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Yoshihito SAITO
yoshihito.saitou@boj.or.jp
Yoko TAKEDA
youko.takeda@boj.or.jp

International Department
Bank of Japan

C.P.O. BOX 203 TOKYO
100-8630 JAPAN

Predicting the US Real GDP Growth Using Yield Spreads of Corporate Bonds

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Yoshihito SAITO[1]

Yoko TAKEDA[2]

International Department, Bank of Japan

Summary

1. In general, the yield spread between long- and short-term bonds contains useful information for future economic activity and inflation. Particularly, it usually reflects market participants' expectations of future monetary policy and credit demand. However, it is becoming increasingly difficult to extract such information from the yield spread of government bonds in the US because of the impact of the so-called "flight to quality" where investors seek refuge in risk-free government bonds during a financial crisis, and also because of a reduction in the new issue of such bonds.

2. This paper examines the power of the yield spread of corporate bonds as a substitute for government bonds in predicting economic activity. From empirical studies, we find that the yield spread of corporate bonds is a more effective predictor than government bonds for economic activity.

3. Since the mid-1990s, the US fiscal balance has rapidly improved. As a result, the risk premium stemming from accumulating public debt has decreased, leading to the

[1] Global Economic Research Division, International Department, Bank of Japan (e-mail:yoshihito.saitou@boj.or.jp).

[2] Global Economic Research Division, International Department, Bank of Japan (e-mail:youko.takeda@boj.or.jp).

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structural narrowing of the yield spread. After excluding the impact of the improved fiscal situation, we find that the yield spreads of both corporate and government bonds provide more useful information for future economic activity.

4. Considering the relatively stable credit risk premium observed in corporate bond yields, more attention should be paid to the information contained in the yield spread of corporate bonds for future economic activity. Our estimation indicate that the current level of yield spread of corporate bonds predicts the strong continuous expansion of the U.S. economy extending into the near future.

1. Introduction

In the US, the yield spread between short- and long-term government bonds, especially the difference between 3-month Treasury bills and 10-year Treasury notes, has long been referred to as an effective information variable that can predict future real GDP growth[3].

Looking at the current situation (Figure 1), yield spreads between 2-year and 10-year notes, and between 10-year notes and 30-year bonds have been inverted. Also, the spread between 3-month bills and 10-year notes is narrowing sharply. Such phenomena seem to imply a significant slowing down of the economy in the future.

However, the spread has become less effective as a predictor of real GDP growth in recent years. This was evidenced during the Asian and Russian financial crises, when the long-term interest rate fell considerably due to a "flight to quality". In addition, since the mid-1990s, the reduction in the risk premium of long-term bonds caused by the considerable improvement in the fiscal balance may have distorted the predictive power of the yield spread of government bonds.

In order to find a more accurate information variable that can substitute for the yield spread of government bonds[4], we examine the following questions; (1) whether the yield spread of corporate bonds or swaps rate, which are less likely to be influenced by a flight to quality or reduction in the amount of government bonds, contain useful information for future economic activity or not, (2) whether the predictive power of the yield spread improves after taking account of the reduction in the budget deficit or not, and (3) to what extent does the current yield spread of corporate bonds, after adjusting for the fiscal balance, incorporate a slowdown of the economy.

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[3] See Dotsey [1998], Estrella and Mishkin [1996] for empirical studies using US data. Kozicki [1997] reports that the yield spread of government bonds has a strong predictive power for the real GDP growth rate in most developed countries excluding Japan.

[4] Gertler and Lown [2000] examines the predictive power of the yield spread between high yield bonds and AAA-rated corporate bonds for future economic activity, emphasizing the role of 'financial accelerator'. They report that this yield spread shows higher forecasting power than that of government bonds.

2. The Yield Spread and the Real Economy

(1) Why might the yield spread help predict economic growth so well?

Although the theoretical background for the yield spread's predictive power for economic growth is not clear, the following points are considered to explain why the yield spread predicts economic growth in the US so well.

(a) The yield spread reflects the stance of monetary policy

The yield spread between the long- and short-term interest rates is considered to reflect the current stance of monetary policy. According to the expectation hypothesis of the term structure of interest rates, the current long-term interest rate is an average of expected future short-term interest rates. Thus, when the short-term rate is high relative to the long-term rate, i.e. the yield spread is inverted, it implies that monetary policy is relatively tight[5].

As the impact of monetary policy on economic activity takes time to materialize, a low yield spread reflects that future economic growth will slowdown in response to tight monetary policy. Actually, in the US, there have been many cases where tight monetary policy, taken to fight inflationary pressure, has led to recession.

(b) The yield spread reflects credit market conditions

The long-term interest rate reflects conditions in credit markets. For example, when credit demand for consumption and investment increases, the long-term yield will rise, leading to a widening yield spread. The funds procured in credit markets will be used for consumption and investments eventually stimulating economic activity. Thus, changes in the yield spread are considered to forecast economic growth.

(2) Other factors influencing the yield spread

As mentioned above, the yield spread is considered to have predictive power for

[5] If the central bank raises interest rates, the short-term interest rate increases, yet the long-term interest rate does not increase as much, as long as the markets do not expect the central bank to continue raising rates. Therefore, under a tight monetary policy, the yield spread between long- and short-term interest rates normally shrinks.

economic activity. However, it should be noted that expectations of future economic growth are not the only force causing fluctuations in the yield spread. The following factors also contribute to inducing fluctuations:

(a) Changes in expected inflation

Assuming the Fischer's effect[6], changes in expected inflation will be incorporated in the nominal long-term interest rate. Furthermore, when the expected inflation rate fluctuates, uncertainty about future inflation will push up the term premium on long-term bonds. Thus, the yield spread will also be affected by changes in expected inflation.

(b) Changes in the fiscal situation

Changes in the fiscal situation also influence the yield spread affecting the term premium on long-term government bonds. When the fiscal balance improves, the risk premium stemming from accumulated public debt[7] decreases, contributing to the lowering of the yield spread. Since the mid-1990s, risk premium has decreased considerably due to the rapid improvement of the fiscal balance, leading to a lowering of the yield spread in the US.[8]

(c) Changes in investors' risk preferences

Changes in the risk preferences of investors also influence the yield spread through

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[6] The Fischer effect is the process where changes in expected inflation influence changes in nominal interest rates (Fischer formula: Nominal interest rate = Real interest rate + Expected inflation).

[7] It is highly unlikely for developed countries like the US to default on their debts. However, uncertainties about price fluctuations caused by downgrading of their sovereign ratings due to accumulated debt can lead to an increase in term premium, which is incorporated into long-term interest rates.

[8] Other than this, market speculation regarding the debt buyback program of the Department of the Treasury is considered to influence the yield spread. That is, because of the improved fiscal situation, the Treasury has gradually reduced the issuance of government bonds. The Treasury also proposed a debt buyback program in 1999 and actually bought back debt in March 2000. Since then, such moves have led to increased expectation of tight demand-supply conditions in Treasury securities markets, especially for long-term bonds, leading to a lowering of long-term government bond yields.

changes in the term premium requested for long-term bonds. Especially during financial crises, sudden changes in the risk preferences of investors occasion a 'flight to quality' or 'flight to liquidity', which lowers the long-term interest rate considerably.

