

THE BENCHMARK EFFECT IN THE JAPANESE GOVERNMENT BOND MARKET

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In the Japanese government bond (JGB) market, there is at any given time one bond issue that is designated as the liquid bond. Often called the benchmark bond (BMB), this security is not necessarily the most recent issue as in many other markets. The BMB trades at a price premium, with a yield thirty to one hundred basis points lower than the yield on comparable issues with similar maturities and coupons.

Figure 1 shows the yield spread between a basket of side issues and the various benchmark issues over the period July 1984–June 1987.

RELATIVE TRADING VOLUME

Turnover in the BMB is rapid; sometimes as much as twice the total outstanding stock changes hands each day. The BMB is traded in large quantities over the counter, as well as on the Tokyo Stock Exchange (TSE), and on the Nagoya and Osaka stock exchanges. The TSE trading volume represents only about 5% of the total cash transactions that occur in the BMB.

In Figure 2 the total par value of bonds traded during April 1990 in the various ten-year JGBs is plotted.* JGB119, the benchmark issue in April 1990, the month for which the snapshot is taken, is responsible for over 97% of the trading in JGBs during the month.

WHAT SHOULD THE PRICE DIFFERENCE BE?

How much of the price and yield differences are explained by the fact that the assets we consider are not exactly identical? Compare, for example, JGB89, which was the BMB from October 1986 until December 1987,

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FIGURE 1 ■ The Benchmark Spread. Yield to Maturity of non-BMB Minus Yield on Various BMBs.

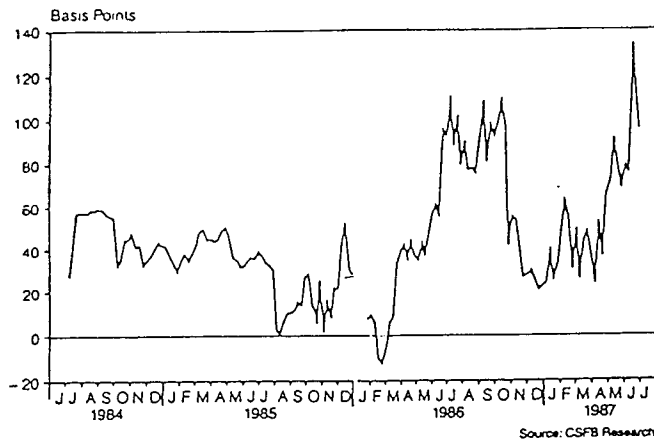
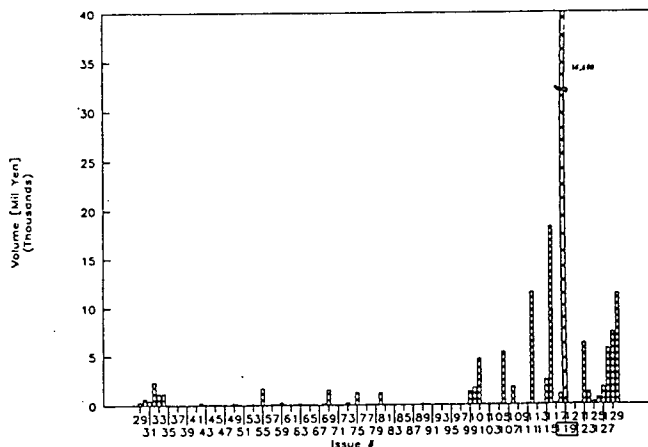


FIGURE 2 ■ Relative Trading Volume. Tokyo Stock Exchange Data of Monthly Par Value of Trade for April 1990.



and JGB90, which has the same coupon rate of 5.1%, paid semi-annually.

The timing of the cash flows is not identical for the two issues. JGB89 pays coupons on June 20 and December 20 of each year (of 2.55% of face value) until maturity, June 20, 1996, at which point the bond pays 102.55% of face value. JGB90's payoffs differ only in their timing, occurring one month later than those on JGB89. The prices of such similar assets should be close.

In fact, in May 1987 the average price of JGB90 was 107.70 yen, implying an average, semi-annually compounded yield to maturity of 4.30%. Given this yield, the price of JGB89 should have been approximately 108.08. Its average price was, in fact, 110.07 yen, with an implied yield of 4.05%.

