NBER WORKING PAPER SERIES

THE JAPANESE BUBBLE:
A 'HETEROGENEOUS' APPROACH

Robert B. Barsky

Working Paper 15052
http://www.nber.org/papers/w15052

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
June 2009

The Japanese Bubble: A 'Heterogeneous' Approach
Robert B. Barsky
NBER Working Paper No. 15052
June 2009
JEL No. G0,G00,G1,G12

ABSTRACT

Employing the neutral Kindleberger definition of a bubble as "an upward price movement over an extended range that then implodes", this paper explores the causes of the "Japanese Bubble" of 1985 to 1990 without precluding the possibility that the bubble was due to perceptions of fundamentals. Survey evidence indicates that at the peak of the bubble in the second half of 1989, the majority of Japanese institutional investors thought that the Nikkei was not overvalued relative to fundamentals. Such a belief was not entirely unfounded. Long-term real interest rates fell sharply between 1985 and 1986, and the view that there was a significant increase in the permanent component of the growth rate was defensible though certainly not undeniable. Invoking the literature on asset prices with heterogeneous beliefs and limitations on short sales, the paper argues that in a period characterized by the arrival of news that is difficult to digest and subject to multiple interpretations, it is the more optimistic assessments of fundamentals that are likely to be reflected in the market equilibrium. At the same time, high prices resulting from the heterogeneity phenomenon are fragile and prone to collapse. From this vantage point it is perhaps not surprising that the Japanese Bubble, as well as the subsequent implosion, appeared when they did. Survey evidence on investor beliefs during the bubble period, as well as the covariation of price and volume, lend some support to the heterogeneity approach.

Robert B. Barsky
Department of Economics
University of Michigan
Ann Arbor, MI 48109-1220
and NBER
barsky@umich.edu

Between January 1985 and December 1989 the real value of the Nikkei 225 stock price index tripled. By the middle of 1992, the index in real terms was less than 20% above its January 1985 level. While this paper focuses on the equity market, land prices behaved similarly. An index of land prices in Japan's six largest cities almost tripled in real terms between 1985 and 1990. Land prices fell more gradually than did stock prices, but by 1998 the real land price was no more than 20% higher than its 1985 value. Without making any presumption as to the cause (or the "rationality") of this dramatic asset price behavior, we will refer to it as the "Japanese Bubble" observation[2].

Much previous discussion of the Japanese Bubble and similar asset pricing phenomena focuses on whether the price behavior was "justified by fundamentals" or, alternatively, indicative of either "irrationality" or "speculative" behavior. Alternatively, one might pursue the idea that there are legitimate differences of opinion as to what is the "right" model with which to interpret the available signals about fundamentals. Models in which agents have heterogeneous beliefs about fundamentals occupy a fruitful middle ground between those in which agents with strictly rational expectations focus exclusively on fundamentals and those heavily "behavioral" models that eschew fundamentals and focus either on irrationality or purely speculative motives. Using survey data - especially the results of an interesting survey of Japanese institutional investors by Shiller, Kon-Ya, and Tsutsui (1996) - in addition to market data, I illustrate how this "disagreement" approach to asset pricing might help us to understand the Japanese data.

---

[2] I thus adopt the neutral Kindelberger (1996) definition of a bubble as merely "an upward price movement over an extended range that then implodes".

Our story goes roughly as follows. The period from 1955 to 1975 was one of extraordinary productivity growth. In line with the world productivity slowdown, Japan entered a low growth regime in 1974, with little sign of a reprieve at least until 1986. Beginning in 1986, there were vague "New Economy" signs. Growth in GDP, corporate earnings and dividends picked up. Between 1985 and 1986 the cost of capital had apparently fallen due to a loosening of monetary policy by the Bank of Japan and perhaps also financial liberalization. Consider two extreme readings of this situation. The optimist believes that a New Economy period has indeed arrived. The renewed growth is a sign that the productivity slowdown that began in 1974 has partially attenuated, and the low interest rates are in part a permanent consequence of financial liberalization and other developments in the real economy rather than the transitory result of easing by the Bank of Japan. The pessimist takes the opposing view on both counts.

With the foregoing observations in mind, we see an explanation of the Japanese bubble emerging. A subset of investors decided that high growth and perhaps low interest rates were going to continue indefinitely, justifying a permanently higher price of equity on fundamental grounds. These investors were able to borrow and make their voices heard, while their bearish counterparts were silenced by constraints on short sales[3]. The high growth rates, in particular, were subject to multiple interpretations, particularly as to whether they were merely transitory or were an early manifestation of a new era with a permanently higher rate of growth as compared with the previous decade. After all, Japan had experienced astronomical growth prior to 1974 and without the benefit of

---

[3] We should state at the outset that it is not true that short sales were either completely forbidden or technically impossible in Japan during this period. However, for extensive evidence of limitations on short-sales in Japan during the period in question, see Schaede (1993). I review the issues in Section III below.

hindsight there was perhaps little reason to conclude that the productivity slowdown was not partly transitory.

One might focus on the relative reasonableness of the two positions, but the heterogeneity theory takes a different tack. Its key insight is that of the two positions, it is that of the optimist that is likely to prevail in the market. It is certainly fair game to ask whether the two positions are equally rational, and – if not – to inquire what sorts of 'behavioral finance" considerations or cognitive errors might be responsible for belief in the seemingly less plausible scenarios, as we do near the end of section II. In this framework, though, whether or not the optimists and pessimists are equally rational is an interesting but second order issue. It is the optimists rather than the most rational agents that prevail in equilibrium.

In Section II I review, with some new twists, the case for rationalizing the behavior of stock and land prices via the Gordon formula in the context of a homogeneous agent model. Both growth rates and interest rates moved in the right direction to lend some support to this approach. However, there are obstacles in the way of a satisfactory account of the Japanese experience based on these considerations under homogeneous beliefs. First, many agents must have questioned, as the economist with the benefit of hindsight certainly does, whether the changes in real interest rates and growth rates could have been sufficiently persistent. Second, if one can rationalize the high prices of the late 1980s based on growth rates, prices should have been even higher in the extraordinarily high growth regime prior to 1974 - unless the risk premium was also especially high in this period. Third, if agents believed the growth rate was

permanently higher, consumption should have – counterfactually - risen sharply relative to current income.

At least two of the above obstacles would be significantly less severe in a world of heterogeneous beliefs. The persistence problem would be mitigated if we allow for disagreement about the extent to which the new higher growth rates reflect a permanent change in the economy rather than a temporary aberration. At worst, in the heterogeneous beliefs framework only a fraction of the agents in the economy need be guilty of a cognitive error in extrapolating from the recent past to the indefinite future. The consumption problem is mitigated because aggregate consumption reflects the beliefs both of stockholders and those who are out of the market.

Section III introduces recent theoretical ideas about asset pricing when agents have heterogeneous beliefs about fundamentals, particularly when there are institutional or other limitations on short sales. The basic theory, as sketched by Miller (1977) and elaborated by Harrison and Kreps (1978), Chen, Hong and Stein (2002), Scheinkman and Xiong (2003) and others, says that in the presence of constraints on short-sales, the value of the market is determined by the most optimistic agents. Even with many bearish investors, the market will be high if optimists have sufficient wealth or borrowing capacity and if pessimists have sufficient limitations on their ability to sell short.

One might wonder if the theory of heterogeneous beliefs under short sales constraints, while facilitating explanation of the high prices at the peak of the bubble, is primarily a theory of systematic overvaluation rather than a theory of booms and busts that can explain why there was a bubble between 1986 and 1990 and not before, and why the bubble collapsed when it did. This need not be the case. Heterogeneous beliefs are

fueled by news that is difficult to interpret, and the heterogeneity may subside as events unfold. As we detail in Section III, there are also somewhat more esoteric reasons that heterogeneity-induced elevation of asset prices is fragile and not prone to persist forever.

Turning next to the data, we find that even at the height of the bubble, a high fraction of investors thought the market was not overvalued relative to fundamentals. Belief heterogeneity is high near the peak of the bubble, and attenuates as the bubble collapses. Further, many - but not all - of the predictions of dynamic models with heterogeneous beliefs appear to characterize the data. Many agents who believe that the market is overvalued relative to fundamentals believe that the price will not fall in the short run, presumably because other agents are willing to hold the stock at the existing high price. Volume is high at the peak of the market and falls dramatically as the market collapses. The expectation that volatility also is highest at the peak, however, is not confirmed by the data. Section IV summarizes and concludes the paper.

II. *Rationalizing the Japanese Bubble: The Gordon Formula Under Homogeneous Beliefs*

Figure 1 shows the real value of the Nikkei 225 index in monthly data from 1980 to 1995. As noted in the introduction, the real value of the Nikkei 225 stock price index tripled between January 1985 and December 1989. By the middle of 1992, the index was less than 20% above its January 1985 level in real terms. Figure 2 shows annual data on the real price of urban land in Japan's six largest cities over the same period. The index almost tripled in real terms between 1985 and 1990. Land prices did

not implode quite as rapidly as stock prices, but by 1998 the real land price was no more than 20% higher than its 1985 value[4].

In this section we focus on evidence as to whether or not the behavior of stock prices can be interpreted as a natural response to fundamentals – in particular, growth rates and interest rates. Much applied work has already been conducted in the Gordon formula context in the case of Japan (French and Poterba, 1991; Frankel, 1991, and Ito and Iwaisako, 1995 are good examples). The results have been somewhat inconclusive, but have for the most part shed doubt on the plausibility of a fundamentals-based explanation of the bubble and its collapse. I conclude that, though are many reasons for doubt, there is at least *an* interpretation of the data in which the prices at the peak might well have been justified by expectations of fundamentals. This will set the stage for the next section, in which I argue that it is likely that this optimistic reading of the fundamentals is the one that would be reflected in the equilibrium price.

I begin by reviewing the behavior of valuation ratios (dividend and earnings yields) between 1980 and 1992. I draw attention to the pre-existing condition of low yields as of the beginning of this period, and explain why that made the later appearance of a bubble more likely. We then turn to the determinants of yields, focusing first on the real interest rate and then on the growth rate of the economy. I show that there were

---

[4] This paper will focus on stock prices alone. However, before leaving the topic of land, we should dispose of a frequently made argument that price appreciation of land held by corporations *caused* of the stock market boom. One form of the argument is based directly on the value of the land in companies' portfolios. A more subtle version is that land served as collateral for bank loans to corporations and raised equity values by facilitating corporate borrowing. Neither of these arguments is satisfying. First, stock prices *lead* (and Granger-cause) measured land prices (though that may be because the measured land prices lag behind true land prices). More fundamentally, theory tells us that stock and land prices are functions of the same underlying economic forces – namely growth rates and discount rates – and are thus jointly endogenous.

indeed changes in both the interest rate and the growth rate going in the right direction, but that it is hard to determine whether or not a rational fundamentals-based model would have given rise to asset price variation of the magnitude seen in the data. We go on to discuss the pros and cons in some detail, focusing especially on the issue of whether or not fluctuations in real interest rates and growth rates were sufficiently persistent. The remaining ambiguity suggests that is precisely the sort of situation in which a disagreement model is appropriate.

II-a. The Gordon Formula and Variation in Dividend-Price and Earnings-Price Ratios

The traditional fundamentals-based approach to market valuation is in a representative agent framework, and focuses on the discounting of expected cash flows by an appropriate discount factor ρ. The classic analysis of valuation ratios that comes out of this approach, the Gordon formula, tells us that the dividend/price ratio is equal to the required rate of return minus the expected growth rate of dividends: $\frac{D}{V} = \rho - g$ [5].

According to the Gordon formula, fundamental value changes if and only if the current level of dividends, the growth rate of dividends, or the required return changes. Our task is therefore to find measures of at least some of these quantities. Strong and persistent

---

[5] To derive the Gordon formula in a simple context, we first define fundamental value as equal to the present value of expected future dividend: $V_t = \int_0^\infty E_t[D_{t+k}]e^{-\rho k}dk$. Assume that both ρ and the exponential growth rate of dividends g are constant. Then substituting $E_t[D_{t+k}] = D_t e^{gk}$ into the expression for V and integrating, we have $V_t = \frac{D_t}{\rho - g}$. Pastor and Veronesi (2003) show that the Gordon formula holds when dividends follow a diffusion process with constant drift g. The simple Gordon formula stated here does not apply when dividend growth follows a general stochastic process rather than remaining constant, but we discuss in the text an approximate dynamic Gordon formula that handles this case.

movements in these fundamentals would warrant equally impressive movements in stock prices, while an absence of appropriate variation in growth rates and interest rates would suggest that an explanation of movements in the price relative to dividends would have to rely either on misinterpretation of fundamentals or on nonfundamental, speculative considerations.

