OPTIONS ON SHORT-TERM INTEREST RATE FUTURES*

Anatoli Kuprianov

Options are contracts that give their owners the right, but not the obligation, to buy or sell a specified item at a set price on or before a specified date. An active over-the-counter market in stock options has existed in the United States for about a century. Options began to be traded on organized exchanges in 1973 when the Chicago Board Options Exchange (CBOE) was organized and began listing standardized stock options. Soon after the start of trading on the CBOE, the American, Pacific, and Philadephia stock exchanges also began listing standardized stock options. As interest in options trading among institutional investors and other financial market participants became evident the number of exchange-traded options grew rapidly. Today several different types of standardized options trade on virtually all major futures and stock exchanges, including stock options, other financial options such as foreign currency options, commodity options, and futures options.

Futures options are options on futures contracts. Currently traded money market futures options include options on three-month Treasury bill and three-month Eurodollar time deposit futures. The most active trading in both Treasury bill and Eurodollar time deposit futures options takes place at the International Monetary Market (IMM) division of the Chicago Mercantile Exchange (CME), although Eurodollar futures options also trade on the London International Financial Futures Exchange (LIFFE). Options on actual three-month Treasury bills are listed for trading by the American Stock Exchange (ASE), but this market is not active.

TERMINOLOGY AND DEFINITIONS

A **call option** gives the buyer the right, but not the obligation, to buy a specified item at a stipulated price called the exercise or **strike** price. The **underlying** instrument, or item specified by the option contract, can be a security such as a common stock or a Treasury bond, a specified amount of a commodity, or a futures contract. Call options are bought and sold for a market-determined price termed the **premium** or call price. In exchange for the premium, the seller (or **writer)** of a call option obligates himself to sell the underlying instrument at the strike price at the option of the buyer. When the buyer (or holder) of the option chooses to purchase the underlying instrument he is said to exer-**cise** the option.

A call option is said to be **in-the-money** when the market price of the underlying instrument is above the strike price and out-of-the-money when the market price of the underlying instrument falls below the strike price. When a call option is in-the-money the buyer has the right to purchase the underlying instrument at a price below the market price. The holder of an in-the-money **American** option can exercise it at any time before expiration date. In contrast, a **European** option can only be exercised on the expiration date.

Before the expiration date, out-of-the-money options will typically sell at a positive premium because of the possibility that the price of the underlying instrument will rise before expiration. At expiration the buyer will exercise the option if it is in-the-money or let it expire unexercised if it is out-of-the-money. An out-of-the-money call option has no value at expiration, since buyers will not purchase the underlying instrument at a price above the current market price. The value of an in-the-money call option at expiration is the current market price of the underlying instrument minus the strike price.

The buyer (holder) of a **put option** receives the right to sell a specified security at the strike or exercise price stipulated by the contract. In exchange for a cash premium **(put** price), the seller (writer) of a put option becomes contractually obliged to buy the underlying security at the strike price at the option of the holder. A put option is in-the-money when the market price of the underlying instrument is below the strike price and out-

of-the-money when the market price is above the strike price.

Exchange-traded or **standardized** options, like futures contracts, are standardized contracts traded on organized exchanges. An option contract is completely specified by the description of the underlying instrument, strike price, and the expiration date. An exchange-traded option always specifies a uniform underlying instrument, one of a limited number of strike prices, and one of a limited number of expiration dates. Strike price intervals and expiration dates for traded contracts are determined by the exchange. Contract performance for exchange-traded options, as with futures contracts, is guaranteed by a clearing corporation that interposes itself as a third party to each option contract. The clearing corporation becomes the seller to each buyer and the buyer to each seller, thereby removing the risk that the seller of an option might fail to meet contract obligations.

Contract standardization together with the clearing corporation guarantee facilitates options trading. A holder or seller of an exchange-traded option can always liquidate an open position in an option before expiration by making an offsetting transaction. For example, a holder of a Treasury bill futures call option can offset his position by selling a T-bill futures call with the same strike price and expiration date; the net profit or loss from such a transaction is determined by the difference between the premium originally paid for the call and the price received when it is sold. Similarly, the holder of a put option can liquidate his position by selling a put with the same strike price and expiration date. As with futures contracts, most positions in standardized options are liquidated before the expiration date with an offsetting transaction rather than being held for the purpose of selling or buying the underlying instrument.

