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Abstract

This paper extends the previous analyses of the forecastability of Japanese stock market returns in two directions. First, we carefully construct smoothed market price–earnings ratios and examine their predictive ability. We find that the empirical performance of the price–earnings ratio in forecasting stock returns in Japan is generally weaker than both the price–earnings ratio in comparable US studies and the price dividend ratio. Second, we also examine the performance of several other forecasting variables, including lagged stock returns and interest rates. We find that both variables are useful in predicting aggregate stock returns when using Japanese data. However, while we find that the interest rate variable is useful in early subsamples in this regard, it loses its predictive ability in more recent subsamples. This is because of the extremely limited variability in interest rates associated with operation of the Bank of Japan's zero interest policy since the late 1990s. In contrast, the importance of lagged returns increases in subsamples starting from the 2000s. Overall, a combination of logged price dividend ratios, lagged stock returns, and interest rates yield the most stable performance when forecasting Japanese stock market returns.

Keywords: forecastability of stock returns; price–earnings ratio; price dividend ratio.
JEL classification: C32, G17.

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1 Introduction

In our previous study (Aono & Iwaisako, 2010), we examine the ability of dividend yields to forecast Japanese aggregate stock returns using the single-variable predictive regression framework of Lewellen (2004) and Campbell & Yogo (2006). This paper continues and extends our earlier efforts in two respects. First, we examine the predictive ability of another popular financial ratio, namely, the price–earnings ratio. This is motivated by the fact that some studies using US data (for example, Campbell & Vuolteenaho, 2004) find that smoothed market price–earnings ratios have better forecasting ability than dividend yields. We carefully construct Japanese price–earnings ratios following the methodology pioneered by Robert Shiller (1989, 2005) and examine their ability to forecast aggregate stock returns. We find that the predictive ability of the price dividend ratio is consistently better than that of the price–earnings ratio.

Second, we examine the predictive ability of several other variables for stock market returns, namely, lagged stock returns and interest rates. For the latter, we consider the so-called *relative bill rate* (the current interest rate minus its moving average), a variable introduced by John Campbell and Robert Hodrick to ensure the stationarity of the interest rate variable as a regressor. We find that both variables are useful in predicting aggregate stock returns when using Japanese data. However, while the relative bill rate is useful for forecasting stock returns in early subsamples, it loses its predictive ability in more recent subsamples. This is mainly because the movement of interest rates, especially those with short maturities, has become extremely limited since the late 1990s under the Bank of Japan's zero interest policy. In contrast, lagged returns increased its importance as a forecasting variable in subsamples starting from the 2000s.

The remainder of the paper is organized as follows. In Section 2, we discuss the construction of the smoothed market price–earnings ratios, the Japanese version of the relative bill rate, and the remaining forecasting variables. Section 3 details the main empirical results. Section 4 provides some concluding remarks.

2 Data Set

2.1 Financial Ratios

In this paper, we examine two different aggregate price–earnings ratios as forecasting variables, and compare them with an aggregate price dividend ratio. To start with, it is well known that real time US corporate earnings data is volatile and contains much noise. This issue is equally problematic when using Japanese data as aggregate corporate earnings have fluctuated wildly in recent years during the prolonged stagnation of the Japanese economy in place since mid 1990. In fact, simple market price–earnings ratios in Japan even had negative values in 1998–1999 (during the recession following the domestic financial crisis in late 1997), 2001–2002 (associated with the collapse of the IT bubble), and 2008–2009 (because of the global financial crisis). Hence, as in previous empirical studies using US data, we followed Robert Shiller and calculated smoothed price–earnings ratios using the ratio of the current market valuation to the ten-year moving average of earnings.[1]

Perhaps the most widely used aggregate series of Japanese price–earnings ratios is that tabulated and reported by the Tokyo Stock Exchange on its website.[2] As the Tokyo Stock Exchange also provides the corresponding corporate earnings and average stock price data, we use these data to calculate our first market-smoothed price–earnings ratio in the manner proposed by Shiller, PER_t.