Only 16% of the price difference between JGB89's price based on JGB90's yield and JGB89's

observed price can be explained by the timing difference of cash flows. The rest is due to the liquidity difference.

THE BENCHMARK'S CHARACTERISTICS

The BMB is usually designated as such some time after being issued (with the exception of JGB105, which was designated the BMB upon issuance). Table 1 lists the BMBs in the last decade. The issue that is chosen as the BMB tends to have a coupon similar to the coupon rate on newly issued bonds, and a large outstanding par value (recently, about 3 trillion yen). See Table 2 for a comparison of the par values of four recent BMBs to the par values of similar bonds that were not designated.

The time to maturity of the BMB upon designation has increased over the last decade, averaging 9.7 years over the last five years. This information may be useful for investors who engage in speculation on the identity of the next BMB.

In a related paper (Boudoukh and Whitelaw [1991]), we study this phenomenon from a theoretical perspective, as an optimization problem of the issuer, the market maker, and the agents in a simple economy. This article focuses on the market structure that gives rise to the BMB effect. Viewing this market idiosyncrasy in a market structure context is informative. It is one of the rare instances where a measure of liquidity and its value can be obtained.

First we discuss the structural features of the JGB market relevant to the existence of the BMB effect. Next we summarize the main findings in Boudoukh and Whitelaw [1991], where the issuer is shown to benefit from market segregation. This segregation based on liquidity enables the issuer to extract the consumer surplus, thereby increasing revenue. We present recent evidence of the decline in the magnitude of the BMB effect, and emphasize the role of the evolution in market conditions that are relevant to this decline. We also discuss some possible ways to trade on the BMB effect.

THE STRUCTURAL FACTORS THAT GIVE RISE TO THE BMB EFFECT

A number of institutional features are relevant to the BMB effect: the high cost and difficulty of short sales, the oligopolistic structure of security market competition, the existence of different investment clienteles, namely, short-term speculators and long-term investors, the pivotal role played by the Ministry of Finance (MOF)

TABLE 1 ■ Benchmark Bond Characteristics

Issue	C(%)	Maturity	Total Par (¥ mil.)	BM Period	TTM	C(%)
22	7.7	Nov 89	2,300,000	Jan 82-Sep 83	7.9	8.0
45	7.5	Jun 92	2,000,000	Sep 83-Dec 83	8.8	7.5
53	7.5	Jan 93	2,765,561	Dec 83-Sep 84	9.2	7.5
59	7.3	Dec 93	1,600,000	Sep 84-Jul 85	9.3	7.3
68	6.8	Dec 94	1,450,000	Jul 85-Dec 85	9.5	6.8
78	6.2	Jul 95	1,300,000	Dec 85-Oct 86	9.7	6.5
89	5.1	Jun 96	2,707,500	Oct 86-Dec 87	9.7	5.1
105	5.0	Dec 97	2,831,850	Jan 88-Dec 88	10.0	5.0
111	4.6	Jun 98	3,055,536	Dec 88-Nov 89	9.6	4.8
119	4.8	Jun 99	2,995,791	Nov 89-Feb 91	9.7	5.0
129	6.4	Mar 00	3,858,399	Feb 91-Present	9.1	6.9

Notes: BM period is the time period for which the issue was the BMB. TTM is the time to maturity upon designation as the benchmark. Current coupon is the coupon rate on the most recent ten-year JGB at the time of the BMB designation.

and the Bank of Japan (BOJ), and issuance through a syndicate of financial institutions.

Short Sale Constraints

Until recently, short sales were illegal in the JGB market. Even now, when short-selling is legal, the arbitrage strategy involved in making a profit on the price discrepancy necessitates shorting the overpriced asset — the BMB. Doing so would require in turn finding an investor who “stores” the bond, from whom an arbitrageur might borrow the BMB, while going long in a close-substitute asset (e.g., short JGB89, long JGB90). Typically the holder of the BMB would itself be a speculator, and, given the short investment horizon, would be unwilling to lend it or would charge a premium so as to extract the entire surplus of the strategy.