Figure 3 shows stock yields – both dividend price and earnings price ratios in monthly data from 1980 to 1992.   Several interesting points arise from figure 3.   To begin with, the Japanese bubble story doesn't really start in 1985-86.   Between the beginning of 1982 and the beginning of 1985, the dividend yield fell from 1.5 to .88   - more than it did between 1985 and 1987.   This rarely discussed fact is important for two reasons.   First, it puts the further drop in yields from the beginning of 1986 to the end of 1989 in perspective.   Second, as we make clear below, it is because the yields were so low at the end of 1985 that the subsequent percentage changes in the stock price were so large.

Japanese dividend yields were chronically low by U.S. standards.   One might be concerned that this is simply a mechanical consequence of the fact firms were not paying out a high fraction of earnings in the form of dividends (indeed, between 1970 and 1984 real dividend growth was negative) and that perhaps the dividend price ratio is less meaningful than, say, the earnings price ratio.   This view is mistaken, because retention of earnings implies higher profits in the future, and eventually higher dividends as well. Further, as Figure 3 makes clear, earnings yields are themselves low.   The real reason for the low yields is that Japan did not have an "equity premium puzzle" as did the United

States. Our best guess of the risk premium in Japan in the 1980s suggests it was not much more than a couple of hundred basis points.

The chronically low level of dividend and earnings yields points to the underlying principle behind the possibility that prices might not have been out of line with fundamentals. When the required return is only slightly above the long-rate expected growth rate of an asset's earnings stream, asset prices can be both "nearly infinite" and "nearly indeterminate". Merely rewriting the Gordon formula as

$V = \dfrac{D}{\rho - g}$ shows that when ρ is close to g, not only will the level of asset prices be high,

but the logarithmic derivatives of fundamental value with respect to each of the three determinants (current cash flows, expected growth rates, and discount rates) will be large in absolute value (see Barsky and DeLong, 1993)[6].   For instance, at the peak of the market in 1989, the dividend yield was as low as one-half of a percent per year. If we are willing to argue that *this* is consistent with fundamentals, it is not difficult to generate a crash as well. We turn next to the determinants of yields flagged by the Gordon formula to see if the fundamentals approach to stock yields is a tenable one.

II-b. Movements in the Required Return

The Gordon formula points to the required rate of return ρ as one determinant of stock yields. This in turn consists of a riskless rate and an equity premium. Unfortunately, little can be discerned about how the equity premium might have varied

---

[6] Note that all of these derivatives will have a factor r-g in the denominator . The point was stressed in the Japanese context by Boone and Sachs (1988) and French and Poterba (1991).

over time[7]. We do, however, know that the Bank of Japan reduced the discount rate

sharply at the beginning of the bubble period, and raised it equally sharply at the end.

These interest rate movements are often cited as the cause of the inception and collapse

of the bubble (see, e.g. Okina, et al, 2001; and Hoshi and Kashyap, 2001).

On the other hand, Ito and Iwaisako (1995) note that the interest rate-based

explanation of the bubble depends on the presumption - very likely incorrect - that the

movements in interest rates were largely permanent.   A way to see their general point is

to work with the log linear approximation to the Gordon formula that holds when

required rates of return and dividend growth rates are non-constant over time but follow

stationary stochastic processes (the "Dynamic Gordon growth model" - see Campbell,

Lo, and Mackinlay, 1997, p. 260-267). One version of the formula (equation 7.1.22 in

Campbell, Lo, and MacKinlay) tells us that the log stock price p_t can be written (apart

from a constant) as an expected present value of weighted future log dividends and

future discount rates: $p_t = \dfrac{k}{1-\rho} + E_t\left[\sum_{j=0}^{\infty}\rho^j[(1-\rho)d_{t+1+j} - r_{t+1+j}]\right]$,   where

$\rho \equiv 1/(1+\exp(\overline{d-p}))$ and $\overline{d-p}$ is the mean of the log

dividend/price ratio.   Campbell, Lo, and Mackinlay (1997) consider the special case in

which the real interest rate follows an AR-1 process

$E_t[r_{t+1}] = r + x_t, \quad x_{t+1} = \phi x_t + \xi_{t+1}.$

They show that in this case

---

[7] Merton (1980) shows for the case of the United States that using historical stock returns to estimate the required expected return on the market leads to unreliable estimates – the time series is too short given the great volatility of the market. The same argument applies *a fortiori* for Japan, given the shorter time series of market returns.

$$p_{rt} \equiv E_t \left[\sum_{j=0}^{\infty} \rho^j r_{t+1+j} \right] = \frac{r}{1-\rho} + \frac{x_t}{1-\rho\phi} \qquad (2).$$

Equation (2) is a satisfying framework in which to discuss the persistence problem.

Suppose we take $\rho = .99$, to reflect the fact that the dividend price ratio in 1985 hovered around .01. If interest rate movements are all permanent, $\rho = 1$ and the change in the log price is 100 times the change in the interest rate If = .95 (in annual data), on the other hand, the change in the log price is only about twenty times the change in the interest rate; i.e a one hundred basis point drop in the interest rate would raise the market value by about 20%. Thus to have large effects on stock prices, interest rate movements must be not only persistent but more or less permanent. The choice of = .95 corresponds to a half-life of about six years; for an interest rate reduction induced by monetary policy, this is a long time. Yet its effects are far too small to justify the bubble observation.

Suppose we wish to explain the change in the dividend price ratio from .01 to .005 between 1985 and 1986. The simple Gordon formula tells us that a permanent reduction in the real interest rate of 50 basis points would do the job. The actual drop in the real rate exceeded 100 basis points (see below), but was not necessarily permanent. A 100 basis point drop would have a potency equal to that of a 50 basis point permanent drop only if phi is as high as .98, corresponding to a half life of some thirty years.

Table 1 shows annual averages of the official discount rate, an index of long-term government bond rates, and a measure of the expected real long-term rate using the ten year forecast of inflation from Data Resources, Inc. (The nominal long-term interest rate series is very close to the series for the ten year bond rate given by the Bank of Japan). While theory tells us that variation in real short rates associated with monetary

12

policy ought to be short-lived, Table 1 suggests that there was an impressive reduction in real long-term interest rates of 120 basis points between 1985 and 1986, and a subsequent rise of 100 basis points between 1989 and 1990.

Ito and Iwaisako (1996) focused on the persistence of the short term real rate (which of course has implications for long-term rates through the term structure). However, the fact that long-term real rates fell as much as they did means either that the presumption that the Bank of Japan could not reduce real rates for years at a time is incorrect or that we were witnessing something other than exogenous monetary policy. Perhaps the Bank was in part responding endogenously to economic forces that militated for a lower real rate[8] or perhaps the Bank had been holding the interest rate above the natural rate prior to 1986, so that the 1986 rate was in fact sustainable.

Ultimately, Ito and Iwaisako may or may not be correct in their conclusion that the interest rate reduction can't explain much of the 1985-1986 stock price increase. Our interest rate measure is roughly the ten year real rate. Yet we have seen that expectations at much longer horizons are highly relevant to the stock price; much depends on the forecasts reflected in the very long end of the yield curve. One might imagine that there is a lot of room for differences of opinion across investors as to whether or not disturbances that persist for ten years are closer to permanent or closer to transitory.

II-c. *Growth Expectations*

The second determinant of fundamental value that the Gordon formula points to is the growth rate of cash flows. How much variation in growth rates was there, how

---

[8] For example, appreciation of the yen was a major motive for the rate decrease (see, e.g. Ito,2003)

persistent was it, and what fraction of stock price fluctuations would it explain? Figure 4 shows annual growth in real GDP and real dividends. Both measures show a sharp upturn in growth between 1986 and 1988. GDP growth peaks in excess of six percent per annum. Dividend growth rises strikingly, from slightly negative to four percent per annum. It is true that the first part of the market boom actually comes at a time of weak growth that preceded the high growth period of 1987-1989, but for 1985-1986 we have the drop in the interest rate to fall back on[9]. Both growth measures show sharp declines between 1989 and 1991, offering at least some hope for those who would attribute the crash in asset prices to a decline in expected growth.

Figure 5 shows two survey measures in the form of index numbers: "Business Conditions" from the Tankan Survey, and Income Growth Expectations from the Survey of Consumer Confidence. After considerable weakening in 1985 and 1986, both measures rose dramatically in 1987 and 1988, and fell equally dramatically in 1990 and 1991. These data further the finding that there was a period of high expected growth and favorable perceptions of the overall business environment, which also ended abruptly.

As in the interest rate case, a key question is whether the changes in expected growth rates were sufficiently persistent to have strong leverage on the price. The g in the dynamic Gordon formula is the "permanent" growth rate of dividends. Even if growth rates were to be elevated for a period of several years, the effect on the very long-run growth rate would be quite modest. French and Poterba (1991) illustrate this point by considering (among others) a scenario in which investors expect temporarily high

---

[9] It might also be that the stock market was anticipating growth to come, though one also has to consider the possibility that the boom and bust in the real economy could have been the *result* rather than the cause of the stock market fluctuations.

earnings growth due to a supernormal rate of return on reinvested corporate earnings that is expected to last ten years – the horizon of our survey expectation of Nikkei earnings growth. The effect of even ten years of elevated earnings growth on the stock price is still only a fraction of the effect of a permanent rise in the growth rate.   As in the interest rate case, even quite persistent transitory processes cannot deliver the required near-permanence of growth changes .

However, the conclusion that growth rate changes were clearly not persistent enough to justify large swings in asset prices runs into a potential contradiction when one considers a longer sample period.   Over the period 1955:2 to 1973:4, the mean growth rate of GDP was an astronomical 8.8%, while from 1974:1 to 2001:4, mean growth was 2.7%. Clearly there was a permanent shock somewhere.   If it were known with certainty that there was a once-and-for-all shift in the mean growth rate in 1974:1, say, then it would be appropriate to regard subsequent fluctuations in growth rates as transitory and to conclude that they could not possibly account for major asset price fluctuations.   On the other hand, there could be periodic small, permanent shocks that have major implications for asset prices without accounting for much serial correlation in growth rates, and these can be hard to detect in finite samples (Barsky and DeLong, 1993).   Without the benefit of hindsight, would it not have been equally reasonable to believe that the reduction in growth after 1973 was due partly to transitory shocks? Might not a Japanese investor in 1987 have reasonably believed that he was witnessing a partial return of the high growth period?

The classic stochastic process that captures the idea of a mixture of permanent and transitory shocks is $g_t = p_t + \tau_t$, where the permanent component p_t is a random walk

and the transitory component τ_t is a white noise process uncorrelated with the innovation

in p_t (see Muth, 1960).

To an agent (or an econometrician) that does not separately observe the

permanent and transitory components, the growth rate has the

representation $g_t = g_{t-1} + \varepsilon_t - \beta\varepsilon_{t-1}$, where ε_t is white noise and $0 < \beta < 1$. Here ε_t is the

innovation in the growth rate (a composite of the transitory component and the

innovation in the random walk component), and β is the fraction of each period's

innovation that is transitory. If β is close to 1, most of the innovation is transitory, and

the overall growth process will exhibit little serial correlation. Yet, as we shall see, the

relatively small permanent component can have major implications for asset prices. The

process implies that the estimate of the permanent component is a distributive lag on past

growth rates with geometrically declining weights, and that for β close to one, the

weights decline very slowly.

Estimation of the above process for quarterly GDP growth from 1955:2 to 2001:4

yields an estimate of β equal to .90. Figure 6 shows the implied permanent component

of g. The permanent component falls dramatically in 1974 and 1975. Though most of

the loss is never made up, there is a rise in the permanent component of more than a

percentage point between 1986 and 1989 – far more than is needed to explain the drop in

the dividend price ratio over this period.

The above process fits Japanese GDP growth rather well, but the dividend process

less well. Alternatively, one might deal with the persistence problem by moving

somewhat into the behavioral realm. Barsky and Delong (1993 b) argue that

"extrapolative expectations" of dividend growth – expectations formed as a distributive

16

lag on past growth rates - help to account for a century of stock price behavior in the U.S. and interpret such expectations as "reasonable" - though not necessarily strictly "rational" - rules of thumb. A regards extrapolative expectations, particularly those that put much weight on the recent past, as the result of a cognitive error - a"New Economy fallacy" under which high recent growth rates are expected to continue forever. Since it is unlikely that all agents in the economy would exhibit the same sorts of cognitive idiosyncrasies, this route would seem to bring us naturally into the world of heterogeneous beliefs. The new economy fallacy would then become an explanation of the optimism of one category of bullish investors. It is worth noting that even when this story is told with less than fully rational agents, it is still a story about perceived fundamentals rather than speculative processes.