However, the Tokyo Stock Exchange's data employ a simple average of corporate earnings per share and individual stock prices, rather than their weighted averages. Because of this bias, PER_t tends to excessively reflect the behavior of small stocks in the market price–earnings ratio. For this reason, we calculate another measure of the market price–earnings ratio using the individual firm database, as originally prepared for the construction of Fama–French portfolios. First, we calculate aggregate corporate earnings as of August each year following convention for the construction of Fama–French portfolios in the Japanese market. We then calculate its ten-year moving average by assuming the monthly corporate earnings from August to the following July are constant and equal to the earnings measured in August. This smoothed earnings series is then divided by the total market capitalization at the end of the month to obtain our second market-smoothed price–earnings ratio, PER_ff.

Finally, our measure of the market price dividend ratio PDR is the inverse of the market dividend yield, employing the data for individual firms paying any dividend during the current period. The market price dividend ratio data are also obtained from the Tokyo Stock Exchange's website.

The data for PER_t are available since the beginning of 1980. Accordingly, we set the beginning of our full sample as 1981. Unfortunately, because of the unavailability of data, our second price–earnings ratio PER_ff only

[1]We closely follow Shiller's (1989, 2005) methodology in calculating the smoothed price–earnings ratio data. See Shiller's homepage for a detailed description of the data construction entailed at http://www.econ.yale.edu/~shiller/data.htm

[2]http://www.tse.or.jp/english/market/topix/data/index.html

starts in July 1987. For the examination of stock return predictability below, we take the natural logs of the financial ratios, respectively denoted in lower case as *lpdr*, $lper\_t$, and $lper\_ff$. Table 1 provides descriptive statistics of the log financial ratios, as well as the estimated autoregressive coefficients for an AR(1) model using these forecasting variables. Apparently, all of the estimated AR(1) coefficients are very close to one. The results of unit root tests (not reported here) also confirm the potential nonstationarity problem for all three financial ratios, at least when we specify the full sample in the absence of potential structural breaks.

[Insert Table 1 about here]

Figure 1 plots the financial ratios. As Aono and Iwaisako (2010) documented, the first panel in Figure 1 suggests there is a structural break in about 1990–1991 in the log price dividend ratio *lpdr*. Through most of the 1980s, the *lpdr* series then exhibits a clear increasing trend. After the sharp subsequent decline corresponding to the collapse of the asset bubbles in 1990–1993, *lpdr* had been relatively stable throughout the late 1990s and until about 2007. We then observe another significant decline in *lpdr* in 2008 and 2009, followed by a sharp, but not substantial, rebound in late 2009. The latter movements in 2008 and 2009 can be easily explained by the effects of the global financial crisis on the Japanese economy and stock prices during this period.

[Insert Figure 1 about here]

While *lpdr* peaks at the height of the bubble economy at the end of 1989, the global peaks of log price–earnings ratios, $lper\_t$ and $lper\_ff$, shown in the second panel are in the mid 2000s. This perhaps reflects the fact that corporate earnings had been at particularly low level in the late 1990s and in the early 2000s as discussed in the Introduction. Such negative shocks in corporate earnings keep the smoothed earnings exceptionally low until the second half of the 2000s, while stock market started to pick up in the mid 2000s.

At the same time, the movements in $lper\_t$ and $lper\_ff$ also exhibit some stark differences. For example, in the second half of the 1980s, $lper\_ff$ is consistently higher than $lper\_t$. As $lper\_ff$ reflects the movements of larger stocks relative to $lper\_t$, such a difference suggests that the overvaluation of stock prices during the bubble economy had more to do with the overvaluation of larger stocks. Their levels and movements are somewhat similar in the mid 1990s during the initial stage of the prolonged Japanese stagnation. Then, following the severe recession of 1998 and 1999 prompted by the domestic financial crisis in late 1997, $lper\_ff$ increased sharply at the beginning of the 2000s. Later, $lper\_t$ caught up in around 2006–2007. Such movements in $lper\_t$ and $lper\_ff$ in the new millennium suggest that the stock prices of large corporations recovered first, gradually followed by the stock of smaller corporations during the course of Japan's mild recovery throughout the 2000s.