For example, at the time of the Asian currency crises in late 1997 and the Russian crisis as well as the LTCM crisis in late 1998, drastic changes in risk preferences were observed. On these occasions, government bond yields were considerably lower than other bond yields, and the yield spread fluctuated in a highly volatile way.[9]

(d) Changes in credit risk premium

Adding to the above points, as corporate bond yields and swaps yields contain information on credit risk, the yield spread may fluctuate through changes in credit risk premium. In addition, because the corporate bond market is less liquid than the government bond market, its liquidity premium shows volatile movements.

As seen above, information contained in the yield spread of corporate bonds is not as perfect in predicting economic activity as government bonds. However, since the late 1990s, owing to the improvement in the fiscal balance as explained under (b) above and sudden changes in investors' risk preferences as explained under (c) the usefulness of the yield spread of government bonds in predicting economic growth has been decreasing. Therefore, the rest of this paper examines (1) whether the yield spread of corporate bonds can predict economic growth more accurately than government bonds, (2) whether taking the improvement in the fiscal balance into consideration improves the forecasting power of the yield spread, and (3) whether the yield spread of corporate

[9] Looking at yield spread trends of the during the period, a flight to quality triggered by the Russian crisis in August 1998 was observed. This led investors to shift assets from equities and high yield bonds to investment-grade bonds and eventually to government bonds. In this process, as alternatives to equities and corporate bonds, capital flowed into government bonds (especially long-term government bonds). Thus, long-term interest rates fell much faster than short-term interest rates, resulting in the lowering of the yield spread. During the LTCM (Long Term Capital Management) crisis in the fall of the same year, a flight to liquidity caused a shift in funds to short-term government bonds with high liquidity, resulting in the widening of the yield spread. As seen above, changes in the risk preferences of investors can affect the volatility of not only the interest rate level but also the yield spread.

bonds after adjusting for the fiscal balance is the most effective information variable in predicting economic growth.

3. Estimation and Prediction Results

(1) Predicting real GDP growth by the yield spread of government and corporate bonds

We use long time series data since 1970 to examine the predictive power of the yield spread of government bonds and corporate bonds. Though there can be several variations in the combination of short- and long-term interest rates, we use the yield spread between 10-years and 3-months for both government bonds and corporate bonds; Government bonds: 10-year Treasury notes – 3-month Treasury bills, Corporate bonds: long-term AAA corporate bonds[10] – 3-month CP in the non-financial sector. Regarding the time lag between real GDP growth and the yield spread, we chose 2, 4, 6, and 8 quarters, i.e., from half a year to two years as candidates. That is to say, we compare prediction results by applying a function that predicts the real GDP growth rate for the period from t+h-4 to t+h with the yield spread at period t.[11]

Table 1 summarizes the results, which are as follows:

(a) The four-quarter lag shows the best performance for both government bonds and corporate bonds.

(b) Estimates of the coefficients on the spread, β, for both government bonds and corporate bonds, are around 1, indicating a 1% change in the yield spread corresponds to a 1% change in real GDP growth one year ahead.

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[10] The yield of long-term corporate bonds used here is on a composite basis with more than 20 years of remaining maturity and therefore is not on a constant maturity basis.

[11] The estimated function used here is: $GDP_{t+h-4,t+h} = \alpha + \beta \times Sp_t + \varepsilon_t$ ($GDP_{t+h-4,t+h}$: real GDP growth for period t+h-4 to t+h, where h=2, 4, 6, 8. Sp: the yield spread between long- (10 years) and short-term rates (3 months). As some empirical research includes the real GDP growth rate for the period as an explanatory variable (e.g., Bonser-Neal and Morley [1997] and Kozicki [1997]) , we also try this function. However, since significant differences in the performance are not evident

(c) Comparing the performance of government bonds and corporate bonds, the t-statistics of β and R^2 for corporate bonds are higher than those for government bonds, indicating relatively higher predictive power for economic activity.

These results confirm that corporate bonds contain effective information for forecasting economic activity.[12]

Table 1 Prediction of Real GDP Growth Using the Yield Spread of Government and Corporate Bonds (In-Sample Forecasts)

		2 quarters ahead	4 quarters ahead	6 quarters ahead	8 quarters ahead
Government bonds	β	0.79 (5.007)**	1.08 (7.662)**	0.88 (5.846)**	0.46 (2.805)**
	R^2	0.179	0.338	0.229	0.064
Corporate bonds	β	0.69 (6.159)**	0.90 (9.049)**	0.65 (5.715)**	0.35 (2.827)**
	R^2	0.256	0.427	0.232	0.070

Notes:

1. Estimation equation: $GDP_{t+h-4,t+h} = \alpha + \beta \times Sp_t + \varepsilon_t$
   GDP $_{t+h-4,t+h}$: real GDP growth for period t+h-4 to t+h, where h=2, 4, 6, 8.
   Sp: yield spread between long-term (10 years) and short-term rates (3 months).
2. Estimation period: 1st quarter 1971 to 1st quarter 2000 (Government bonds)
   2nd quarter 1972 to 1st quarter 2000 (Corporate bonds)
3. Figures in parentheses are t-statistics, * is significant at the 5% level, ** is significant at the 1% level.
4. Shaded areas show the highest t-statistics or R^2 among lags.

Following the in-sample forecasts conducted above, we next conduct out-of-sample forecasts, to compare the performance of government and corporate bonds. An in-sample forecast shows the average relationship between the yield spread and real

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between these two functions, we report only the most simple function.

[12] In Table 1, the sampling periods for government bonds and corporate bonds are slightly different due to data availability. However, our analysis of government bonds using the same period as corporate bonds also renders the same result, where corporate bonds give higher performance than government bonds.

economic activity over the entire period for which data are available. An out-of-sample forecast, in contrast, only uses information available at the time market participants form their forecasts. For example, in conducting out-of-sample forecasts for real GDP growth in the first quarter of 1975, we use the estimated relationship between the yield spread and real GDP growth only through the fourth quarter of 1974.

The performance of out-of-sample forecasts is evaluated using RMSE (root mean squared error) statistics.[13] Table 2 shows the results.

(a) The RMSE figures for the four quarter lag (one year ahead) of both government bonds and corporate bonds are the smallest, indicating that the yield spread provides the best forecasts of the real GDP growth for one year ahead.

(b) The RMSE figure for corporate bonds is lower than that for government bonds. This indicates that corporate bonds' performance is slightly better in predicting economic activity than government bonds.

As shown above, both the in-sample and out-of-sample forecasts confirm a higher predictive power for corporate bonds than government bonds.

Table 2 Out-of-Sample Forecasts (RMSE)

	2 quarters ahead	4 quarters ahead	6 quarters ahead	8 quarters ahead
Government bonds	2.258	2.027	2.031	2.250
Corporate bonds	2.190	1.907	2.146	2.328

Thus, these results verify the high predictive power of corporate bonds. Yet, the performance of the prediction has deteriorated during the 1990s. During the 1970s and 1980s, predicted real GDP growth[14] traces actual GDP growth relatively well. During

[13] RMSE (root mean squared error) is obtained by taking the square root of the average of the squared gap between predicted and actual value. The lower the RMSE, the more effective the forecast.