For the second half of 1989 on, we have direct survey information on expected earnings growth at a fairly long horizon. Figure 7 plots the ten year expected growth in Japanese corporate earnings from the survey of Japanese institutional investors introduced in Shiller, Kon-Ya, and Tsuitsui (1996) and discussed in detail in our next section[10]. The data are semi-annual. In addition to focusing on the earnings of the Nikkei companies, this has the advantages that it addresses the horizon over which growth expectations are being assessed and that the horizon is a relatively long one[11].

The results in Figure 7 indicate that mean expected earnings growth in the second half of 1989 and in 1990 was quite high - somewhat in excess of 5%[12]. Let us

---

[10] Question wordings are found in the Appendix.

[11] Still,it is difficult to say whether or not the stated expectation contains a perceived temporary component. When investors answer the question about ten year earnings expectations, are they giving their expectations into the indefinite future, or do they have in mind(along the lines of French and Poterba, 1991) a scenario in which there will be a prolonged, but finite period of "supernormal" earnings growth?

[12] There is an unfortunate gap in the data collection in the first half of 1990, but one might interpolate and assume that expected growth was approximately 5% throughout 1990.

provisionally take the position that these are expectations of earnings growth for the indefinite future. Table 1 tells us that the ten year real interest rate at the end of 1990 was 3.0%. If we take that to be the very long-term interest rate, then the 5% growth expectations and the dividend yield of 0.5% imply a very reasonable equity premium of 2.5%. In this sense, the level of the stock price in 1990 does not seem to be particularly excessive[13]. Further, the reduction in expected earnings growth to 4.25% by the second half of 199, coming on top of the 100 basis point rise in the real interest rate the previous year, if anything *over-explains* the rise in the dividend price ratio.

The conclusion that developments in the growth rate of the economy may have been an important part of the story behind the Japanese bubble is furthered by the observation that an increase in *uncertainty* about the growth rate has the same effect on asset values as an increase in mean growth. Pastor and Veronesi (2003) show that when g is constant but unknown, the correct version of the Gordon formula is $\frac{V}{D} = E[\frac{1}{\rho - g}]$ (where the expectation is over the subjective distribution of g), They note that the convexity of the function $\frac{1}{\rho - g}$ in g implies that the expectation rises with the variance of g. The idea that g is particularly uncertain in the period in question fits well with the notion that mixed signals regarding the possibility of a "new economy" were difficult to interpret. It also suggests that this era was ripe for differences of opinion across agents and that a heterogeneous beliefs model is an appropriate way to model this period.

---

[13] Recall that Japanese equity premia have historically been lower than those in the U.S. One might be concerned that the implication that the required return on equity is only 5.5% is in conflict with Figure 13 below, which shows Japanese investors' expected return on the Nikkei to be about 10%. That, however, is a one-year expected return, whereas the required return in the Gordon formula calculation is the infinite period return.

One reason for doubting that high growth expectations are the explanation for the bubble observation is the behavior of aggregate consumption. If expected growth rates were high for the long haul, PIH considerations suggest that this would have shown up in consumption that was abnormally high relative to income. Figure 8 shows the actual, fitted, and residual values from the regression of log consumption on log GDP withannual data over the period 1955 to 1998. The regression residuals indicate that conditional on income, consumption was not in any way high during the bubble period. It is hard to believe that consumption would not have risen more sharply relative to income if all agents in the economy believed that growth would continue indefinitely at four percent or more. On the other hand, a heterogeneous agent model in which only *some* people believed that growth rates were very high would have a better chance of matching the consumption observation

III. *Heterogeneous Beliefs, Survey Data, and the Japanese Bubble*

In the previous section we argued that there is some reason to believe that fundamentals shifted in a way that ought to increase asset values sharply, but that the generation and collapse of expectations of high growth and low discount rates in a world with homogenous beliefs may or may not be sufficient to provide a satisfactory account of the Japanese stock and land markets between 1985 and 1992. In this section, we examine the implications for Japanese Bubble analysis of allowing agents to have heterogeneous beliefs about growth rates and fundamental value, particularly in conjunction with limitations on short sales. We outline some of the implications of heterogeneous beliefs treated in the literature, and point out how they might address some

19

of the most serious embarrassments that arise in the homogeneous beliefs case. We then examine some evidence on whether the implications of models with heterogeneous beliefs and short-sale constraints are to be found in the Japanese stock market in this period.

Some of the evidence we examine is in the form of statistics about stock prices, volume, and volatility. However, we make particular use of the Shiller, Kon-Ya, and Tsutsui (1996) survey data. Because beliefs about both fundamentals and possible speculative processes are so central to the stories we consider in this section, it is essential to have a window into investors' minds. To the best of our knowledge, no data other than SKT ask for investors' assessments of price relative to fundamentals, or investors' assessments of the beliefs and actions of other agents in the market. We first present the theoretical background and then proceed to a discussion of the survey data and presentation of the results. Our findings will suggest that heterogeneous beliefs models with short-sale constraints do indeed help to provide a more satisfactory account of what happened during the Japanese Bubble period.

As noted in the introduction, there were no wholesale prohibitions on short-selling in Japan in the 1980s. However, there were a number of important legal and institutional restrictions that sharply limited short-selling in practice. These are carefully detailed in Schaede (1993). Most notable among these are the prohibition on naked short sales (those in which the stock is neither owned nor borrowed by the short-seller) and the uptick rule (short sales cannot be carried out at a price lower than that of the preceding trade). Schaede notes that most short-selling by securities companies was of the "against the box" variety, in which the motive is merely hedging inventories.

Schaede (1993) proposes as a measure of the importance of short-selling the ratio of average outstanding short interest to average daily trading volume. She reports that this number was 49.3 percent in 1988, 48 percent in 1989, and 104 percent in 1990. In comparison, she cites 210 percent as a representative number for the U.S. during that period. By this measure short-selling in Japan was a quarter to a half of what it was in the United States, where short-selling is already costly and quite circumscribed (see Lamont, 2004).

Heterogeneity of beliefs may arise in theoretical models for several reasons, including a) differences in priors and b) differences in information in combination with overconfidence regarding one's own judgment (as the latter causes agents to place excessive weight on their own signals and thus dismiss the information value of the other agents' market behavior). Classic contributions of Miller (1977) and Harrison and Kreps (1978) established the theoretical implications of combining heterogeneous beliefs about fundamental value with constraints on short-selling. The very intuitive basic insight is that with restrictions on short-selling, agents with the most pessimistic assessments of the asset's fundamental value are not able to express their beliefs via market behavior, so that asset prices then reflect the beliefs of the more optimistic investors only. An increase in the degree of heterogeneity that also represents an increase in the most optimistic valuation of the assets thus raises market value. At the same time, if this heterogeneity-based "overvaluation" arises because of differential interpretations of news, it is fragile and prone to crashes as the news is digested and a consensus begins to develop.

iii-a. Heterogeneous Beliefs, Short Sales Constraints, and Share Valuation

To offer a sense of how the interaction of disagreement and short sales constraints raises prices, we sketch here a two-period model taken from Chen, Hong, and Stein (2002) that demonstrates the effect of the degree of heterogeneity on the level of the asset price and the corresponding expected return. This can be thought of as a formalization of the Miller (1977) model, which is static and emphasizes the disproportional effect of optimists on the asset price. Dynamic models, which emanate from Harrison and Kreps (1978), have additional implications that we will address later on in this section.

There are Q shares of a stock that pays a one-time dividend of F+ε per share in the second period (the "fundamental"). Two kinds of agents trade the stock in the first period: a group of "buyers" who cannot go short, and a group of rational arbitrageurs who can take short or long positions, limited only by risk aversion. The "buyers" have heterogeneous beliefs, represented by a uniform distribution of valuations on the interval [F-H, F+H] centered on the true fundamental F, with a degree of heterogeneity measured by H. Let the buyers have constant absolute risk aversion (CARA) utility with risk tolerance γ_B and the arbitrageurs have CARA utility with risk tolerance γ_A.

Normalize the total mass of buyers to one. It is well known that CARA utility gives individual asset demands that are linear in the deviation between the individual's valuation V and the market price p, where the constant of proportionality is the risk tolerance γ. Thus buyer i has asset demand $\gamma_B (V_i - p)$, which of course can in general be negative. Integrating over the distribution of valuations, we see that if the buyers were permitted to sell short, the total market demand would be

$$Q^{DU} = \frac{1}{2H} \int\limits_{F-H}^{F+H} \gamma_B (V_i - P) dV_i + \gamma_A (F - P),$$

where the second additive term is the demand of the arbitrageurs. Letting Q be the outstanding quantity of the asset, and setting $Q^{DU} = Q$, it is not hard to show that the price in the absence of short sales constraints is

$$P^U = F - \frac{Q}{\gamma_A + \gamma_B}.$$

The price is increasing in the mean of the fundamental and the risk tolerance of both types of agents, decreasing in the asset supply, and - most importantly - independent of the degree of heterogeneity H.

If, on the other hand, we impose that buyers cannot sell short, the demand of a buyer with valuation V_i will be equal to $Max[0, \lambda_B (V_i - P)]$. Integrating over the buyers and adding the demand of the arbitrageurs, we have market demand characterized by

$$Q^{DC} = \frac{1}{2H} \int\limits_{P}^{F+H} \gamma_B (V_i - P) dV_i + \lambda_A (F - P).$$

Chen, Hong, and Stein (2002) show that the short-sales constraint is binding when heterogeneity is sufficiently great, namely $H \geq \frac{Q}{\gamma_A + \gamma_B}$, and that the equilibrium price in that case exceeds the price when short-sales are unconstrained. Finally, the price is increasing in H. This result is intuitive, because a rise in H adds positive asset demands without creating any offsetting negative demands. Thus the degree of heterogeneity is

positively related to price, and (since the stock simply pays a liquidating dividend in period 2) negatively related to expected return[14].

iii-b. Heterogeneous Beliefs in the SKT Survey Data

In this section, we use survey data to document the heterogeneous beliefs of investors during the bubble period.   We show that there was a great deal of divergence of opinion as to whether or not the market was overvalued relative to fundamentals, and that this divergence of opinion generally varied in the way that the theory predicts. In particular, belief heterogeneity was high at the high of the bubble and attenuated as the bubble crashes.   We also show that on the whole, institutional investors did not believe that the bubble was due to purely speculative considerations.   Rational or not, beliefs about fundamentals played a central role in generating the bubble.

In our attempts to acquire information about expectations, beliefs, and sentiments of participants in the stock market, we employ data from the Survey of Investor Behavior conducted by Shiller, Kon-Ya, and Tsutsui (1996).   As noted above, the SKT Survey is in the form of a written questionnaire aimed at institutional investors in Japan and was given semi-annually. We have already used the data from the SKT question on the expected growth of corporate earnings. Here we make use of questions aimed at diagnosing overvaluation beliefs (beliefs that the market is too high relative to fundamentals) and speculative considerations in investor decisions, as well as questions about the expected return on equity.

---

[14] Park (2005) shows that in U.S. data, high dispersion of analyst's earnings forecasts predicts low subsequent returns.

As we have stressed throughout, the appearance of a bubble based on beliefs about fundamental value does not require that all (or even most) agents have high expectations for fundamentals. Figure 9 shows the fraction of Japanese investors that believe that the market is *not* overvalued relative to fundamentals. At the peak of the bubble in 1989, over 60 percent thought that the market was not overvalued. Just proceeding the collapse, some thirty percent of the respondents still regard the market as correctly priced (or even underpriced). Thus there was a large group of investors ready to hold the market on the basis of their own beliefs about fundamentals, without invoking any speculative considerations.

Figure 10 shows two additional variables that might be considered measures of overvaluation beliefs – a) the fraction claiming that the trend of prices is primarily "speculative" and b) the fraction citing excessive "excitement" about stocks. We learn several things from Figure 10 . First, assertions that the trend is primarily speculative or that excitement about stocks is excessive are alternative statements of the view that the market is high for reasons other than fundamental ones. The small fractions expressing these views are thus welcome confirmations of the results in Figure 9. Second, these responses seem inconsistent with some popular alternative accounts of the high equity prices. If there were a rational speculative bubble of the sort discussed above, agents would have been aware of it, and would describe the "trend" in stock prices as "mostly speculative" [15].