2.2 Other Forecasting Variables

In the empirical analysis in this paper, we include two other important forecasting variables in addition to the above financial ratios. These variables are lagged stock returns and the interest rate variable. First, the lagged stock return is found to be useful in forecasting stock returns in our previous work (Aono 2008; Aono & Iwaisako 2008). On the other hand, John Campbell and Robert Hodrick suggest the use of a stochastically detrended interest rate variable, often referred to as the "relative bill rate," instead of the interest rate itself to ensure the stationarity of the regressor. See Section 7.2 in Campbell, Lo, & MacKinlay (1997) for details. In our earlier work (Aono 2008, Aono and Iwaisako 2008, 2009), we constructed a Japanese version of the relative bill rate by specifying the call rate (the Japanese interbank rate) as the short-term interest rate. While this variable is also found to be useful in forecasting Japanese stock returns, it loses its predictive ability in recent samples because Japanese short-term interest rates have moved in an extremely limited manner and very close to zero since the commencement of the Bank of Japan's zero interest rate policy in the late 1990s.

For this reason, we examined some market interest rates with longer maturities as they are more volatile than the call rate, even in comparatively recent samples. In the current paper, we use the ten-year Japanese government bond yield (JGB) to construct a new version of the Japanese "relative bill rate." Obviously, its ten-year maturity is too long to consider this as a counterpart of the US relative bill rate. Overall, our decision to employ this as the interest rate variable in our analysis is mainly because of its forecasting ability and the availability of long-run data.

Hence, the new interest rate variable in this paper is obtained by subtracting the twelve-month moving average of the yields of ten-year Japanese government bonds from their current yield.[3][4] This variable is denoted as

[3] We also considered the long–short yield spread as a potential interest rate variable. However, its empirical performance is not particularly impressive when compared with $rbill_{t-1}$.

[4] Another interest rate variable often used in the empirical finance literature when

$rbill_{t-1}$ in the following empirical analyses.

$$rbill_t = JGB_t - \sum_{i=1}^{12} JGB_{t-i}/12$$

3 Empirical Results

3.1 Financial Ratios as the Only Forecasting Variable

First, we compare the predictive abilities of financial ratios in a single variable regression framework:

$$r_t = \beta_0 + \beta_1 x_{t-1} + \epsilon_t \tag{1}$$

where r_t are stock returns and x_{t-1} are the (log) financial ratios. In calculating stock returns, we use the return on the value-weighted market index calculated from the individual stock return data (including dividends) used for the construction of Fama–French portfolios. We then subtract the call rate (next day, with collateral) from the value-weighted market index return.

Table 2 includes descriptive statistics of the excess returns r_t calculated in this way. We also considered several alternative sources of aggregate stock return data. The first of these is the excess return of the TOPIX over the call rate. The second is real stock returns calculated by subtracting CPI inflation from the value-weighted index return discussed above. Table 2 contains information about the correlations between our excess return measure r_t with these alternative measures of market portfolio returns. All correlations are higher than 99.0%. On this basis, we conclude that the use of any alternative monthly stock return data will not change our main results. Consequently, we concentrate on the examination of excess return r_t in the following.

[Insert Table 2 about here]

considering US data, such as in Jagannathan and Wang (1996), is the yield spread between high yield and AAA-rated corporate bonds. Unfortunately, unlike the US market which has a long history with a data set beginning in the interwar period or even earlier, the Japanese corporate bond market only started to develop in the late 1970s. Accordingly, its size and other characteristics have changed significantly during the sample period considered in this paper. Regardless, the yield spread of corporate bonds has not been a popular forecasting variable in Japan. Hence, we do not examine its ability in predicting aggregate stock returns in this paper.

As in the discussion concerning Table 1, all three financial ratios considered — *lpdr*, *lper_t*, and *lper_ff* — are either unit root or near unit root processes. Hence, rigorous statistical inference about their predictive ability requires discussion unlike the usual treatment of statistical significance in estimated coefficients. This is exactly the focus of recent studies such as Lewellen (2004) and Campbell & Yogo (2006). We apply their statistical framework to the Japanese data in Aono & Iwaisako (2010). However, as our main interest in this paper is a comparison of the performance of financial ratios and other variables as forecasting variables, we refrain from such statistically rigorous treatment and rely on a horse race between the coefficient of determination (R^2) and the adjusted coefficient of determination (adjR^2).