[14] The result with in-sample forecasts.

the 1990s, however, predicted GDP growth started to diverge from actual GDP growth (Figure 2).

As one of the reasons for such divergence, the structural lowering of the yield spread could be mentioned. In the late 1990s, the fiscal balance improved rapidly, leading to the lowering of risk premium stemming from accumulated public debt.[15] The lowered risk premium caused downward pressure on the long-term interest rate, resulting in a narrowing yield spread. In fact, the yield spread of government bonds and the outstanding amount of marketable public debt show a positive correlation (Figure 3). Therefore, we calculated a 'fiscal balance adjusted' yield spread, which eliminates the impact of changes in fiscal balance, to improve the predictive power for economic activity.[16]

(2) Predicting real GDP growth with a 'fiscal balance adjusted' yield spread

To adjust for the improvement in the fiscal balance and to obtain a 'fiscal balance adjusted' yield spread, we make estimation using the following function[17]:

$$\text{Yield spread}_t = \alpha + \beta \times \text{Marketable public debt}_t\text{(annual change)} + \varepsilon_t$$

Then we define the 'fiscal balance adjusted' yield spread as:

'Fiscal balance adjusted' yield spread = Yield spread – ($\beta \times$Annual changes in marketable public debt)

Plotting the 'fiscal balance adjusted' yield spread and unadjusted yield spread (Figure 4), the former is higher than the latter reflecting the improvement in the fiscal balance

[15] In principle, the fluctuation in the fiscal balance is considered to affect only the yield of government bonds but not the yield of corporate bonds. However, arbitrage between the government bond market and the corporate bond market is considered to affect the yield of corporate bonds as well. Therefore, we have also estimated the 'fiscal balance adjusted' yield spread of corporate bonds.

[16] In addition to the above, the decrease in expected inflation may have contributed to lowering inflation risk premium that was incorporated into long-term interest rates in the 1990s.

[17] We confirm that the parameters of marketable public debt for both corporate bonds and government bonds are significant.

after 1998 and shows an upward trend after the mid-1990s.

Next, we examine the predictive power of the real GDP growth rate using the 'fiscal balance adjusted' yield spread. By applying the same function above,[18] we obtain the following results (Table 3) :

(a) For government bond and corporate bond yield spreads, t-statistics and R^2 improve; R^2 of the function with government bonds rises to 0.454 from the previous 0.338. R^2 of the function with corporate bonds rises to 0.555 from the previous 0.427.

(b) Especially since the mid-1990s, the yield spread of corporate bonds shows better performance (Figure 5).

(c) The out-of-sample forecast confirms improved performance of both the government bond yield and corporate bond yield. The relatively higher performance of the corporate bond yield compared to the government bond yield is also confirmed; The RMSE of the government bond function changes to 1.846 from the previous 2.027 and the RMSE of the corporate bond function changes to 1.677 from the previous 1.907.

The result actually proves that by eliminating the impact of the improvement in the fiscal balance, the yield spread still has predictive power for real GDP growth with the same accuracy even in the 1990s.[19]

[18] A function with a four-quarter lag is used for the yield spread of both corporate bonds and government bonds.

[19] We should note however that, even adjusting for a fiscal balance improvement by the equation described above, we cannot completely adjust for investors' expectations of a further fiscal surplus, or expectations of tightening demand for long-term bonds following the buyback of long-term government bonds. Thus, it should be noted that the lowering effectiveness of the yield spread of government bonds in recent years as a result of the distortion in the supply and demand of government bonds is not completely adjusted.

Table 3 Prediction of Real GDP Growth Using the 'fiscal balance adjusted' Yield Spread of Government and Corporate Bonds (In-sample Forecasts)

		2 quarters ahead	4 quarters ahead	6 quarters ahead	8 quarters ahead
Government bonds	β	1.14 (6.445)**	1.50 (9.771)**	1.21 (6.853)**	0.59 (2.868)**
	R^2	0.265	0.454	0.294	0.069
Corporate bonds	β	0.96 (7.845)**	1.21 (11.704)**	0.85 (6.420)**	0.37 (2.500)*
	R^2	0.359	0.555	0.276	0.056

Notes:

1. Estimation equation: $GDP_{t+h-4,t+h} = \alpha + \beta \times MSp_t + \varepsilon_t$
   GDP $_{t+h-4,t+h}$: the real GDP growth for period t+h-4 to t+h, where h=2, 4, 6, 8.
   MSp: the yield spread between long-term (10 years) and short-term rates after adjustment of fiscal balance (3 months).
2. Estimation period: 1st quarter 1971 to 1st quarter 2000 (Government bonds)
   2nd quarter 1972 to 1st quarter 2000 (Corporate bonds)
3. Figures in parentheses are t-statistics, * is significant at the 5% level, ** is significant at the 1% level.
4. Shaded areas show highest t-statistics or R^2 among each lag.

(3) Predicting real GDP growth using the yield spreads for government bonds, corporate bonds, and swaps during the 1990s

To complement the above findings, we compare the relative performance of the yield spreads for government bonds, corporate bonds and swaps, all of which are 'fiscal balance adjusted' using 1990s data. Considering the smaller sample size of real GDP, we use industrial production data instead of real GDP as the dependent variable.

Table 4 summarizes the results:

(a) The yield spread of corporate bonds shows the best performance among the three. Performance of the yield spread of both government bonds and swaps is almost the same.

(b) Regarding time lag, the performance of a one-year lag is the best for government bonds and corporate bonds. For swaps, a two-year time lag shows the best performance.

The above results confirm the high predictive power of the yield spread of corporate

bonds.

Table 4 Prediction of Real GDP Growth Using the 'fiscal balance adjusted' Yield Spread of Government Bonds, Corporate Bonds, and Swaps (In-Sample Forecasts)

		6 months ahead	12 months ahead	18 months ahead	24 months ahead
Government bonds	β	1.58 (5.513)**	1.56 (5.539)**	1.26 (4.278)**	0.74 (2.539)**
	R^2	0.201	0.202	0.131	0.051
Corporate bonds	β	1.35 (6.036)**	1.45 (7.292)**	1.39 (6.885)**	1.22 (5.904)**
	R^2	0.231	0.305	0.282	0.224
Swaps	β	1.32 (4.818)**	1.36 (5.262)**	0.96 (3.395)**	1.32 (5.529)**
	R^2	0.161	0.186	0.096	0.219

Notes:

1. Estimation equation: $IIP_{t+h-4,t+h} = \alpha + \beta \times MSp_t + \varepsilon_t$
   IIP $_{t+h-12,t+h}$: changes in industrial production for period t+h-12 to t+h, where h=6, 12, 18, 24.
   MSp: the yield spread between long-term (10 year) and short-term rates (3 month) after fiscal balance adjustment.
2. Estimation period: January 1990 to March 2000 (for swaps, the estimation period for 18 months ahead and 24 months ahead is January 1991 to March 2000).
3. Figures in parentheses are t-statistics, * is significant at the 5% level, ** is significant at the 1% level.
4. Shaded areas show highest t-statistics or R^2 among each lag.