Short sale restrictions are also relevant for market makers, who may find intertemporal hedging of the interest rate risk of carrying inventory prohibitively expensive. The high level of activity in the yen interest rate-related futures markets (which since 1986 have been the largest futures markets in the world) would mitigate this effect. Nevertheless, market makers are still reluctant to carry large inventories, especially in the less liquid securities. The most common short-selling mechanism in the Japanese fixed-income market is via a *gensaki* agreement (bond repurchase).

Clientele Effect

Division of the JGB market into clienteles is very clear-cut. Trust banks, which manage pension funds, and insurance companies follow buy-and-hold trading strategies, trying to match the income from their bond portfolios to their liability streams. City banks and securities

TABLE 2 ■ JGB Coupon, Par Value, and Maturity

Issue	C(%)	Total Par (¥ mil.)	Maturity
100	4.00	1,179,511	Jun 97
101	3.90	800,000	Jun 97
102	4.30	450,000	Sep 97
103	4.60	1,866,200	Sep 97
104	4.90	980,000	Sep 97
105BM	5.00	2,831,850	Dec 97
106	4.90	2,192,100	Mar 98
108	4.80	2,703,400	Jun 98
109	4.80	1,485,550	Mar 98
111BM	4.60	3,055,500	Jun 98
112	5.00	3,029,100	Sep 98
113	5.00	660,000	Dec 98
114	4.80	1,367,750	Dec 98
115	4.70	670,000	Dec 98
116	4.70	1,490,000	Mar 99
117	4.70	660,000	Jun 99
118	4.80	4,350,000	Mar 99
119BM	4.80	2,995,750	Jun 99
121	4.90	710,000	Jun 99
122	5.00	1,821,633	Sep 99
123	4.90	2,146,851	Sep 99
124	4.90	710,000	Dec 99
125	5.10	932,592	Dec 99
126	5.30	720,000	Dec 99
127	5.60	660,000	Mar 00
128	6.20	770,000	Mar 00
129 BM	6.40	3,858,399	Mar 00
130	6.70	2,737,284	Jun 00
131	6.60	897,000	Jun 00
133	7.30	1,027,000	Sep 00
134	7.90	827,000	Dec 00
135	7.20	877,000	Dec 00

Coupons are paid semi-annually. BM next to an issue number indicates that the issue was the BMB.

firms, on the other hand, are involved in interest rate risk management, mostly via the BMB and futures markets. Such separation supports and reinforces the BMB effect.

The Issuance Process

The size of an issue is determined by the MOF, according to the government's financial needs, and is partially a function of market conditions and of the negotiation process between the BOJ and the underwriting syndicate and selling group. The syndicate consists of approximately 800 financial institutions: various banks, insurance companies, securities firms, and, since 1986, foreign institutions. Each issue is sold to the syndicate at par, with the coupon and size of each issue to be negotiated.

The MOF and BOJ have a strong enough negotiating position to impose terms on the underwriting syndicate — a course of action that they undertake when interest rates “overheat.” In such cases the syndicate members may take temporary losses because they must pay par for bonds with coupons below current market yields.

One such case occurred in the early 1980s, when interest rates rose above 8%, while new issues had 8% coupons, creating a temporary wedge between market rates and issue rates. Recently a hybrid auction method was introduced, where 20% of an issue is sold to bidders, who bid for quantity. Price/coupon determination is still the result of negotiation with the syndicate. This change is designed to enhance liquidity, because a large fraction of all issues had usually disappeared from the market into buy-and-hold portfolios upon issuance.

The Designation Process

There is no systematic method by which the next BMB is designated, although consent of the big-four securities firms, which are the major market makers, is necessary for designation. Disagreement of any of the firms may cause a delay in the transfer, as happened in the switch from JGB78 to JGB89.

In July 1986, JGB89 exhibited an increase in price and in trading volume because of speculation that it would become the next BMB. Opposition of Nomura caused a loss of confidence in JGB89 and an ensuing decline in volume and price. A decline in spot rates during September 1986 again made JGB89 a likely candidate (the coupon rate on JGB78 was 6.2% when rates were at roughly 5.2%, closer to the JGB89 coupon rate of 5.1%). In October 1986 the yield on JGB78 fell sixty basis

points in one week, and JGB89 became the next BMB.