Figure 11 shows the result of computing a natural measure of heterogeneity among Japanese investors: $h = f(1-f)$, where f is the fraction regarding the market as

---

[15] Since in a rational bubble each agent is behaving appropriately given the equilibrium, respondents might not describe excitement about stocks as excessive.

overvalued.   This measure is at a maximum when f=.5 − i.e. when half believe the

market is overvalued and half believe it is not. In line with the theory, heterogeneity is

high near the peak of the bubble and falls sharply during the crash.   On the other hand,

the second period of strong disagreement between 1993 and 1995 is not met be a renewed

bubble, though it correctly predicts a powerful market decline of some forty percent

between 1996 and 1998.   Clearly, heterogeneity is not the whole story, but it does seem

to be an important part of the story.

iii-c. Disagreement between Japanese and U.S. Investors

Although it is something of a digression from the main argument, it is interesting

and instructive to note the differences of average opinion about the Nikkei between

Japanese and U.S. institutional investors.   Figure 12 again shows the fraction of Japanese

institutional investors that regard the Nikkei as overvalued, now adding a second line

representing the fraction of U.S. institutional investors sharing that view. As Shiller,

Kon-Ya, and Tsutsui (1996) stressed, the divergence is striking.   In the second half of

1989, three quarters of U.S. investors regard the Nikkei as overvalued, while only a

minority of Japanese respondents holds that view.   The overvaluation beliefs of U.S.

investors showed up in trading behavior.   As French and Poterba (1991) document, U.S.

investors reduced their long position in Japanese stocks as the bubble proceeded.

Disagreement between U.S. and Japanese investors also shows up in Figure 13,

which shows mean expected returns on the Nikkei of U.S. as well as Japanese investors.

While Japanese expected high returns during the bubble period, U.S. investors believed,

at the height of the bubble, that prices would fall.   It is thus important for the generation

and sustenance of the bubble that the U.S. investors could not- or at least did not – sell short Nikkei stocks in large quantity, for this might have lead to a "cancelling out" of the bullish behavior of the Japanese optimists.

The reasons for the strong disagreement between Japanese and U.S. investors are not obvious. One alleged phenomenon that is apparently *not* the answer was chauvinism on the part of Japanese investors.   Figure 14 shows returns on the *Dow Jones* expected by U.S. and Japanese institutional investors, respectively.   Strikingly, during the bubble period, Japanese investors were just as unilaterally bullish about the U.S. market as they were about the Nikkei.

iii.d. Fragility of Heterogeneity-Based Bubbles

One might wonder whether the heterogeneity theory is a theory of systematic overpricing, rather than of bubbles that arise and then collapse. However, this is not the case. First, heterogeneity of beliefs is higher at some times than others. It rises in response to news, particularly news that is subject to a variety of alternative interpretations – most especially, when one admissible interpretation is a highly optimistic one.   Heterogeneity tends to fall as the news is digested. As long as heterogeneity is stationary, bubbles will tend to arise and then attenuate.   Second, because bubbles based on heterogeneity are supported by heavy borrowing on the part of optimistic investors, such bubbles are sensitive to borrowing conditions and are prone to being pricked by tightening of credit coming either from the central bank or from other considerations.

Third, Hong and Stein (2003) present a more esoteric argument as to why heterogeneity-generated asset price increases are prone to collapse. They study the case

in which agents agree to disagree because they have differential information sets and are overconfident about the relative value of their own information. In the Hong and Stein formulation, the heterogeneous beliefs model with short-sale restrictions is particularly prone to "crashes" that seem out of proportion to the news that generated them because of the pent up information that is in the hands of the pessimists. The information of these would-be short sellers is not initially reflected in the asset price.; once someone is out of the market there is nothing to indicate whether his information was just barely adverse enough to keep him from a long position, or whether he is quite infra-marginal. However, that information may be revealed when the opinions of the optimists shift in an adverse direction.

Imagine that some traders who are long in the stock receive bad news that causes them to (partially) unload their positions.   The latent short-sellers who are currently out of the market might react in one of two ways.   If their relative pessimism was sufficiently small, they may begin to buy as the price falls. On the other hand, their judgment might be sufficiently adverse that even a substantial drop in the price would not bring them back into the market with a long position. The subsequent behavior of the price depends importantly on which of these alternatives is in fact the case,   If the latent short sellers do not begin to switch to a long position as the price falls, that indicates that the adverse information possessed by the latent the short-sellers was severe. Their failure to return to the market is a "dog that didn't bark" that can be the catalyst for a further drop in asset prices.   Importantly, there is no corresponding effect on the "up side"; those who have gotten good news are long in the stock and thus have already revealed their information to the market.

This asymmetry between the effects of good and bad news due to the constraints on short-selling tends to show up as negative skewness in higher frequency (daily or monthly) price data. Figure 15 verifies that this is the case for Japan.   It shows a histogram of monthly stock prices over the period 1970-2000.   As predicted, the prices are somewhat negatively skewed. In particular, the largest monthly drop in the Nikkei is -22%, while the largest increase is only 17%.

iii.e. Implications of Dynamic Heterogeneity Models

The ability to explain both "overpricing" without systematic over-optimism and proneness to crashes without large negative information shocks is the primary reason that disagreement models are an attractive way to think about the Japanese bubble experience. As we have seen, these features are well illustrated in the fundamentally static models emanating from Miller (1977). In a dynamic model, additional implications emerge. These involve not only price but also trading volume. They have to do with the "crossing" of beliefs between groups of investors who are constantly updating, and the trading that ensues when relative pessimists become relative optimists. First, there arises a "speculative premium" reflecting the option value of selling in the future to those agents that will emerge as the most optimistic investors, causing the asset to sell above the fundamental evaluation of even the most optimistic group of investors (Harrison and Kreps, 1977).   Second, trading volume and volatility are positively correlated with differences of opinion and share prices (Scheinkman and Xiong, 2003; Hong and Stein, 2003).   This is because trading results from pieces of news that are interpreted differently

by different agents, increasing the dispersion of beliefs and thus the degree of optimism among the most optimistic.

In short, the dynamic disagreement theory predicts high volume and high volatility at the peak, and a reduction in both at the time of the crash. Figure 16 presents data on trading volume and a volatility measure computed from daily data alongside the real closing price. The figure indicates that the prediction for volume is borne out handsomely. Note in particular the dramatic drop in volume in 1990. The volatility prediction, on the other hand, is rejected – volatility seems to be consistently higher in the crash period (as it was in the 1987 crash as well); indeed higher volatility after crashes seems to be a consistent feature of the data.

In the dynamic heterogeneity models, the belief that stocks are overvalued relative to fundamentals need not translate into an aversion to holding stocks in the short run. In the Harrison and Kreps model, agents are willing to hold a stock at a price that exceeds their own fundamental valuations if they believe that next period's optimists may be even more bullish than today's. Abreu and Brunnermeir (2003) present a model in which rational agents receive sequential signals as to whether or not the price is above the fundamental level, but there is no common knowledge of others' signals. In their setup, even in a situation where all agents have received an overvaluation signal, the absence of *common* knowledge prevents agents from coordinating on when to attack the bubble. Rational investors try to stay in as long as possible in order to receive the higher returns from "riding the bubble."

Does this phenomenon of "riding the bubble" show up in the survey data? What we are looking for here is the conjunction of 1) the belief that stocks are overvalued

relative to fundamentals and/or will have a negative return over some reasonably long

horizon and 2) the belief that stocks will continue to have a positive return over some

shorter horizon and are thus a good investment at present.   Figure 17 shows the fraction

of Japanese institutional respondents that believes that the Nikkei is "too high" along

with the fraction that expects a negative return over the next year.   While the former

peaks at 60 percent, the latter never reaches 20 percent.   Similarly, at the height of the

bubble in the second half of 1989, 39% of the respondents answered *true* to the statement

"Although I expect a substantial drop in stock prices in Japan ultimately, I advise being

relatively heavily invested in stocks for the time being because I think that prices are

likely to rise for awhile" (Shiller, Kon-Ya, and Tsutsui, 1996).   Thus the survey data

also reflect some of the phenomena associated specifically with dynamic heterogeneity

models. Though driven by disagreements about fundamentals, these models capture

some of the flavor of "speculative bubbles" in which "overtrading" and speculative

purchases of assets with a view towards resale to other market participants are prominent

features.

IV. Summary and Conclusion

Most discussions of the behavior of Japanese stock and land prices in the

late1980s focus on whether or not the price fluctuations could plausibly be explained in

terms of rational expectations about fundamentals. It may instead be useful to classify

explanations of major asset price changes along two dimensions – a) fundamental versus

speculative; and b) rational versus not strictly rational.   Thus there is, on the one hand,

the possibility of "rational speculative bubbles in which fundamentals play no role but

expectations are strictly rational (Blanchard and Watson, 1982); and, on the other, models

31

in which prices are determined by beliefs about fundamentals but expectations may not

be rational in the sense of being consistent with an econometrician's best estimate of the

probability model characterizing fundamentals.   In the extreme, expectations about

fundamentals may be severely distorted by cognitive errors. A gentler version involves

the idea that there are differences of opinion as to what is the "right" model with which to

interpret the available signals about fundamentals. This paper tends toward the latter

view.

We began with Kindelberger's neutral definition of a bubble as "an upward price

movement over an extended range that then implodes".   This allowed us to explore the

causes of the "Japanese Bubble" without precluding the possibility that "bubbles" are in

fact due to perceptions of fundamentals.   At the peak of the bubble in the second half of

1989, the majority of Japanese institutional investors thought that the Nikkei was *not*

overvalued.   This observation certainly pushes us toward the view that beliefs about

fundamentals were at the center of the bubble.

These beliefs were not entirely unfounded.   Long-term real interest rates fell

sharply between 1985 and 1986. Although there is somewhat more ambiguity regarding

the question of whether the growth rate of the economy rose in a way that could justify a

substantial increase in asset prices after 1986, there were certainly some signs of such a

persistent increase in growth, and the view that there was a significant increase in the

permanent component of the growth rate was defensible though not undeniable. The

apparent drop in required returns and rise in the growth rate came on top of initially lower

dividend and earnings yields, which rendered prices prone to dramatic percentage

increases – as well as dramatic subsequent drops if fundamentals proved not to be as favorable as some might have thought.

Invoking the literature on asset prices with heterogeneous beliefs and limitations on short sales, we argued that in a period characterized by the arrival of news that is difficult to digest and subject to multiple interpretations, it is the more optimistic assessments of fundamentals that are likely to be reflected in the market equilibrium. At the same time, high prices resulting from the heterogeneity phenomenon are fragile and prone to collapse. From this vantage point it is perhaps not surprising that the Japanese Bubble, as well as the subsequent implosion, appeared when they did.

Appendix: SKT Survey, *Question Wordings*

1) What do you think the rate of growth of real (inflation adjusted) corporate earnings will be on average in Japan over the next 10 years?

Annual percentage rate: _____%" (Asked only of Japanese respondents).

2) "Stock prices in Japan, when compared with measures of true fundamental value or sensible investment value are:

      1. Too low.   2. Too high.   3. About right. 4. Do not know." (Asked of both Japanese and U.S. respondents)

3) "How much of a change in percentage terms do you expect in the Nikkei at [each of several horizons]? (Use + before your number to indicate an expected increase, a - to indicate an expected decrease, leave blanks where you do not know: [FILL IN ONE NUMBER FOR EACH]" (Asked of both Japanese and U.S. respondents)`

4)"Although I expect a substantial drop in stock prices Japan ultimately, I advise being relatively heavily invested in stocks for the time being because I think that prices are likely to rise for a while.

     1. True   2. False   3. No Opinion".

Two questions asking the respondent to interpret the actions of other agents in the market are also of interest:

5) "Many people are showing a great deal of excitement and optimism about the prospects for the stock market in Japan and I must be careful not to be influenced by them.

     1. True.   2.   False.   3. No Opinion."

6) "What do you think is the cause of the trend of stock prices in Japan in the past six months?"

    1. It properly reflects the fundamentals of the U.S. economy and firms.

    2. It is based on speculative thinking among investors or overreaction to

       current news.

    3. Other

    4. No opinion."

References

Abreu, Dilip and Marcus Brunnermeier, "Crashes and Bubbles," *Econometrica*, 71(1), pp. 173-204, 2003

Barsky, Robert and J. Bradford DeLong , "Why Do Stock Prices Fluctuate?" *Quarterly Journal of Economics,* 1993.