(4) Out-of-sample forecast of real GDP growth using the 'fiscal balance adjusted' yield spread of corporate bonds

(a) Out-of -sample forecast of real GDP growth using yield spread

Following the analysis described above, we attempt to forecast real GDP growth using the 'fiscal balance adjusted' yield spread.[20] The results using a prediction equation where the real GDP growth rate one year ahead is forecast by the yield spread of corporate bonds are as follows (Figure 6):

[20] Forecasting period is from the second quarter of 2000 to the second quarter of 2001.

The current growth rate will be maintained up to the middle of 2001.[21] Namely, the actual growth rate for the first quarter of 2000 was +5% from the previous year, which is the same as the forecasted growth rate for the second quarter of 2002.

(b) Yield spread as a predictor of recessions

To complement the above result, we calculate the probability of recession one-year ahead that is implied by the yield spread of corporate bonds using the Probit model[22].

First, we examine the predictive power for recessions using long time series data. Figure 7 indicates that each economic recession from the 1970s[23] is forecast with high probability by the 'fiscal balance adjusted' yield spread of corporate bonds. During recessions, the estimated probability is high,[24] namely, the yield spread tends to narrow roughly one year before the start of recessions.

Next, based on the estimated Probit model, we forecast the probability of recession in the near future. The result is that the probability of recession remains at a very low level of about 2% until mid-2001.

As such, using both a time series approach and the Probit approach, it is concluded that economic expansion is highly likely to continue for the time being, judged by the current level of the yield spread of corporate bonds.

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[21] These results are different from the forecast using the yield spread of government bonds, where real GDP will peak in the first quarter of 2001, then fall to 3% in mid-2001.

[22] The Probit model is an econometric model that uses discrete data concerning qualitative options, such as "whether or not the economy is in recession", and "whether or not to purchase cars". By using the Probit model, we are able to calculate the probability of future economic recessions implied by the yield spread.

[23] Recession periods: from November 1973 to March 1975, January 1980 to July 1980, July 1981 to November 1982, and July 1990 to March 1991 (by NBER).

[24] Forecasting results show an increased probability of recession from 1995 to 1996. Though this period is not a recession, increasing pressure for inventory adjustment following tightening monetary policy caused a temporary slowdown in economic activity.

4. Concluding Remarks

The above analysis indicates that the yield spread of corporate bonds can play a role as an alternative to the yield spread of government bonds. This fact indicates that the credit risk premium incorporated into corporate bonds (AAA rated corporate bonds) is stable[25] and that the impact of a flight to quality is large enough to distort the effectiveness of government bonds as a leading indicator of economic activity.

However, we must note a few points in interpreting the above analysis. First, as described in Section 2, the yield spread of corporate bonds may be affected not only by expectations for future economic conditions, but also by recognition of credit risk and expectations of inflation. In some cases, factors other than expectations with respect to economic activity could act as a dominant factor for the change in yield spread. In particular, under current conditions where the US economy is rapidly expanding, we should be careful about the probability that a widening yield spread may not be caused by expected economic growth but by enhanced expectations with respect to inflation.

In addition, the Treasury markets' benchmark status is now being called into question by the improved fiscal situation in the US. There has been a lot of discussion searching for a more desirable benchmark asset instead of government bonds. We believe that the results above have a certain contribution with respect to such discussion. The following points can be pointed out as the benchmark functions of US Treasury bonds:

They are (1) a tool for forecasting future short-term interest rates, inflation, and economic activity, (2) a risk-free asset that can be used as a basis to analyze securities in

[25] Generally speaking, credit risk premium increases when a recession is expected. However, the high predictive power of corporate bonds in forecasting future economic activity obtained in this study indicates that the relationship between changes in credit risk premium and real GDP growth is relatively stable. Also, the fact that the market size of corporate bonds is larger than that of government bonds in the US (Treasury notes: 3,652.1 billion dollars, corporate bonds: 4,129.1 billion dollars as of the end of 1999), and that the corporate bond market has relatively high liquidity is the background for the stable relationship between the yield spread of corporate bonds and real GDP growth.

other markets that contain default risk, and (3) a hedging tool in other markets.[26] The high predictive power of the yield spread of corporate bonds with respect to economic activity suggests it can substitute for government bonds in forecasting future economic activity(a part of benchmark function (1)).[27]

[26] See Fleming [2000] for this classification.

[27] However, the high predictive power of the yield spread alone does not indicate that corporate bonds are able to replace government bonds as the benchmark. Considering that the corporate bond market is far more segmented and less liquid than the Treasury market, corporate bonds are not sufficient to work as a benchmark. Hence, required characteristics of a benchmark need to be discussed from various points of view in considering way alternative to government bonds.