MARKET SEGREGATION AND VOLATILITY

Boudoukh and Whitelaw [1991] develop a model of investors, a market maker, and an issuer of bonds, and provide an explanation as to why and how market segregation occurs. Not only can divergent prices for assets with identical payoffs be sustained in a rational expectations equilibrium, but such divergence may also be optimal from the perspective of the issuer.

The Optimality of Segregation

The model is a three-period model with a continuum of agents who differ in their endowment uncertainty, two securities with identical payoffs, and a market maker that is modeled as a regulated monopolist. In a rational expectations equilibrium, agents maximize their expected utility by trading in bonds whose prices are set by the market maker.

Model equilibria are categorized as either symmetric (the prices of the two securities are identical) or segregated (prices differ). It is shown that for some parameter sets a segregated equilibrium is in fact optimal from the perspective of the issuer.

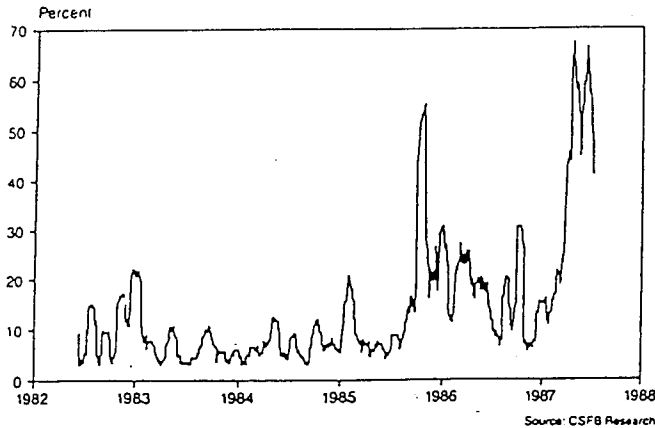
Packaging different amounts of liquidity with each bond forces agents to pay for the liquidity that they need and therefore increases revenue, given a fixed face amount of bonds issued. When the relative supply of the liquid and illiquid bonds is also a choice variable, segregation is again shown to be optimal.

Liquidity Premiums and Volatility

Both economic intuition and empirical evidence imply a positive correlation between the value of liquidity and volatility. Boudoukh and Whitelaw [1991] show that the yield spread between the liquid and illiquid bonds increases as the volatility of the agents' endowment processes increases. In the context of the BMB yield spread, notice that the increase in interest rate volatility in 1986 was accompanied by an increase in the BMB spread (see Figure 3).

We do not suggest, however, that there is a one-to-one correspondence between volatility and the spread intertemporally. In fact, the evidence in this article indicates a recent decline in the spread during a period of high interest rate volatility. Changes in structural factors have caused the BMB effect to decline over time. Hence, the recent prevalence of low spreads and high volatility

FIGURE 3 ■ Yield Volatility of JGBs. Annualized Yield Volatility of Benchmark Series, Using Daily Data over Monthly Subperiods.



does not contradict the postulated positive link between the yield spread and volatility, when viewed in the context of institutional changes through time.

SOME RECENT EVIDENCE OF DECLINING SPREADS

The BMB effect peaked in 1987, with yield differences between the BMB and side issues of one hundred basis points and more. Since then, a decline in the spread has been observed. This decline is attributable to institutional changes and potentially larger speculation on the BMB effect, and there has not been a corresponding decline in interest rate volatility. Before we present the evidence, we discuss problems in measurement of the effect.

Measurement Problems

There is an inherent problem in measurement of the BMB effect, because it necessitates observing prices of illiquid (thus infrequently traded) assets. The BMB effect is lessened because there are spillover trades between the BMB and its "clones" (e.g., JGB119 versus JGB118 and JGB121; see Table 2), and hence these issues are relatively liquid. To the extent that these clones are close in liquidity to the liquid BMB, it is possible that the yield spread between the BMB and a basket of side issues understates the true liquidity premium.

If speculation between the BMB and side issues is an important component of the pricing of the side issues as well, yield spreads may not be the appropriate measure of liquidity. While it is true that the volume of trade in

the BMB is hundreds to thousands of times higher than in other issues, if, for example, liquidity grows linearly in $\log(\text{volume})$ rather than in volume, which would make some economic sense, then the BMB is only two to three times more liquid than its clones.