Unlike futures contracts, buyers of put and call options are not required to deposit funds in a margin account because their risk of loss is limited to the premium paid for the option. Sellers of put and call options are required to maintain margin accounts, however, since they face a considerable risk of loss, as will become evident when the payoffs to different option positions are examined below.

Finally, **over-the-counter** (OTC) options are custom-tailored agreements for which option specifications (the underlying instrument, amount, strike price, exercise rights, and expiration date) are all negotiated by the two parties to the contract. OTC options are usually sold directly rather than through an exchange. Major commercial and investment banks often write custom-tailored interest rate options for their commercial customers. A bank, for example, might write a cap, or series of interest rate put options, for a commercial customer to fix a maximum interest rate on a floating-rate loan tied to short-term interest rates.

OPTIONS ON SHORT-TERM INTEREST RATE FUTURES

Put and call options on Treasury bill and Eurodollar futures are actively traded at the IMM in trading areas, or **trading pits** as they are called, located next to the trading pits for the underlying futures contracts.[1] Exercising a futures option results in either a long or short futures position. When a holder exercises a futures call option he buys the underlying futures contract at the strike price, or takes on a **long futures position.** To completely liquidate his resulting futures position, the buyer must undertake an offsetting futures transaction. The writer of a call option must in turn sell, or take on a **short futures position,** in the underlying futures contract when it is exercised. When a futures put option is exercised the holder takes on a short futures position and the writer a long position.

The primary advantage of futures options over options for actual securities stems from the liquidity of futures contracts. Because futures markets tend to be more liquid than underlying cash markets, offsetting a position resulting from the exercise of an option is usually easier with futures options than with options on actual securities. This can be especially important to put and call writers, who usually enter into options agreements to earn fee income rather than with the ultimate goal of buying or selling the underlying instrument.

IMM money market futures options are American options. ASE Treasury bill options, in contrast, are European-type options for actual Treasury bills. LIFFE Eurodollar futures options are American options specifying LIFFE Eurodollar time deposit futures contracts as the underlying instrument.

At present trading activity in IMM Treasury bill futures options is relatively light but greatly surpasses trading in ASE bill options, which is almost nonexistent. IMM Eurodollar futures options are very actively traded while volume in LIFFE Eurodollar futures options, although significant, is considerably smaller. Contract specifications for IMM money market futures, options are described in the enclosed box on the following page.

PAYOFF DIAGRAMS

The difference between options and the underlying futures contracts becomes evident once the payoff

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[1] Kuprianov [1986] contains a detailed description of IMM short-term interest rate futures contracts.

diagrams for each contract are compared. The payoff diagrams depicted in Figures 1 through 3 show how profits and losses from different futures and options positions held to expiration vary as underlying futures prices change.

Futures Contracts

Figure 1 displays payoff diagrams for unhedged long and short futures positions. The horizontal axis in these diagrams measures the price, **F,** of the futures contract while the vertical axis measures any profits or losses stemming from changes in futures prices. To simplify the analysis, transaction costs, such as brokerage fees,

are ignored in drawing these diagrams. The buyer of a futures contract earns or loses one dollar for each dollar the price of the contract rises or falls. Thus, the payoff can be depicted by a 45 degree line showing a zero profit at the original purchase price, denoted by the point F_0 in Figure 1a. A trader with an unhedged short position is in the opposite position, profiting when futures prices fall and losing money when prices rise.

Futures Call Options

Figure 2a shows the payoff diagram for an unhedged, or *naked,* bought call option held to expiration. In return for the payment of the call premium, C, the
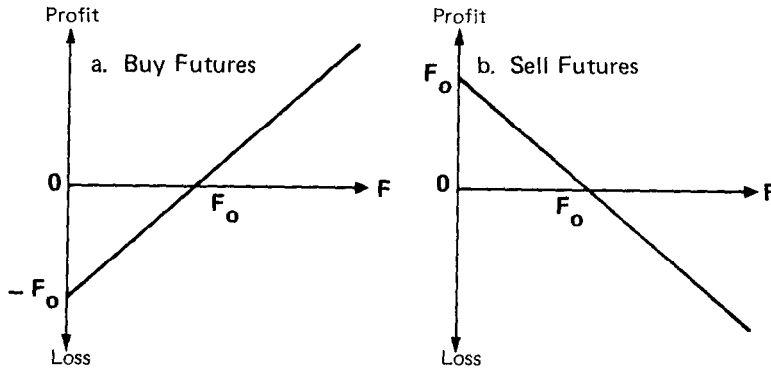
Figure 1
PAYOFFS FOR UNHEDGED FUTURES CONTRACTS