In Table 3, we report our estimation results of the single variable predictive regression (1) using the three different financial ratios for the full sample and two subsamples. The full sample starts in February 1981 and ends in December 2009. The first subsample period starts in August 1987 from when our second measure of the market-smoothed price–earnings ratio data are available. The second subsample starts in January 1991, reflecting findings in our earlier paper (Aono & Iwaisako 2010) that the behavior of Japanese price dividend ratios are likely to exhibit a structural break in the beginning phase of the collapse of stock market bubbles. Both subsamples end in December 2009.

[Insert Table 3 about here]

Although the full sample estimates suggest that the log price–earnings ratio *lper_t* performs slightly better than log price dividend ratio *lpdr*, given the tiny difference of R^2 (0.29 percent vs. 0.31 percent), it is difficult draw any strong conclusion about their relative performance. In contrast, the two subsample estimates clearly suggest that *lpdr* does a better job than both price–earnings ratios in predicting stock returns. Overall, the unavoidable conclusion from Table 2 is that the predictive ability of financial ratios when using Japanese data generally appears weaker than that found using US data. For instance, Campbell & Shiller (1988a, 1988b, 1998) and Fama & French (1988, 1989) report differences in R^2 of at least several percentage points.

3.2 Forecastability in Multivariate Regressions

In this subsection we move on to a more comprehensive examination of the forecastability of Japanese stock market returns by employing several forecasting variables. Table 4 provides the estimation results of the multivariate forecasting regressions for monthly stock market returns r_t:

$$r_t = \beta_0 + \beta_1 \cdot x_{t-1} + \beta_2 \cdot r_{t-1} + \beta_3 \cdot rbill_{t-1} + \epsilon_t \tag{2}$$

where x_{t-1} is the financial ratio and $rbill_{t-1}$ is the stochastically detrended interest rate variable (the relative bill rate). The sample periods for the full sample and the subsamples are exactly the same as in the single variable regressions examined in Section 3.1.

[Insert Table 4 about here]

The estimation results of the specifications with lagged returns and $rbill_{t-1}$, but without financial ratios (the rows "x_{t-1} is N/A"), exhibit generally higher performance than the regression results in Table 3, which include only financial ratios as a forecasting variable. While all R^2s of the regressions in Table 3 are less than 0.5%, the R^2s in Table 4 exceed 1.7%. While these values are not particularly impressive, the higher performance using lagged returns and $rbill_{t-1}$ is readily apparent. In the full sample, the interest rate variable $rbill_{t-1}$ is statistically significant unlike the lagged stock return. In the second subsample starting in 1991, the reverse holds. In addition, the absolute values of the $rbill_{t-1}$'s coefficients are higher for the full sample estimates than the second subsample. In the case of lagged returns, the estimated coefficients are higher in the more recent subsamples. Hence, it is difficult to conclude whether lagged returns or $rbill_{t-1}$ is more important in forecasting Japanese stock returns. However, it is safe to conclude that even our new version of $rbill_{t-1}$ constructed from the ten-year government bond yield loses its predictive ability in recent subsamples in the 2000s, perhaps because of the zero interest rate policy pursued by the Bank of Japan during this time.

When the financial ratios are added, the full sample performance is slightly higher with $lper\_t$ than with $lpdr$. However, as observed with the full sample results in Table 3, the difference is marginal. Conversely, with the subsample estimates, the performance of the specification with $lpdr$ is consistently higher than the performance with $lper\_t$ or $lper\_ff$. Furthermore, $lper\_ff$ has the wrong (positive) sign in the subsample estimates. Overall, combining the log price dividend ratio $lpdr$, lagged stock returns, and $rbill_{t-1}$ together improve forecasting performance in the subsample estimations over the specifications with $lpdr$ or lagged returns alone and with $rbill_{t-1}$.

4 Concluding Remarks

In this paper, we examined the forecastability of Japanese stock returns using monthly data. Our contribution can be summarized into two main points. First, we carefully construct two types of smoothed market price–earnings ratios for Japanese data following the methodology of Robert Shiller. The behavior of these ratios is not only different from the behavior of other price dividend ratios in the same period, but also from each other as one places relatively more weight on smaller corporations. In general, we find that the predictive ability of price–earnings ratios is not as strong as for US data and weaker than that of price dividend ratios. Overall, the empirical performance of predictive regressions for Japanese data including financial ratios as the only forecasting variable are generally weaker than comparable studies employing US data.