Callability and Reverse Coupon Effects

In theory, all JGBs are callable. This may affect prices somewhat, and may be a function of the coupon rate, but for our purposes callability is relatively unimportant. The reasons we can ignore callability are twofold.

First, the government's call of the debt can be exercised only at very low rates (3% or so usually), and even at these rates calls are considered highly unlikely. The belief that the government will not exercise its option even when it is economically advantageous to do so is supported by the fact that in mid-1987 rates did drop below call rates without a major redemption of bonds.

Such a call would have a devastating impact on investors following buy-and-hold strategies, and this consequence perhaps explains the government's unwillingness to call JGBs. Consequently, callability is generally considered a threat or a possible punishment tool.

Second, because we look at issues with similar coupons, the price impact would be roughly the same for both the BMB and its clones, and callability will therefore have virtually no effect when we consider price differences or yield differences.

In the JGB market there is preference for higher-coupon issues, because trust banks and insurance companies can pay dividends only out of income (and not using capital gains). This effect, the reverse coupon effect, causes a price bias in favor of bonds with higher coupons.

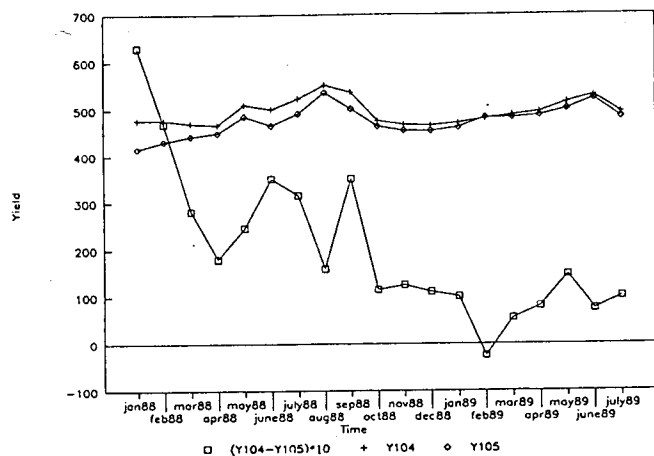
The effect is called the reverse coupon effect because in other markets the bias is usually in favor of low-coupon, high-capital gain securities for tax reasons. The reverse coupon effect introduces a bias in the liquidity spread measure when we compare issues with different coupons (e.g., JGB109 and JGB111).

Recent Evidence

We now present preliminary evidence to support the hypothesis that structural changes and deregulation in the JGB market (and Japanese financial markets as a whole) have resulted in a decline of the liquidity premium. Figure 4 compares the yield to maturity of JGB105, the benchmark, with that of JGB104.

JGB105 became the BMB upon its issuance in

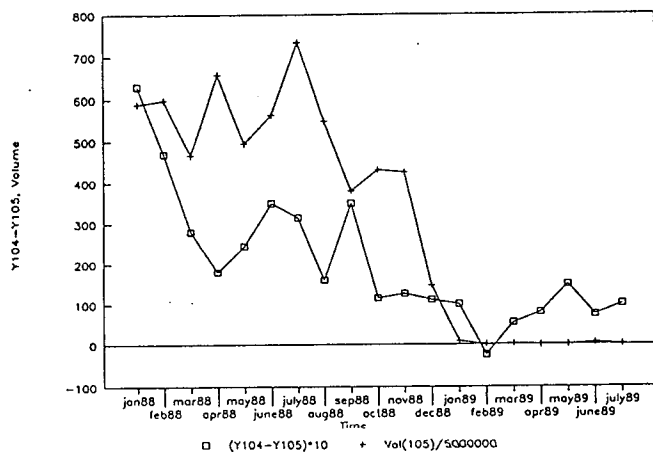
FIGURE 4 ■ JGB104 versus JGB105: Yields and Yield Spread. Annualized Yield (Basis Points) and Yield Spread (Multiplied by 10). JGB105's Tenure as the BMB: Jan 88 (Issue Date)-Dec 88.