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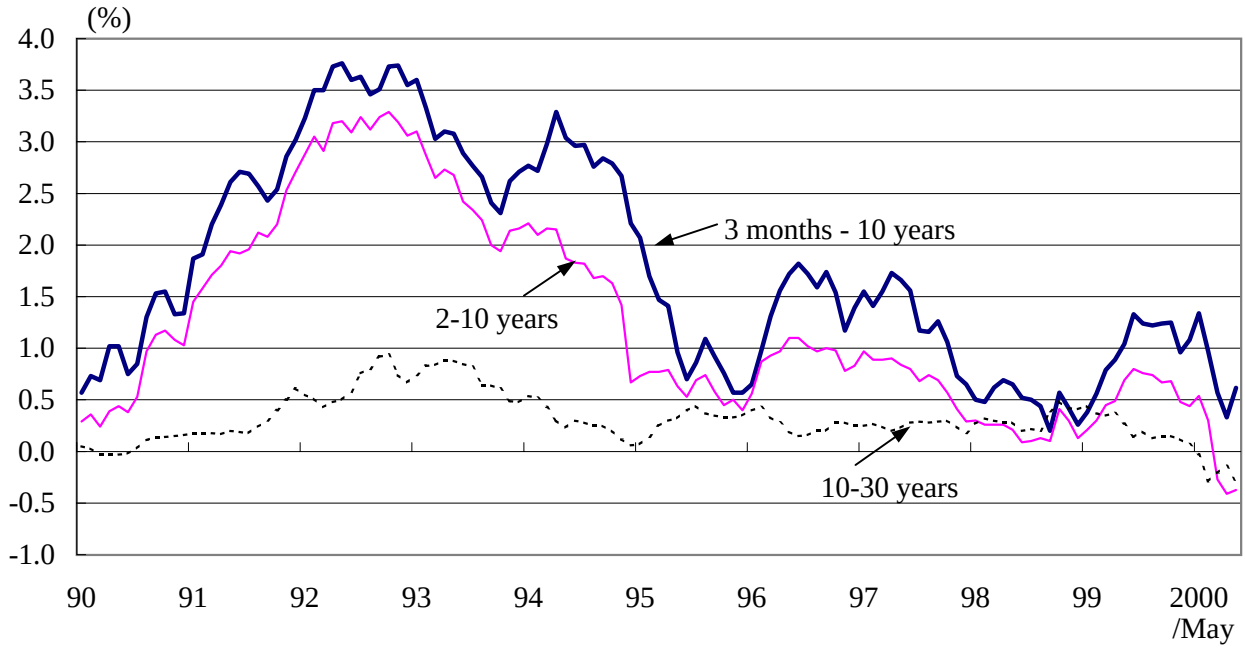
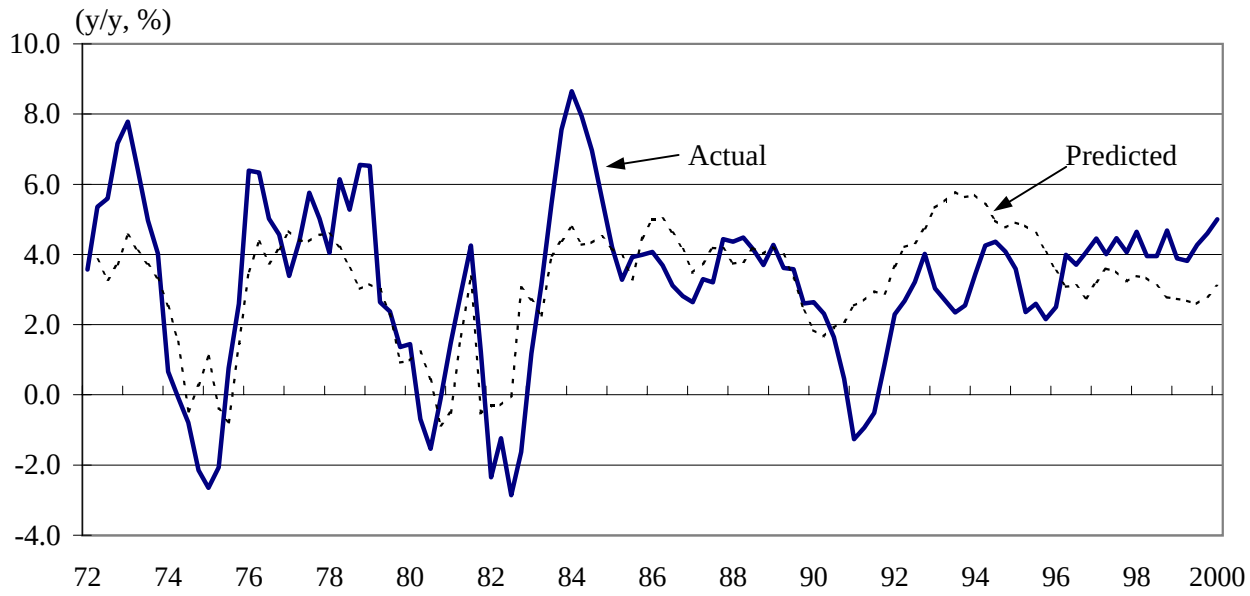
Figure 1 Yield Spreads of US Government Instruments



Note: For May 2000, the average from the 1st to 19th.

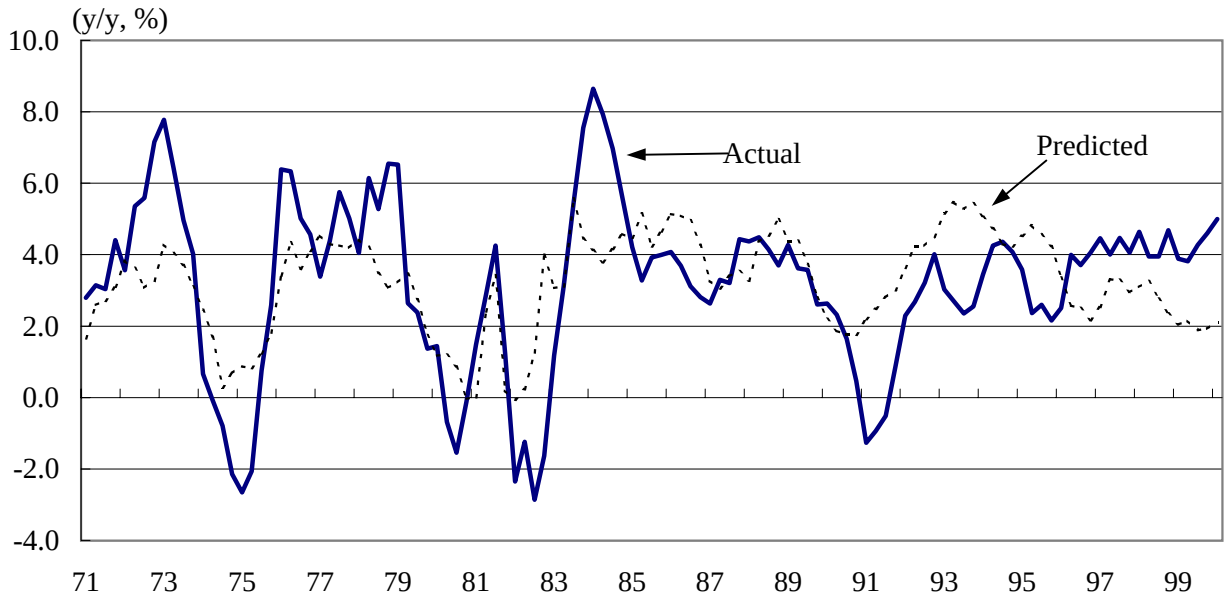
Figure 2 Predicted Real GDP Growth Using the Yield Spread

(1) Corporate Bonds



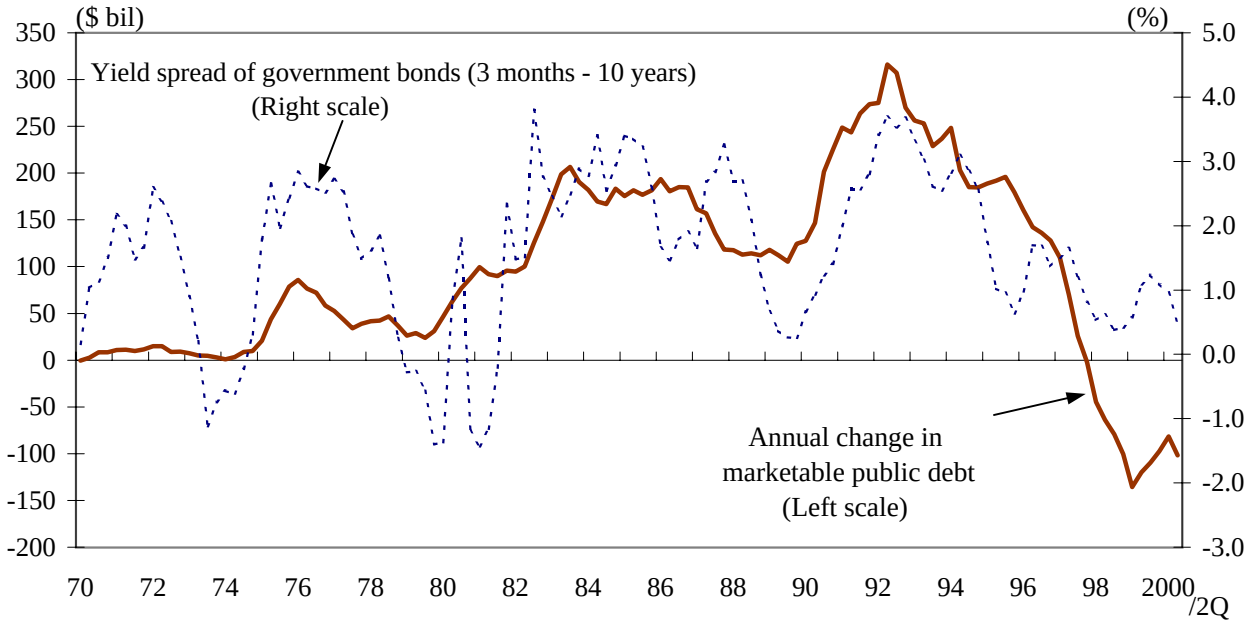
Note: Latest data is for the 1st quarter 2000.