Blanchard Olivier and Mark Watson (1982) "Bubbles, Rational Expectations, and Financial Markets," in P.Wachtel ed., *Crisis in the Economic and Financial Structure*, Lexington Books

Boone, Peter, and Jeffrey Sachs, "Is Tokyo Worth Four Trillion Dollars? An Explanation for High Japanese Land Prices." Papers and Proceedings of the Seventh EPA International Symposium, Structural Problems in the Japanese and World Economy Economic Research Institute, Economic Planning Agency, Tokyo, 1989

Campbell, John Y., A. W. Lo, and C. MacKinlay. *The econometrics of financial markets. Princeton, N.J., Princeton University Press*, 1997.

Chen, Joseph and Harrison Hong and Jeremy Stein, "Breadth of ownership and stock returns." *Journal of Financial Economics* **66**(2-3): 171-205, 2002.

Frankel, Jeffrey, "The Cost of Capital in Japan: Update" *Business Economics,* April 1991

French, Kenneth and James Poterba, "Were Japanese Stock Prices too High?" *Journal of Financial Economics*, 29, pp. 23-50, 1991

Harrison, Michael J. and David Kreps, "Speculative Investor Behavior in a Stock Market with Heterogeneous Expectations," *Quarterly Journal of Economics*, pp. 323-336, 1978

Hong, Harrison and Jeremy Stein, "Differences of Opinions, Short Sale Constraints and Market Crashes," *Review of Financial Studies*, 39(2), pp. 487-525, 2003

Ito,Takatoshi and Tokuo Iwaisako "Explaining Asset Bubbles in Japan," National Bureau of Economic Working Paper No. 5358, 1995

Ito, Takatoshi. "Retrospective on the Bubble Beriod and its Relationship to Developments in the 1990s." *World Economy* **26**(3): 283-300, 2003

Kindleberger, Charles P. *Manias, Panics, and Crashes*, Basic Books, 1996.
Lamont, Owen, "Short Sale Constraints and Overpricing" in Frank Fabbozi, ed. *The Theory and Practice of Short-selling*, Wiley, 2004.

Miller, E., 1977, "Risk, Uncertainty, and Divergence of Opinion," *Journal of Finance*, 32, 1151–1168

Muth, J. F.. "Optimal Properties of Exponentially Weighted Forecasts." Journal of theAmerican Statistical Association **55**(290): 299-306, 1960

Okina, Kunio, Masaaki Shirakawa, and Shigenori Shiratsuka, "The Asset Price Bubble and Monetary Policy: Japan's Experience in the Late 1980s and the Lessons: Background Paper," *Monetary and Economic Studies*, pp. 395-450, 2001

Park, Cheolbeom. "Stock return predictability and the dispersion in earnings forecasts." *Journal of Business* **78**(6): 2351-2375, 2005.

Pastor, L. and Veronesi, P. "Stock Valuation and Learning About Profitability," *Journal of Finance* 58, 1749-1789, 2003.

Schaede, Ulrike "Securities Financing in Japan: Margin Purchases, Short Sales, and Japan Securities Finance Co.", in: Takagi Shinji (ed.), *Handbook of the Japanese Capital Markets*, London: Basil Blackwell, 1993, pp. 517-556.

Scheinkman, Jose and Wei Xiong, "Overconfidence and Speculative Bubbles," *Journal of Political Economy, 2003.*

Shiller Robert, Fumiko Kon-Ya and Yoshiro Tsutsui "Why did the Nikkei crash? Expanding the scope of expectations data collection," *Review of Economics and Statistics*, 78(1), pp. 156-164, 1996.

Ueda, Kazuo "Are Japanese Stock Prices Too High?" *Journal of the Japanese and International Economies*, 4(4), pp.351-370, 1990.

Year	BOJ Discount Rate	Long-term Bond Yield, Nominal	Long-term Bond Yield, Expected Real
1982	5.5	7.8	2.4
1983	5.0	7.4	4.2
1984	5.0	6.9	4.4
1985	5.0	6.3	4.1
1986	3.0	5.5	2.9
1987	2.5	5.2	3.3
1988	2.5	4.8	3.0
1989	4.3	5.8	3.0
1990	6.0	6.8	4.0