January 1988, replacing JGB89, which was the longest-lasting BMB (fourteen months). JGB105 has a higher coupon rate (5%) than JGB104 (4.9%), and thus would have a permanent yield advantage because of the reverse coupon effect. Compared to the average spread during the period January 1989 to July 1989 of approximately five basis points, there is still a visible twenty-five-basis point liquidity premium during JGB105's tenure as the BMB (during which it accounts for over 95% of total cash transactions at the TSE—see Figure 5).

There is also a sharp decline in the spread in January 1989 when JGB105 ceased to be the BMB. Trading activity in the side issues (JGB104 and JGB106) remained relatively stable throughout the period.

FIGURE 5 ■ JGB104 versus JGB105: Spread and Volume. For Scaling, Volume is Divided by 5 Million.



Such clear-cut evidence is not apparent in Figure 6. The yield of JGB111, with a 4.6% coupon and BMB status from December 1988 until November 1989, is plotted along with JGB109 (4.8%). Here the reverse coupon effect and the BMB effect work in opposite directions.

Although the volume of trade in JGB111 is hundreds to thousands of times larger than in JGB109 (Figure 7), the liquidity effect does not show up. Similar comments hold for Figures 8 and 9, where JGB119 (4.8%, BMB November 1989 to the present) is compared to JGB118 (4.8%).

In summary, there is preliminary evidence of a decline in the BMB liquidity premium, while the level of activity in the BMB (measured by the relative volume of trade in the BMB versus side issues) is stable.

TRADING ON THE BMB EFFECT

There are a number of possible trading strategies that exploit this anomaly. We are not certain of the success of any of these strategies, and even if ex post some of them prove profitable, this may not be so in the future because of the decline in the magnitude of the BMB effect.

The most straightforward approach, which is to short the BMB and go long in a close substitute, is precluded by the high cost of short sales (specifically, borrowing the BMB may be impossible). A number of intertemporal and cross-sectional approaches rely on speculation over the identity of the next BMB, using typical characteristics of the BMB. Private communication

FIGURE 6 ■ JGB109 versus JGB111: Yields and Yield Spread. JGB111's Tenure as the BMB: Dec 88-Nov 89.

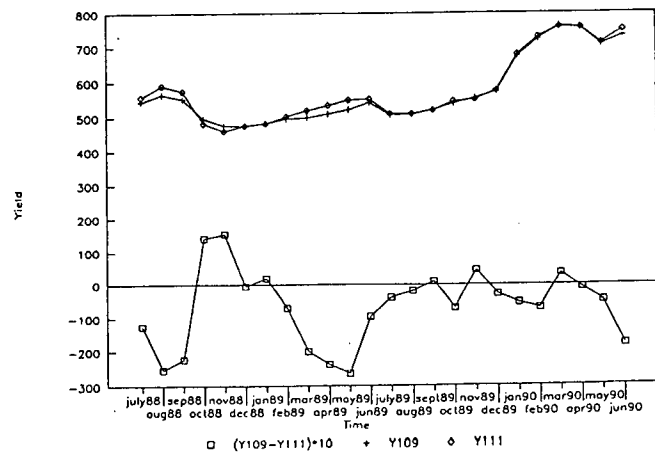


FIGURE 7 ■ JGB109 versus JGB111: Spread and Volume.

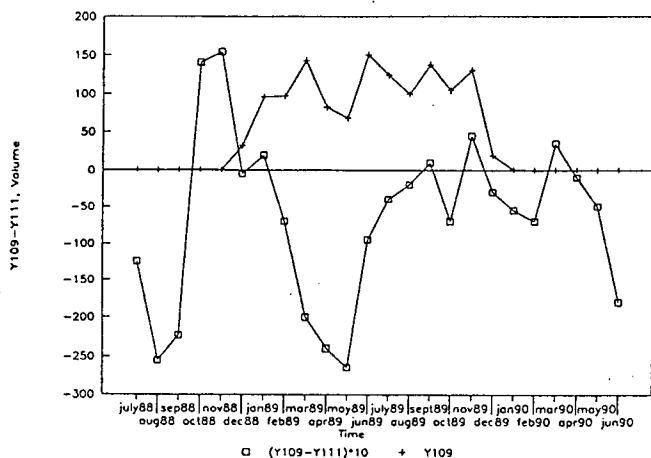


FIGURE 8 ■ JGB118 versus JGB119: Yields and Yield Spread. JGB119's Tenure as the BMB: Nov 89-Present.

