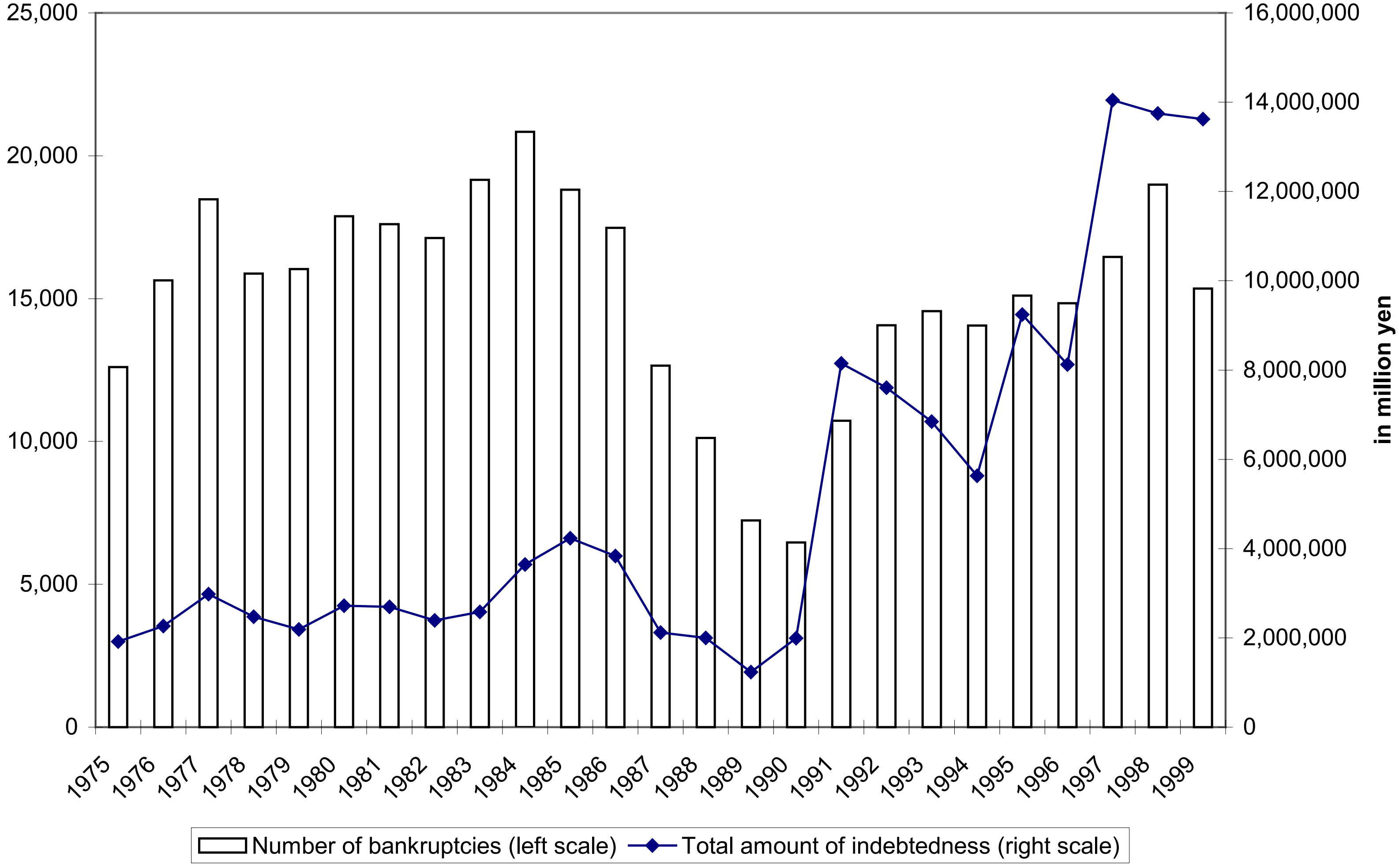

Figure 4b. Bankruptcies of TSE Listed Firms