Table I. Nominal and Real Interest Rates

Source: Discount Rate (last trading day of the year): Global Financial Database; Nominal and Real Bond Yields: French and Poterba, 1991
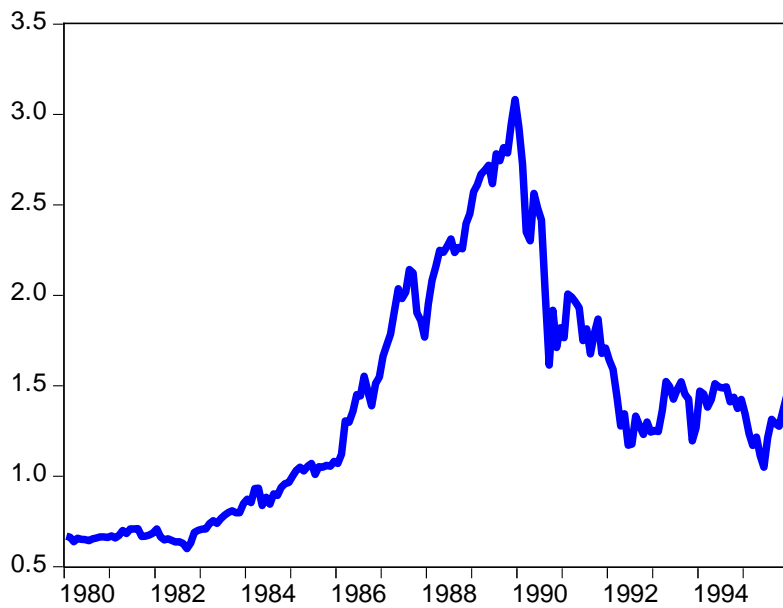
Figure 1: Real Stock Prices, Monthly, 1980 to 1995. Nikkei 225, Closing price on last trading day of the month. Source: Global Financial Database. The series is normalized so that the value in January 1985 is equal to unity.
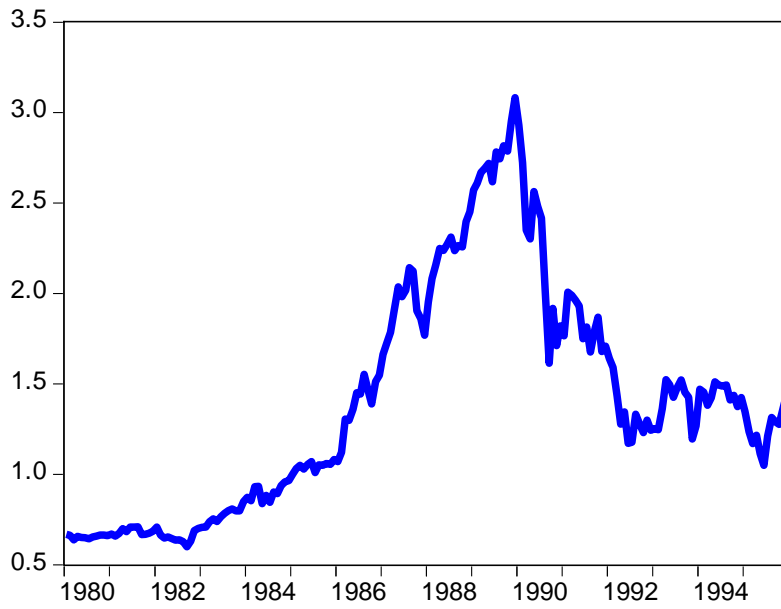
Figure 2: Price of Urban Land in the Six Largest Japanese Cities (deflation by consumption deflator). Annual, 1980-1995.
Source: Statistics Bureau, Historical Statistics of Japan.
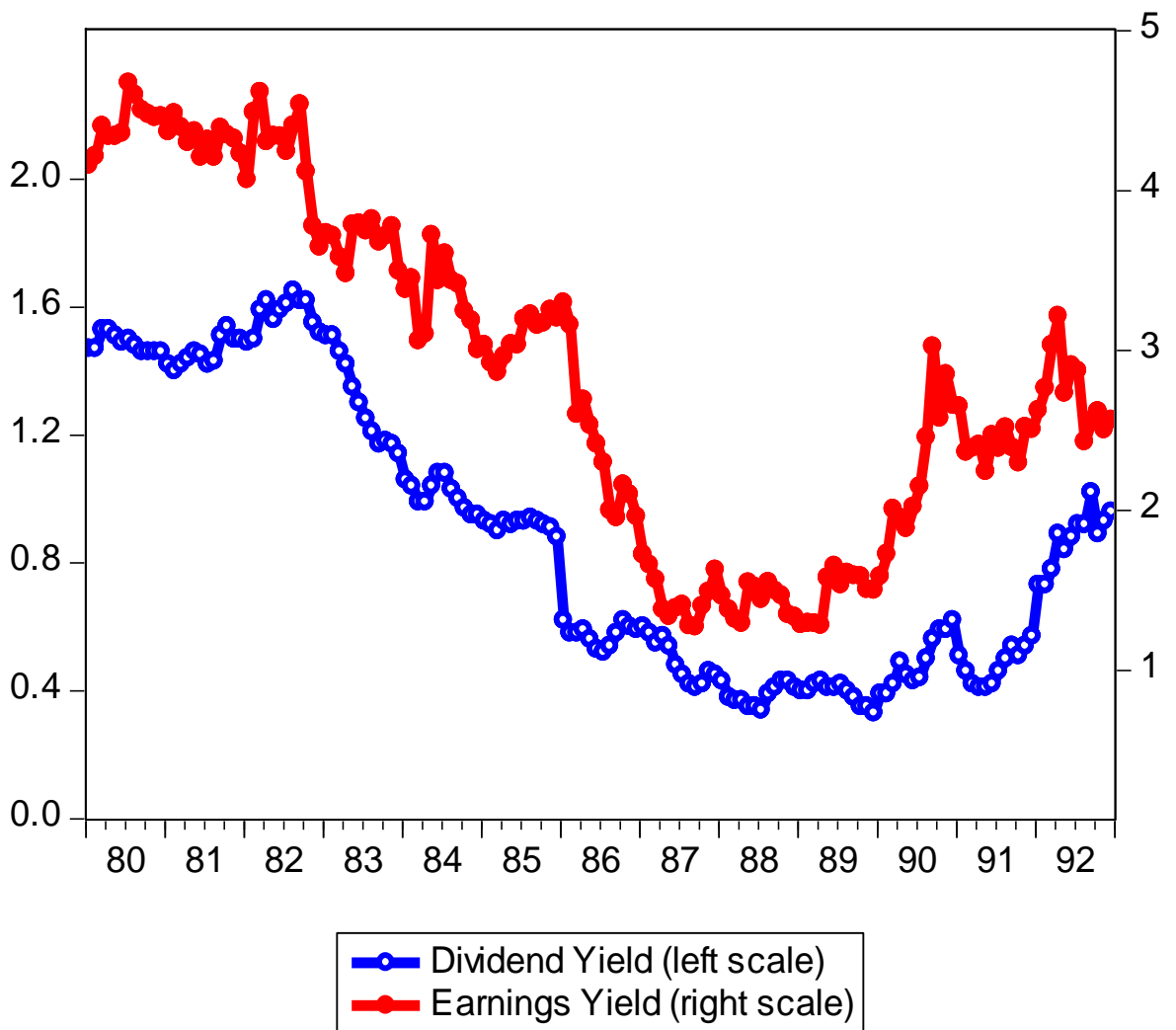
Figure 3: Dividend and Earnings to Price Ratios
Source: Global Financial Database. Series SYJPNPNM (price-earnings ratio) is inverted to form the earnings-price ratio
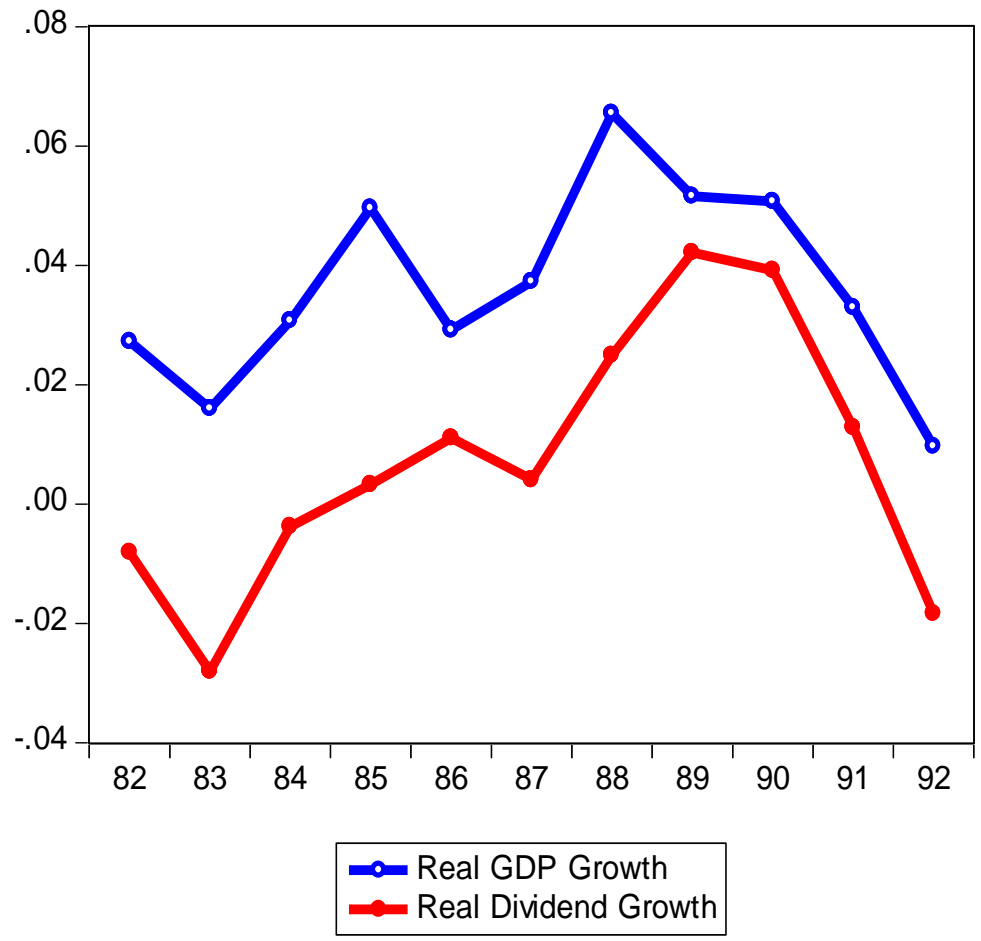
Figure 4: Real Growth in GDP and in Dividends
Source: Statistics Bureau: Historical Statistics of Japan.
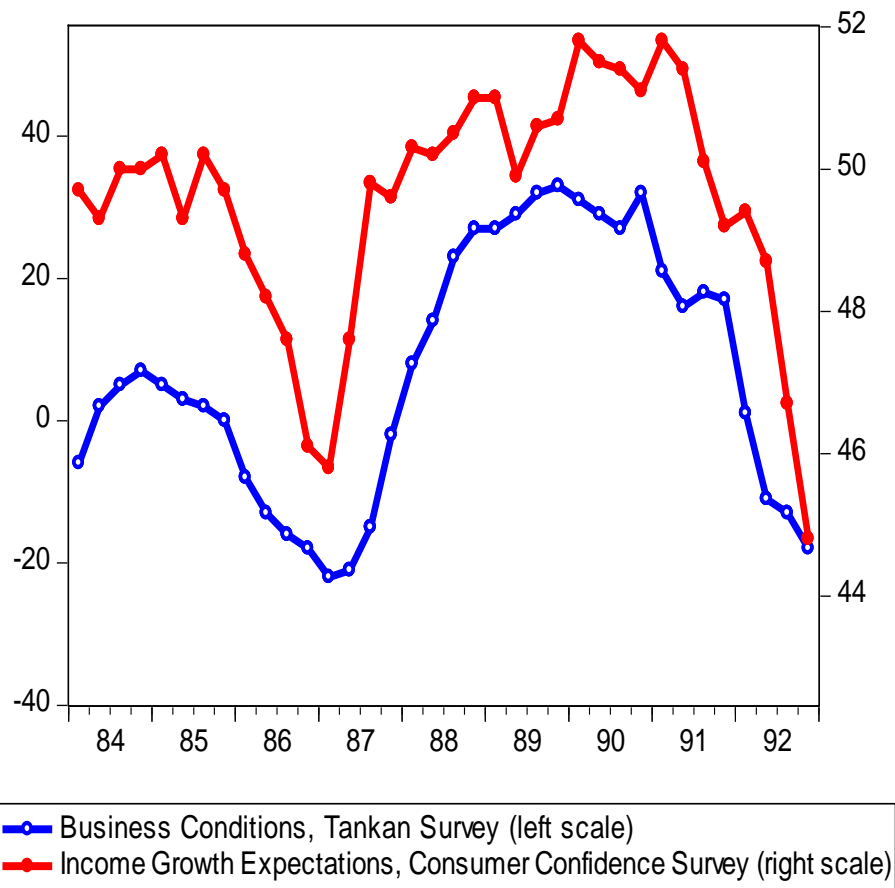
Figure 5: Business and Consumer Confidence Measures.
Sources: Tankan Survey: Bank of Japan
Consumer Confidence Survey: Cabinet Office, ESRI
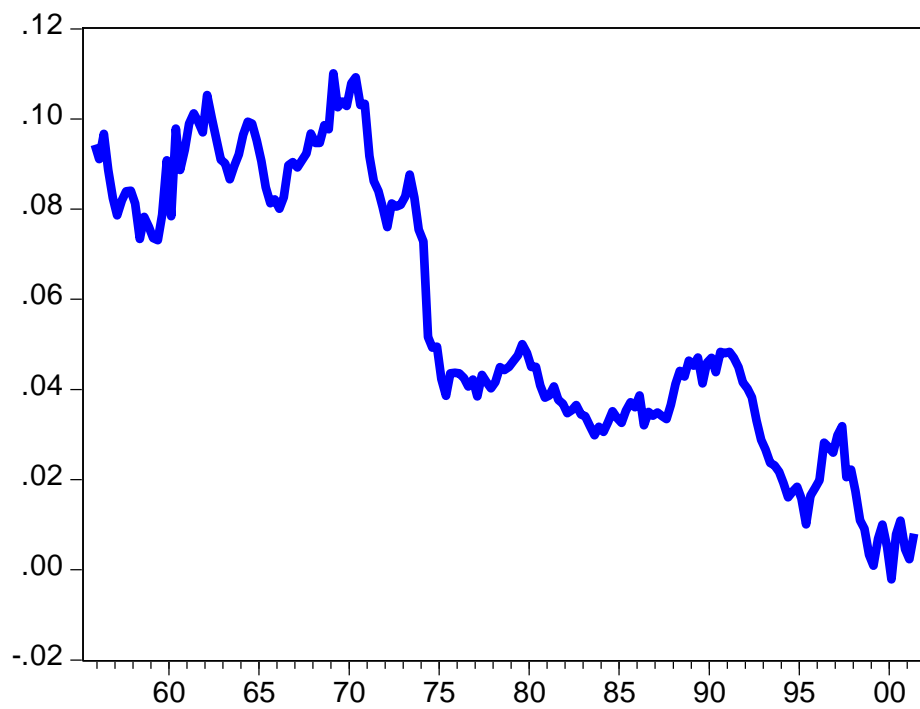
Figure 6: "Permanent Component" of GDP Growth, Quarterly Data
1955:2 to 2001:4, β = .9
Source: GDP: Japanese National Accounts. Permanent Component:
author's computation.
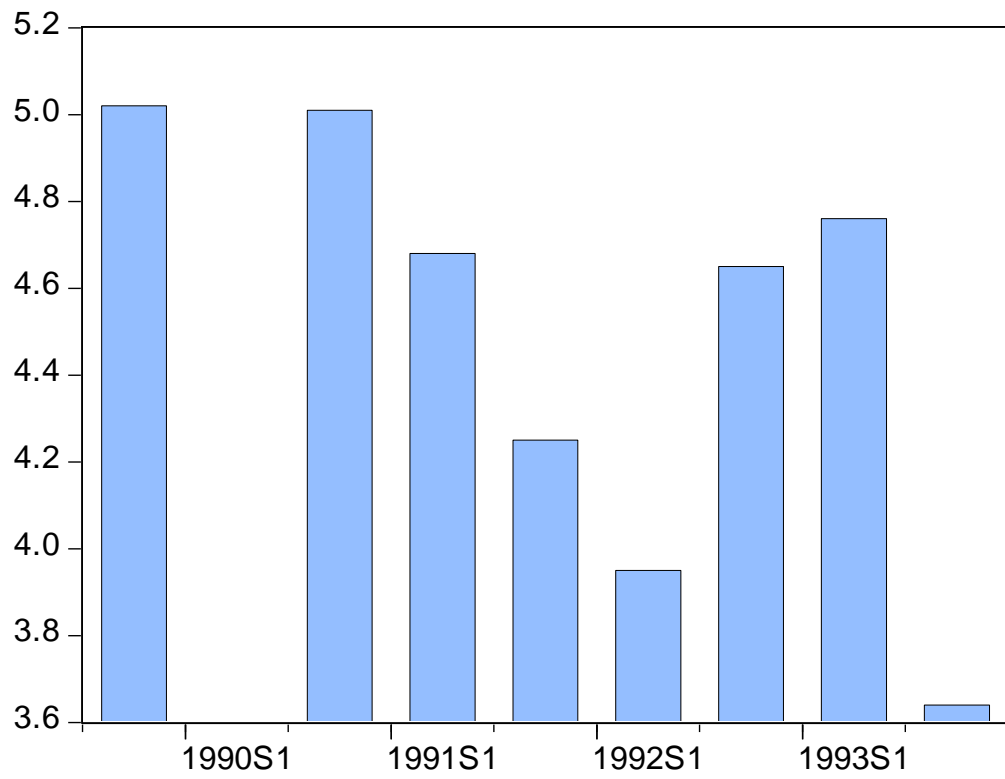
Figure 7: Ten Year Expected Earnings Growth,
Source: Shiller, Kon-Ya, and Tsutsui, 1996.
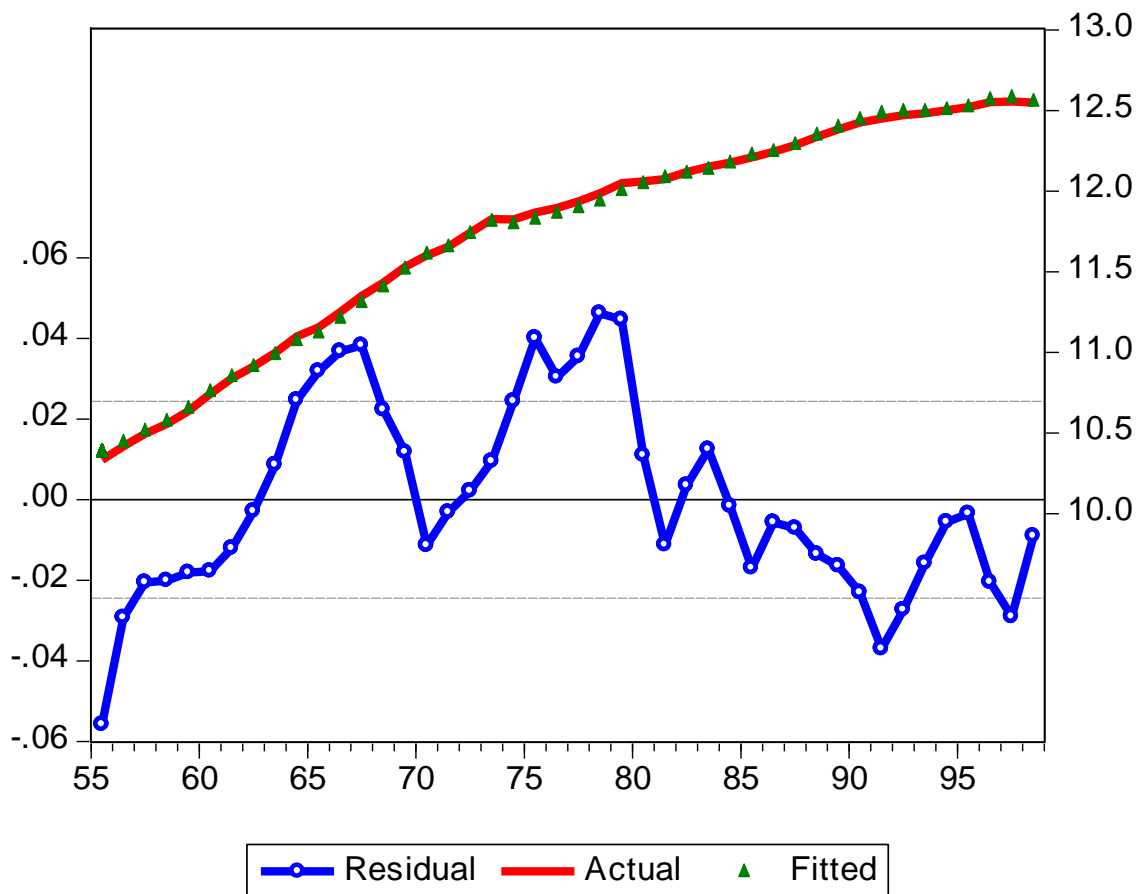
Figure 8: Regression of Log Consumption Expenditure on Log GDP, 1955-1998. The upper lines show consumption and its fitted value. The line below shows the residual from this regression.   Source: Consumption and GDP are annual averages at constant prices from Statistics Bureau: Historical Statistics of Japan.
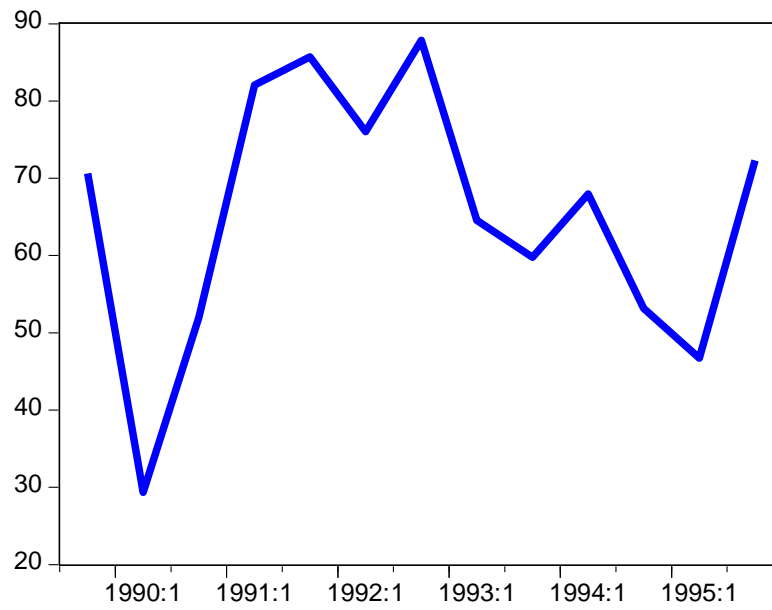
Figure 9: Fraction of Japanese Institutional Investors Who Believe Nikkei is Not Too High. Semi-annual data, 1989:2 to 1995:2. Source: "Valuation Index" from Shiller, Kon-Ya, and Tsutsui, 1996.
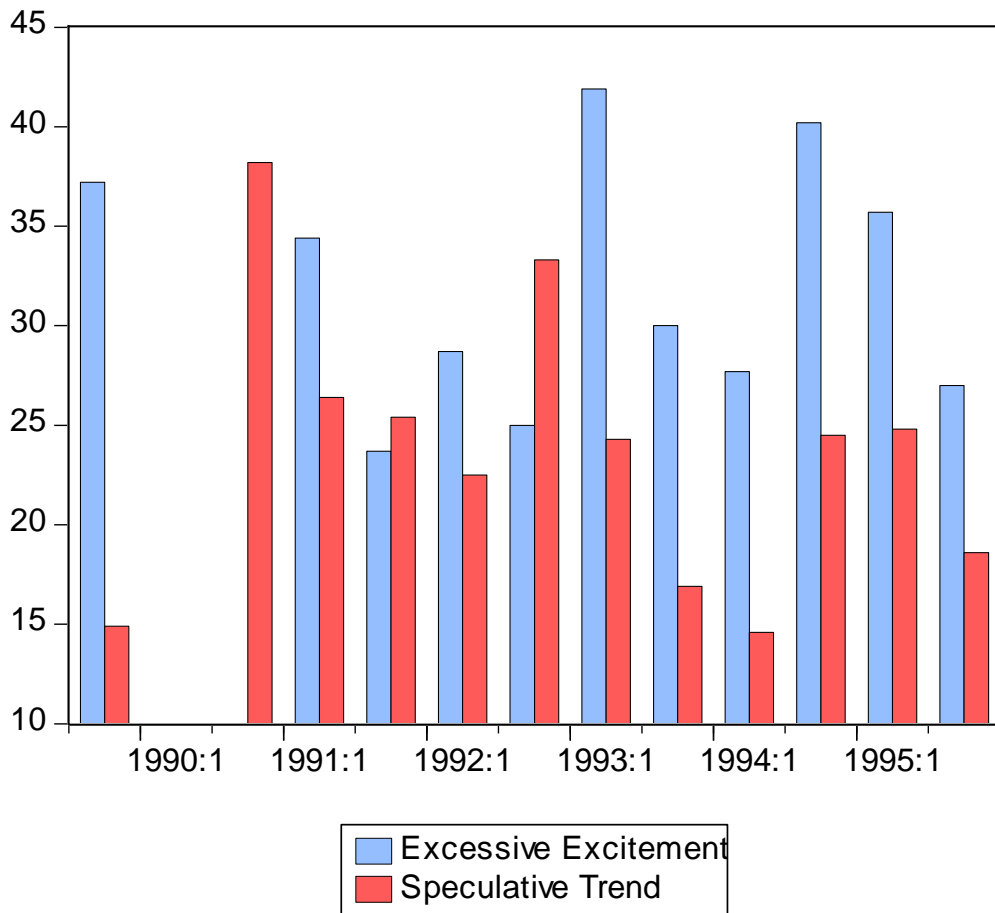
Figure 10: Fraction of Japanese Institutional Investors Seeing Excessive Excitement About Stocks and Fraction Regarding Recent Trend as Primarily Speculative. Semi-annual data, 1989:2 to 1995:2. Source: Shiller, Kon-Ya, and Tsutsui, 1996. There are some gaps in the data in 1990:1 and 1990:2.
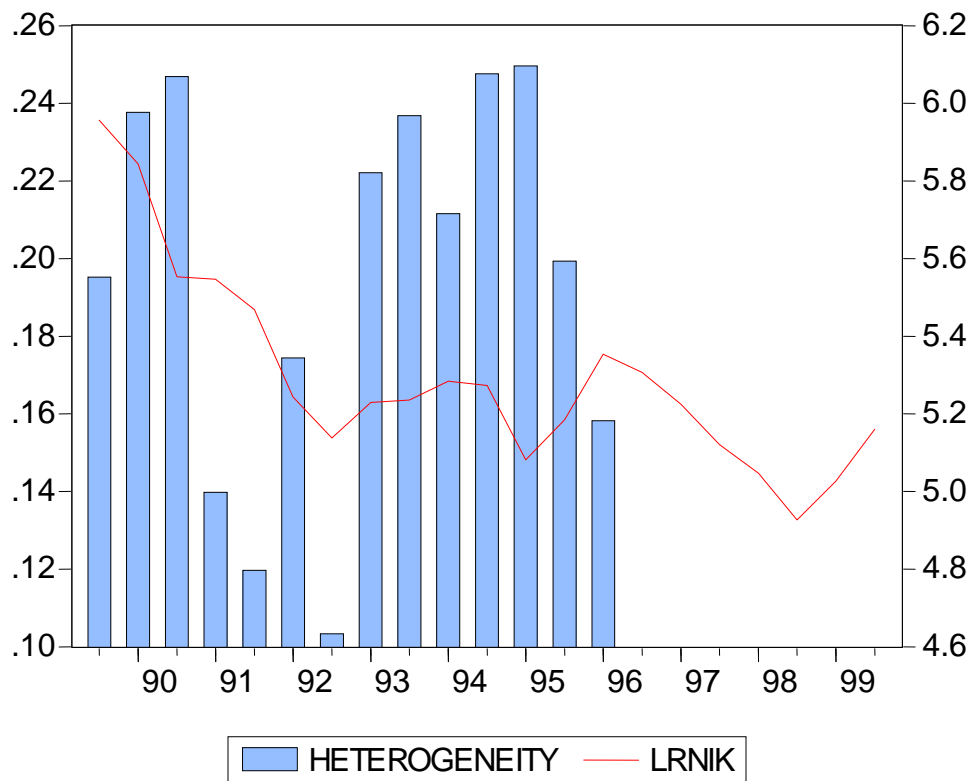
Figure 11: Nikkei 225 (log real) and Heterogeneity Measure f(1-f), where f denotes the fraction of Japanese institutional investors who believe the Nikkei is too high relative to fundamentals.
Source: Shiller, Kon-Ya, and Tsutsui, 1996
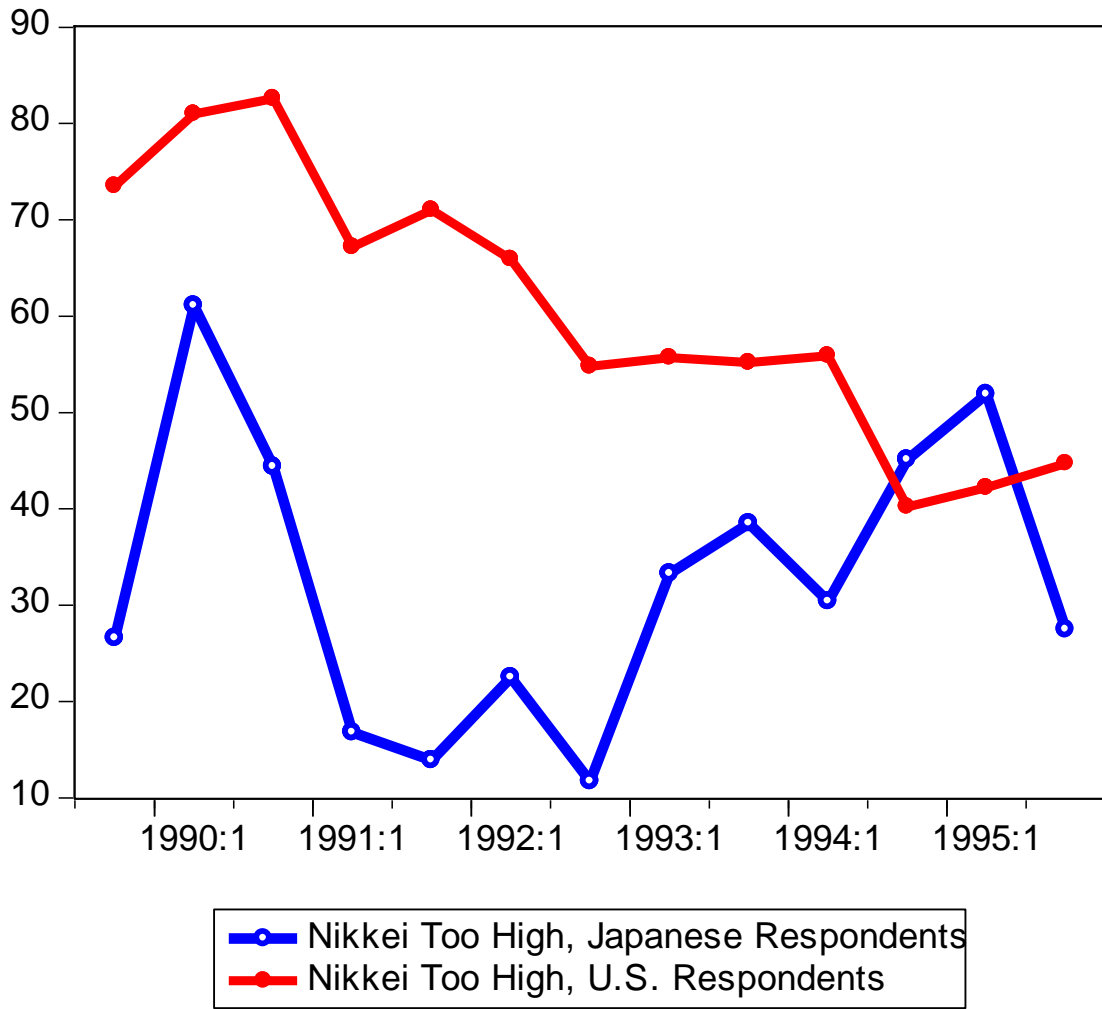
Figure 12: Fraction of U.S. Institutional Investors Believing Nikkei is Too High and Fraction of Japanese Institutional Investors Believing Nikkei is Too High
Source: Shiller, Kon-Ya, and Tsutsui, 1996
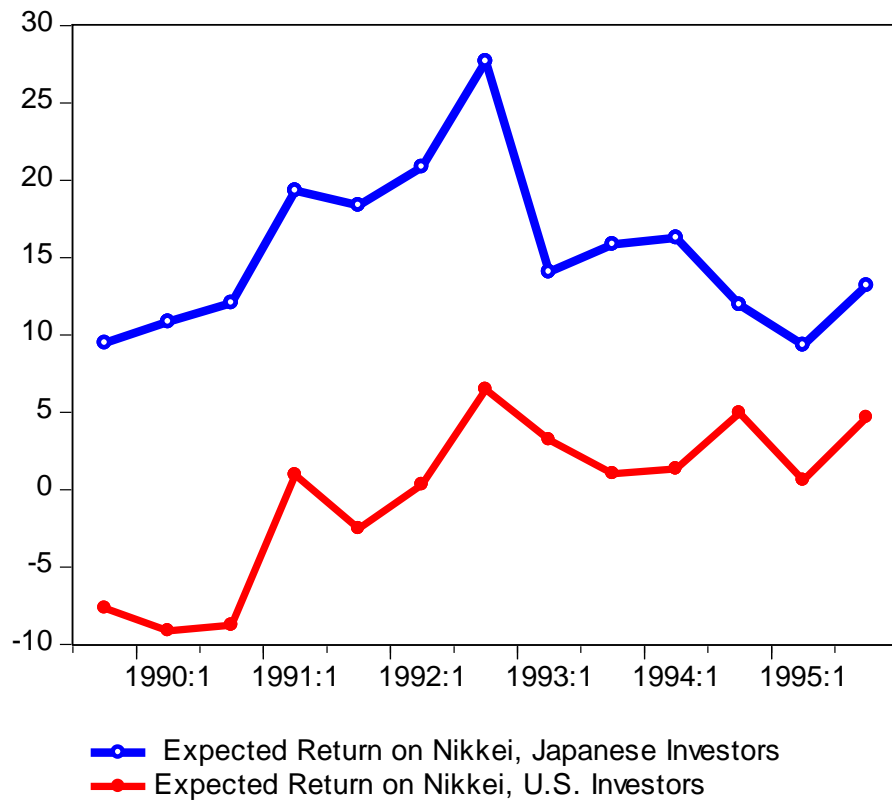
Figure 13: Mean Expected One-year Return on Nikkei of a) Japanese and b) U.S. institutional investors. Semi-annual data, 1989:2 to 1995:2. Source: Shiller, Kon-Ya, and Tsutsui, 1996.
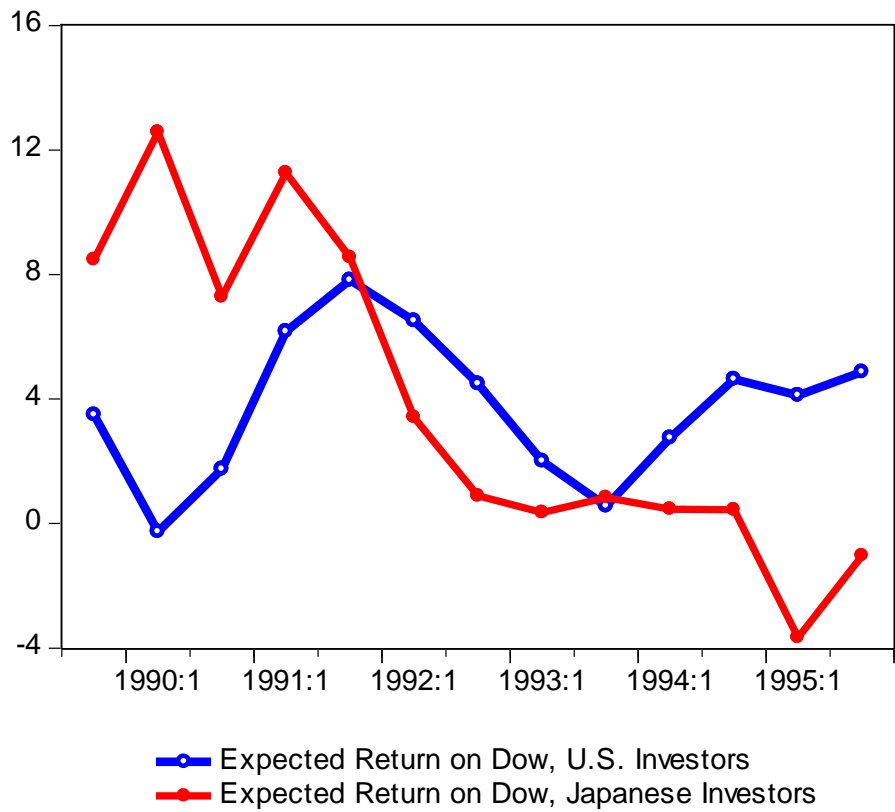
Figure 14: One-Year Expected Return on Dow Jones of a) U.S. and b)
Japanese Institutional Investors
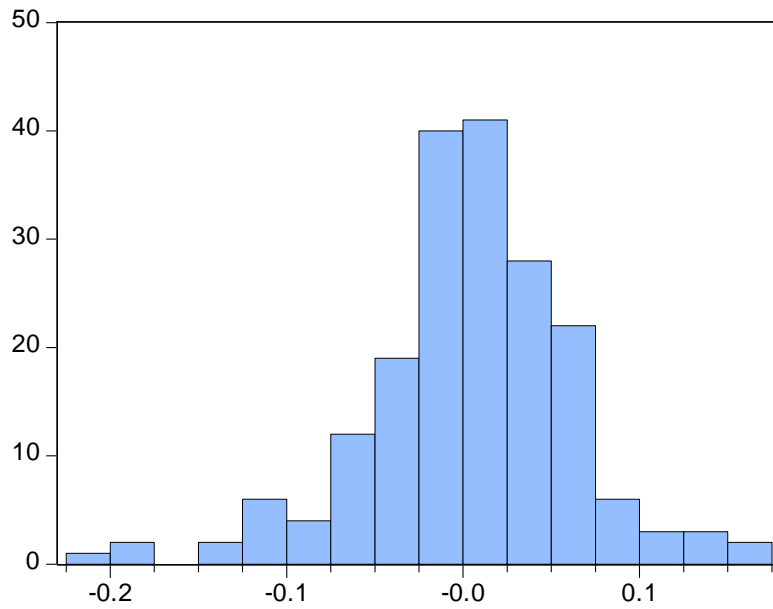Source: Shiller, Kon-Ya, and Tsutsui, 1996.