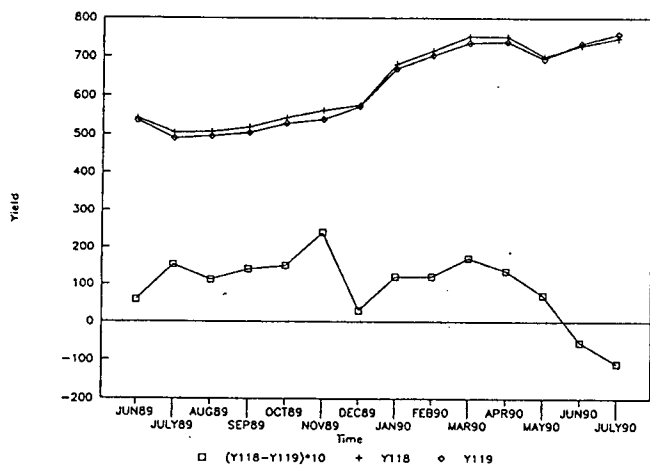
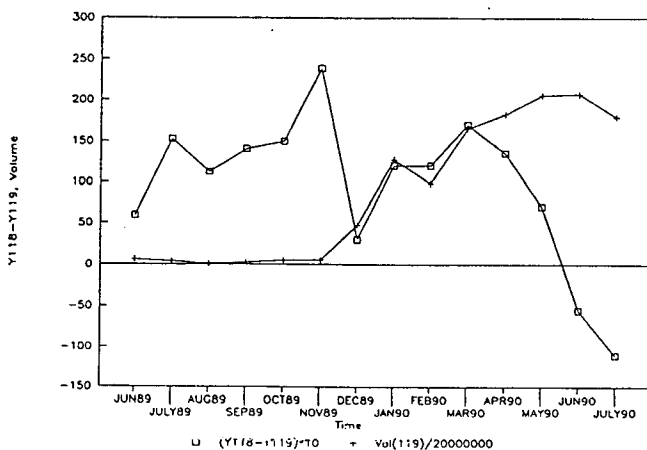


FIGURE 9 ■ JGB118 versus JGB119: Spread and Volume.



suggests that there might be some investment banks involved in such speculative activity.

To the extent that the yield on the BMB adjusts more quickly to relevant economic information than yields on side issues, variations in the spread may be a leading indicator of the direction of yield changes (therefore price changes and returns) of side issues. There would be a problem implementing this strategy during transition times from one BMB to another, for the BMB and the candidate future BMBs would exhibit price changes dominated by speculation over the timing of the switch and the identity of the next BMB.

FUTURE RESEARCH AND SUMMARY

Beyond the potential profitability of different strategies, which requires further investigation, there are interesting empirical, economic, and gaming problems to be addressed in any future research on the BMB.

We have not employed rigorous empirical tests because of sample size and measurement problems. Availability of daily data could mitigate these problems, and non-parametric tests can be conducted to confirm our hypothesis of a decline in the BMB effect.

On a theoretical front, it is not clear why designation does not occur upon issuance, if indeed it is the government that extracts the consumer surplus by segregating the market based on liquidity. Uncertainty over the identity of the next BMB may result in market participants charging a risk premium. Yet if one of each few issues were certain to become the BMB, no risk premiums would be required.

From a game theoretic perspective, the collapse of the premium, which involves large losses to holders of the outgoing BMB and profits to holders of the incoming BMB, is difficult to model as rational behavior. For example, the yield on JGB105 increased by seventy basis points (corresponding to a price decrease of approximately 5%) in less than a week, and the entire issue, with par value of 2831 million yen, decreased in value by 140 million yen.

The future is likely to see a continuation of the decline of the BMB effect, because of liberalization of Japanese and world financial markets and a move toward a more evenly liquid term structure. Such change would also mean a less prominent role for the MOF and the BOJ. The possible desire of these institutions to preserve their control over the market may prolong the benchmark phenomenon and delay the move toward liquidity.

ENDNOTES

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* Trading in ten-year issues constitutes over 99% of the total trading in government issues. Other issues include twenty-year JGBs, short maturity bonds, and municipal bonds.

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