Second, we include lagged stock returns and stochastically detrended interest rates as forecasting variables for Japanese stock market returns. We find that both forecasting variables are particularly useful in predicting stock market returns. However, while our new interest rate variable constructed from the yields of ten-year government bonds is a particularly useful forecasting variable in the full sample, its performance is not as impressive in more recent subsamples. This is because movements in interest rates have been extremely limited given the Bank of Japan's zero interest policy of the 2000s. On the other hand, the importance of lagged stock returns has increased in recent subsamples. In summary, combining the (log) price dividend ratio, the lagged stock return, and stochastically detrended interest rates together yields relatively more stable forecasting performance than the other specifications considered in this paper. Of course, we cannot entirely dismiss the possibility that the price–earnings ratio is a better forecasting variable than the price dividend ratio in the long run, unless we can increase our sample to include observations from the 1960s and 1970s.

Despite some potential limitations arising from the lack of data, the central results in this paper remain robust. An important remaining question is why the importance of lagged stock returns as a forecasting variable has increased in recent years. In other words, it is imperative to examine why autocorrelation has become larger in recent years in order to better understand the behavior of Japanese stock market returns. Our companion analysis in Aono & Iwaisako (2009) suggesting that the lead–lag relationship running from large stocks to small stocks in the sense of Lo & MacKinlay (1990a, b) provides a reasonable explanation why such autocorrelation exists. The recent increase in this lead–lag relationship in Japan will be the subject of future study.

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Table 1
Financial Ratio Descriptive Statistics

Basic statistics of log price dividend ratios ($lpdr$) and log price–earnings ratios ($lper\_t$, $lper\_ff$). $AR(1)$ is the autoregressive coefficient β in the following AR(1) model.

$$x_t = \alpha + \beta \cdot x_{t-1} + \epsilon_t$$

Values in parentheses are heteroskedasticity robust standard errors of AR(1) coefficients using White's method (1980).

	$lpdr$	$lper\_t$	$lper\_ff$
Mean	-0.015	3.860	4.160
Std. Dev.	0.391	0.460	0.448
Skewness	0.07	-0.09	-0.14
Kurtosis	2.81	2.59	1.98
$AR(1)$	0.993	0.987	0.995
	[0.008]	[0.005]	[0.008]
R^2	0.98	0.99	0.98
No of obs.	348	348	270

Table 2
Stock Return Descriptive Statistics

(1) Descriptive Statistics of Excess Market Return

Mean	0.189
Std. Dev.	0.308
Max	17.922
Min	-20.874
Skewness	-0.15
Kurtosis	4.21
No of obs.	348

(2) Correlations with Other Measures of Aggregate Stock Returns in the Full Sample

	(1)	(2)	(3)
(1) **Excess Market Return**	1.000	–	–
(2) **Excess Return on TOPIX**	0.9957	1.000	–
(3) **Real Market Return**	0.9963	0.9927	1.000

Excess Market Return: Returns of value-weighted market index minus the call rate (next day, with collateral).
Excess Market on TOPIX: Returns of TOPIX minus the call rate.
Real Market Return: Returns of value-weighted market index minus CPI inflation rate.

Table 3
Tests of Predictability in Single Variable Regressions

$$r_t = \beta_0 + \beta_1 x_{t-1} + \epsilon_t$$

The forecasting ability of the financial ratios (price dividend ratio and two price– earnings ratios) when specified as the only forecasting variable. Stock return r_t is the monthly excess return of the market portfolio over the call rate. Values in parentheses are standard errors of the coefficients calculated using the Newey–West method (1987) with four lags.