(2) Government Bonds



Note: Latest data is for the 1st quarter 2000.

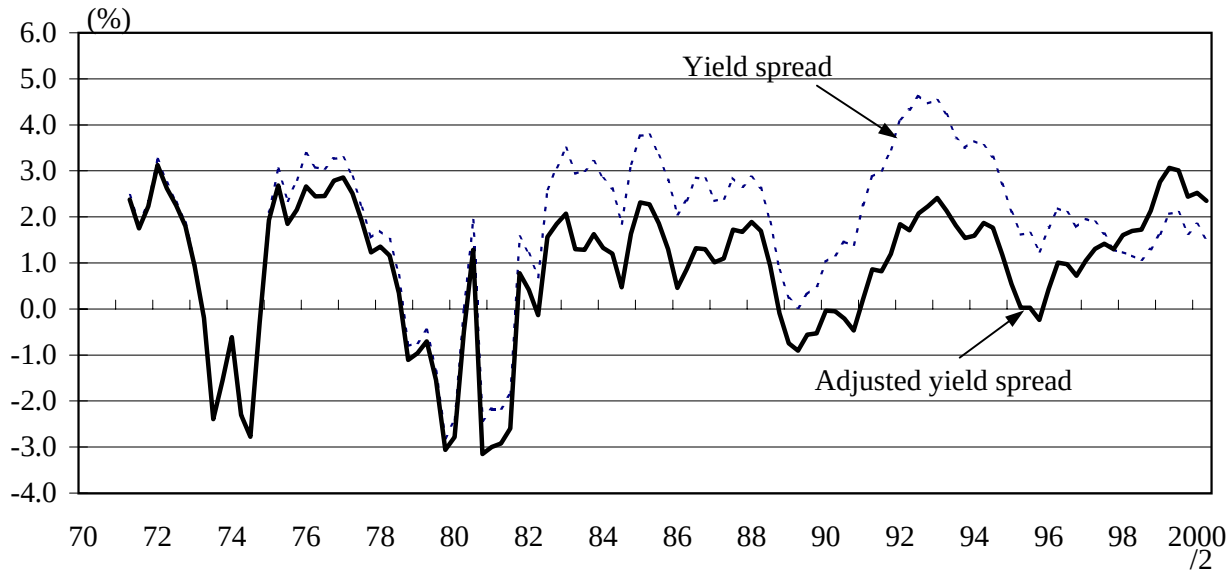
Figure 3 Yield Spread and Marketable Public Debt



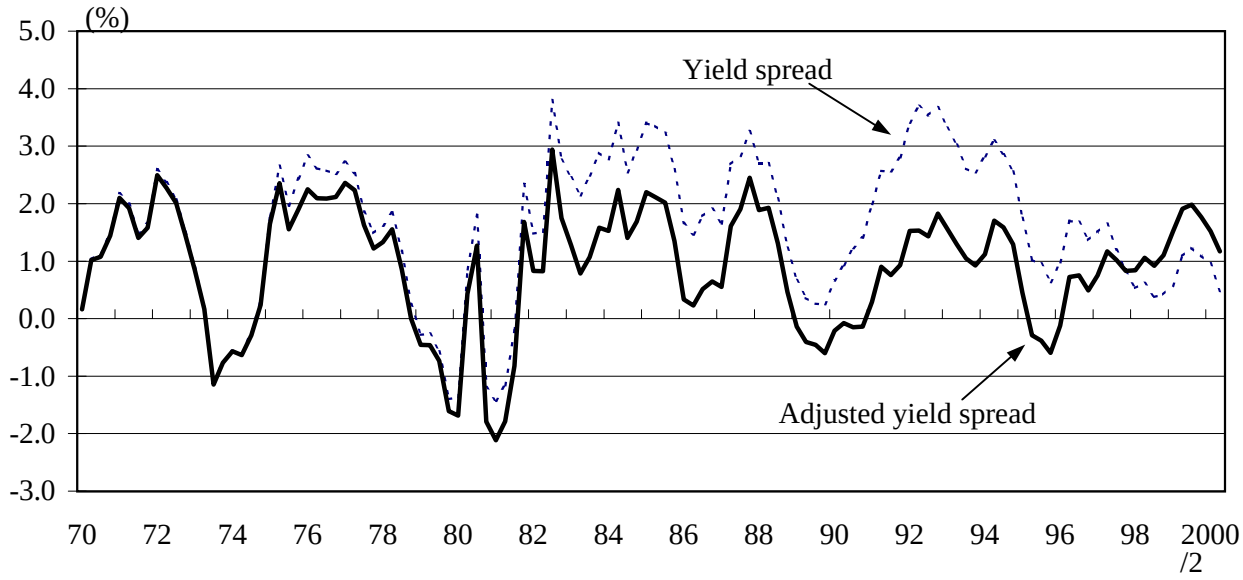
Note: Yield spread for the 2nd quarter 2000 = average from April to May (for May, from 1st to 19th). Annual change in marketable public debt for the 2nd quarter 2000 = average from February to April.