Figure 15: Negative Skewness of Monthly Stock Price Changes:
Histogram of Change in Log Real Value of Nikkei 225
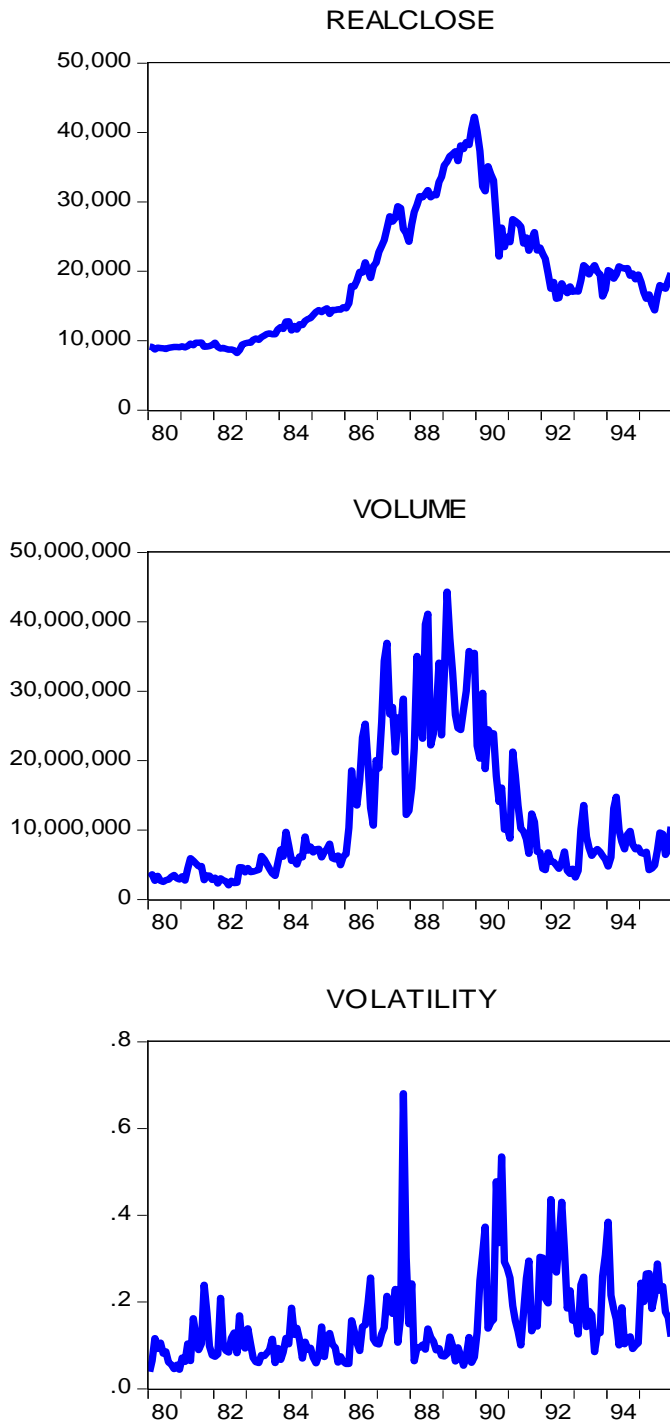Source: Global Financial Database