(1) Full sample: February 1981 to December 2009 obs.347

x_{t-1} is	β_0	β_1	R^2	adjR^2
lpdr	0.179	−0.758	$0.29^{(\%)}$	$0.01^{(\%)}$
	[0.294]	[0.836]		
lper_t	2.720	−0.656	0.31	0.02
	[1.999]	[0.519]		

(2) Subsample I: August 1987 to December 2009 obs.269

x_{t-1} is	β_0	β_1	R^2	adjR^2
lpdr	0.153	−0.988	$0.49^{(\%)}$	$0.12^{(\%)}$
	[0.347]	[0.962]		
lper_t	1.400	−0.394	0.07	−0.30
	[3.433]	[0.844]		
lper_ff	−0.001	−0.042	0.00	−0.37
	[3.142]	[0.733]		

(3) Subsample II: January 1991 to December 2009 obs.228

x_{t-1} is	β_0	β_1	R^2	adjR^2
lpdr	−0.181	−0.790	$0.22^{(\%)}$	$-0.22^{(\%)}$
	[0.364]	[1.261]		
lper_t	−0.315	0.052	0.00	−0.44
	[3.435]	[0.845]		
lper_ff	−1.035	0.227	0.03	−0.41
	[3.271]	[0.769]		

Table 4
Tests of Predictability in Multivariable Regressions

$$r_t = \beta_0 + \beta_1 \cdot x_{t-1} + \beta_2 \cdot r_{t-1} + \beta_3 \cdot rbill_{t-1} + \epsilon_t$$

The predictability of the monthly excess return r_t of the market portfolio over the call rate is examined in the multivariable regression framework. The forecasting variables include the financial ratios x_{t-1}, the lagged stock return r_{t-1}, and the relative bill rate (current ten–year Japanese government bond yield minus its twelve–month moving average) $rbill_{t-1}$. Values in parentheses are the standard errors of the coefficients calculated using the Newey–West method with four lags. (**) and (*) indicate that the estimated coefficients are statistically significant at the 5% and 10% level, respectively.

(1) Full sample: February 1981 to December 2009 obs.347

x_{t-1} is	*const.*	x_{t-1}	r_{t-1}	$rbill_{t-1}$	R^2	adjR^2
N/A	0.005	–	0.097	-15.486^*	$2.22^{(\%)}$	$1.65^{(\%)}$
	[0.312]	–	[0.071]	[8.152]		
lpdr	0.022	−0.784	0.102	-13.838^{**}	2.43	1.61
	[0.294]	[0.808]	[0.071]	[7.263]		
lper_t	1.501	−0.384	0.100	-14.037^*	2.32	1.46
	[2.332]	[0.609]	[0.071]	[8.688]		

(2) Subsample I: August 1987 to December 2009 obs.269

x_{t-1} is	*const.*	x_{t-1}	r_{t-1}	$rbill_{t-1}$	R^2	adjR^2
N/A	−0.248	–	0.093	−12.837	$1.72^{(\%)}$	$0.98^{(\%)}$
	[0.357]	–	[0.082]	[8.152]		
lpdr	−0.214	−0.931	0.099	−11.240	2.14	1.03
	[0.366]	[1.012]	[0.083]	[9.131]		
lper_t	0.001	−0.062	0.093	−12.571	1.72	0.60
	[4.243]	[1.051]	[0.084]	[10.909]		
lper_ff	−1.293	0.2487	0.090	−13.979	1.75	0.64
	[3.726]	[0.871]	[0.082]	[10.513]		

Table 4 (continued)

(3) Subsample II: January 1991 to December 2009   obs.228

x_{t-1} is	*const.*	x_{t-1}	r_{t-1}	$rbill_{t-1}$	R^2	adjR^2
N/A	−0.164	–	0.158**	−5.991	$2.68^{(\%)}$	$1.82^{(\%)}$
	[0.379]	–	[0.066]	[10.639]		
lpdr	−0.2936	−1.2536	0.1675**	−7.3219	3.22	1.92
	[0.360]	[1.299]	[0.065]	[10.495]		
lper_t	0.014	−0.044	0.159**	−5.778	2.68	1.38
	[4.341]	[1.076]	[0.067]	[12.882]		
lper_ff	−0.7364	0.138	0.156**	−6.684	2.69	1.39
	[3.984]	[0.939]	[0.065]	[12.581]		

Figure 1
Log Price Dividend and Log Price–earnings Ratios: January 1980 to December 2009