Figure 4 "Fiscal Balance Adjusted" Yield Spread

(1) Corporate Bonds



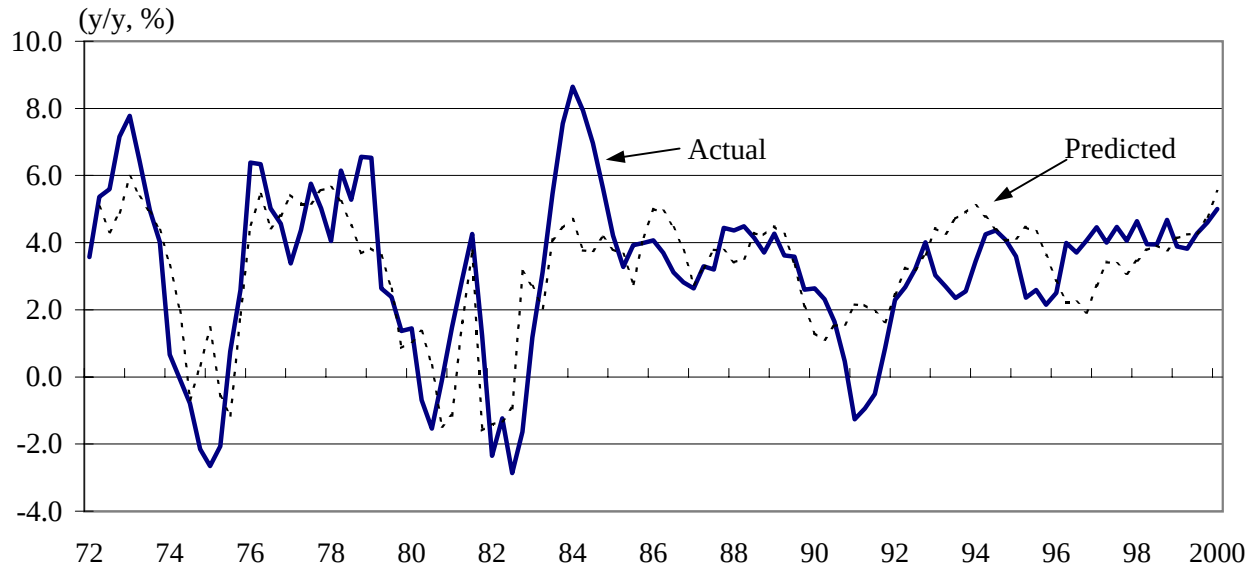
(2) Government Bonds



Note: For the 2nd quarter 2000, average for April to May (for May, from 1st to 19th).

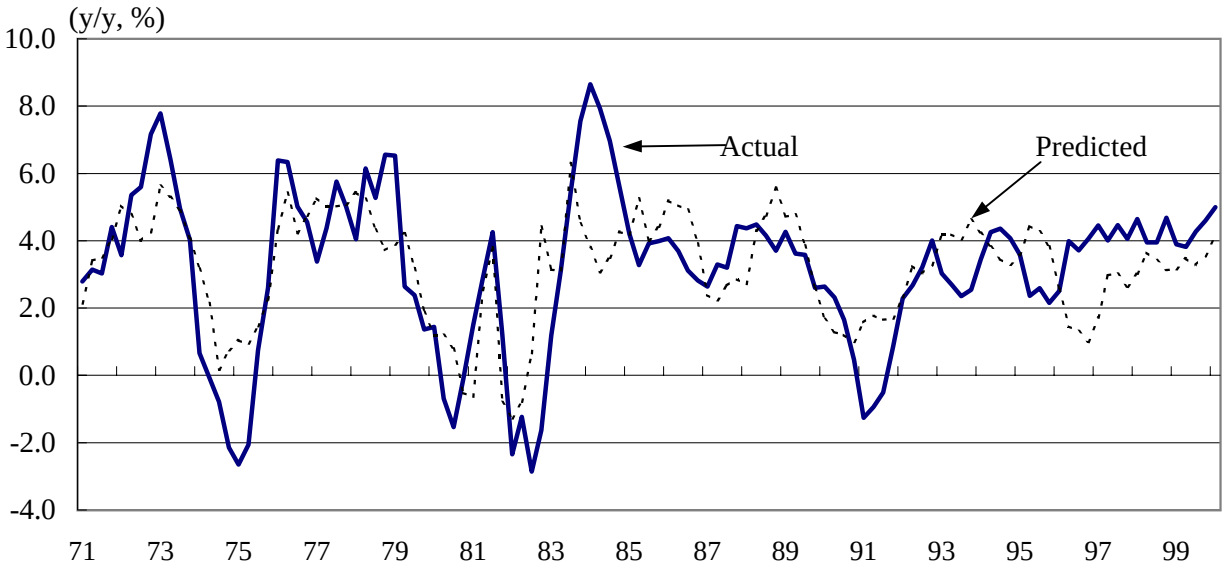
Figure 5 Predicted Real GDP Growth Using the "Fiscal Balance Adjusted" Yield Spread

(1) Corporate Bonds



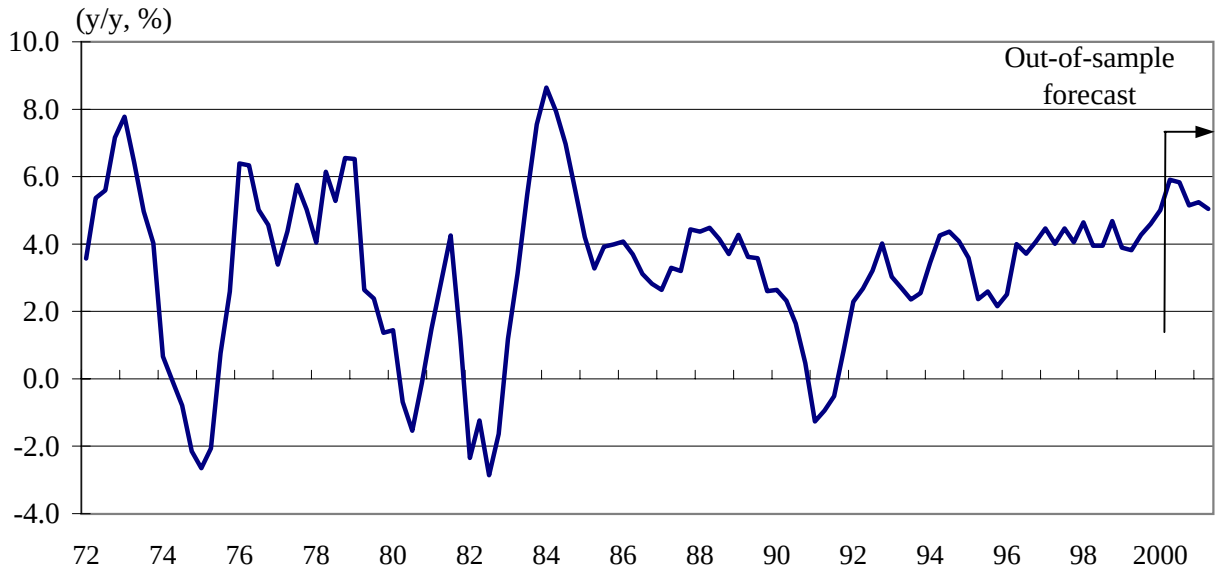
Note: Latest data is for the 1st quarter 2000.