Figure 16: Real Stock Prices, Trading Volume, and Daily Volatility
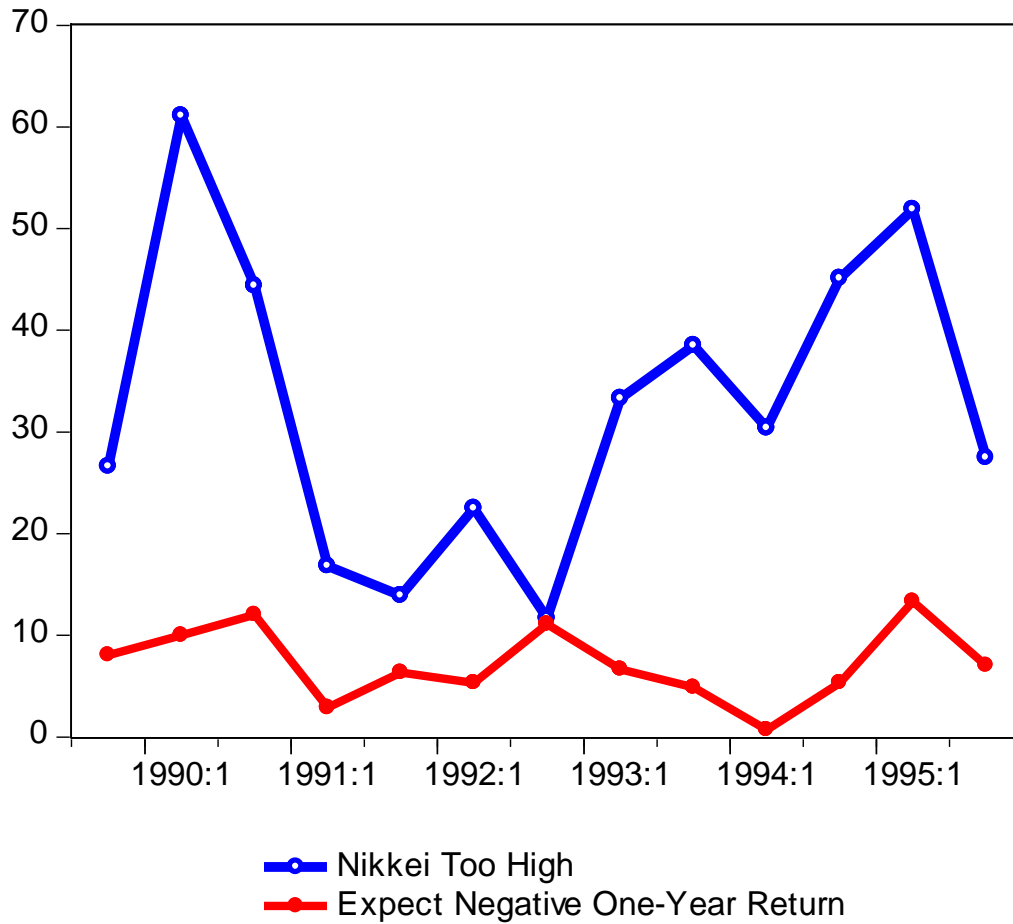Source: Global Financial Database and author's computations.

Figure 17: Fraction of Japanese Institutional Investors Believing Market is "Too High" and Fraction Expecting Negative One -Year Return
Source: Shiller, Kon-Ya, and Tsutsui (1996)