(2) Government Bonds

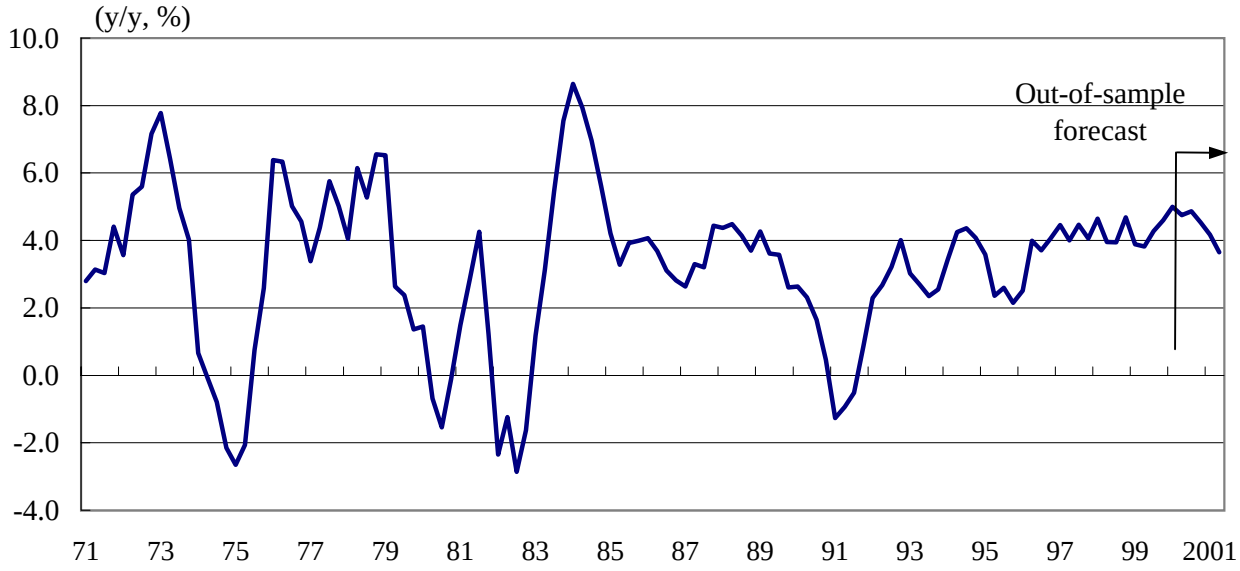


Note: Latest data is for the 1st quarter 2000.

Figure 6 Out-of-Sample Forecast of Real GDP Growth Using the "Fiscal Balance Adjusted" Yield Spread of Corporate Bonds

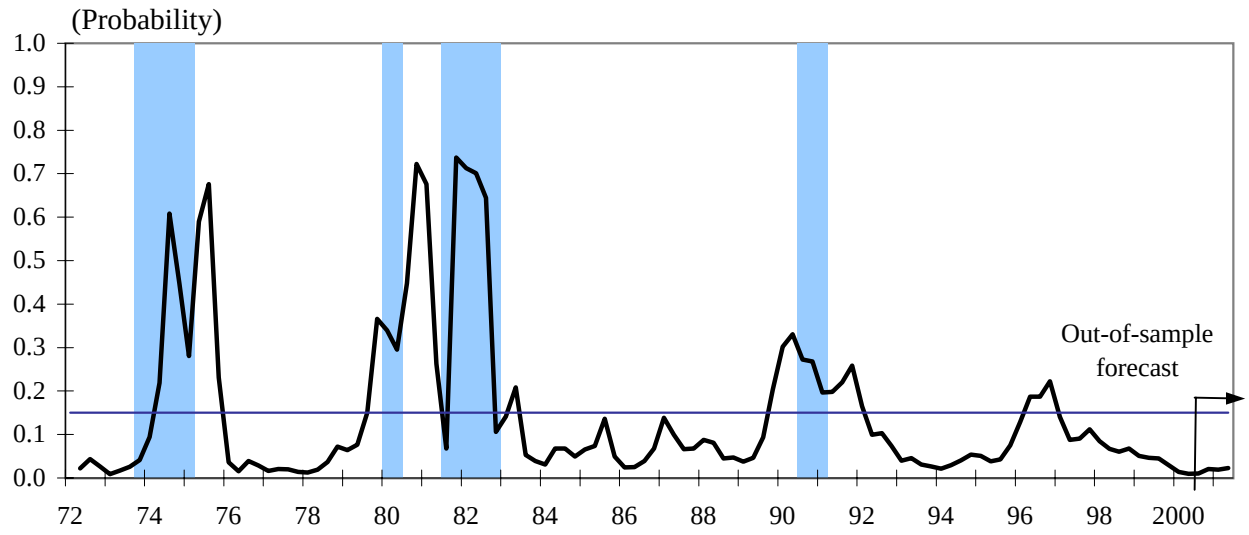


Reference: Out-of-Sample Forecast of Real GDP Growth Using the "Fiscal Balance Adjusted" Yield Spread of Government Bonds

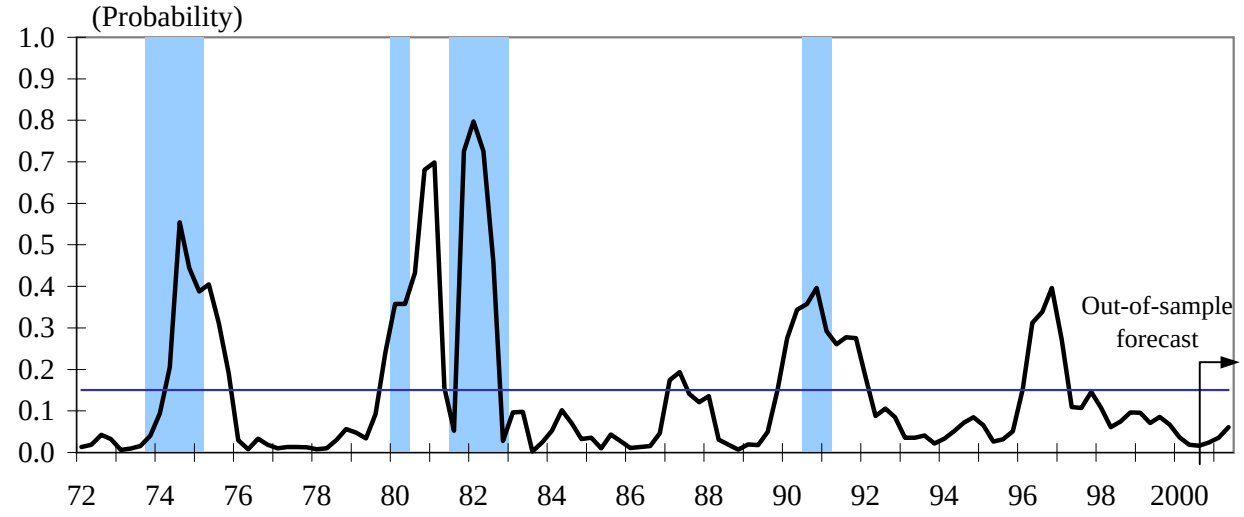


Notes: 1. Real GDP growth is forecast up to 2nd quarter 2001.
2. A 4-quarter lag is used as an explanatory variable.

Figure 7 Predicted Recession Probabilities Using the "Fiscal Balance Adjusted" Yield Spread of Corporate Bonds



Reference: Predicted Recession Probabilities Using the "Fiscal Balance Adjusted" Yield Spread of Government Bonds



Notes:

1. Prediction Equation: $Prob(R_t=1)=\phi(\alpha+\beta \times MSp_t)$
   Prob (R_t=1): probability of recession at period t
   $\phi(\bullet)$: cumulative standard normal density function
   MSp: 'Fiscal balance adjusted' yield spread
   Estimation Period: 1st quarter 1972 -2nd quarter 2000
   Pseudo-R^2: 0.249 (function using corporate bonds), 0.259 (function using government bonds)
2. Shaded areas indicate recession.
   Horizontal line shows average probability of recession during the estimation periods (0.15).