a. Buy Futures

b. Sell Futures

Figure 2
PAYOFFS FOR UNHEDGED CALL OPTIONS

a. Buy Call

b. Sell Call
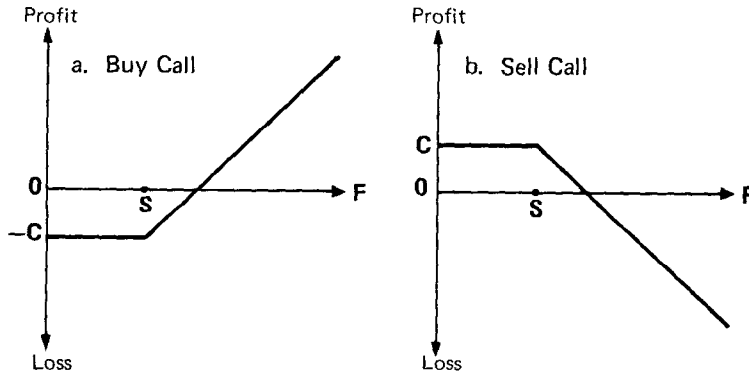
Figure 3
PAYOFFS FOR UNHEDGED PUT OPTIONS

a. Buy Put

b. Sell Put
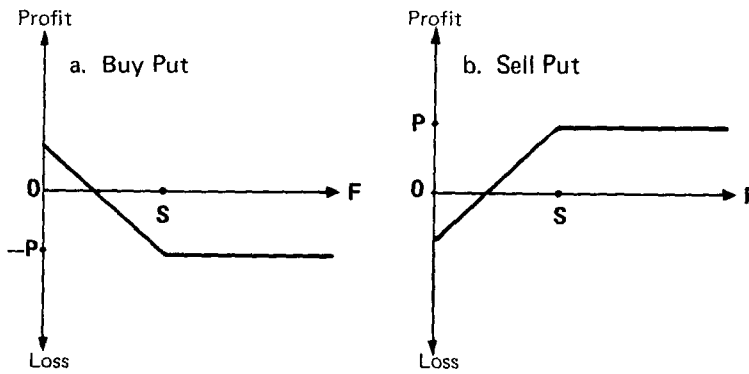
buyer receives the right to buy the underlying futures contract at the strike price S. At expiration an out-of-the-money option has no value. A buyer holding an out-of-the-money call option will allow the option to expire unexercised, earning a total net profit of -C; that is, he loses the call premium paid at the time the option was purchased. When the price of the underlying futures contract is above the strike price the buyer can exercise the option, buy the underlying futures contract at the strike price, and liquidate his futures position at a profit. The buyer's net profit in this second case is the difference between the market price of the futures contract,, **F,** and the strike price, S, less the premium paid for the call, C.

To take an example, suppose that a buyer pays a premium of $800 for a December 1986 Treasury bill futures call option with a strike price of 94.50 (IMM index price).[2] This option is in-the-money when December Treasury bill futures prices rise above 94.50. If the price of a Treasury bill futures contract is 95.00, the buyer can exercise the option and immediately liquidate his futures position at a $1,250 (50 basis points x $25) profit. His net profit is $450 ($1,250-$800).

Figure 2b shows the payoff at expiration earned by the seller of a call option. His profit will be the full amount of the call premium C if the option is not exercised, that is, if the price of the underlying futures contract on the expiration date is below the strike price. If the price of the underlying futures contract is above the strike price, however, the option will be exercised and the writer will be required to sell the underlying futures contract at the strike price S. Liquidating the resulting futures position requires buying the contract back at the higher market price **F.** Thus, the writer's net profit if the option is exercised is the call premium C minus the difference **(F-S).** The net profit is negative if the premium C is less than the loss **(F-S)** incurred from selling the underlying futures contract at the strike price.

Futures Put Options

Figure 3a shows the payoff diagram for a bought put option held to expiration. The buyer pays a put premium **P** in exchange for the right to sell the underlying futures contract at the strike price S. He will allow the option to expire unexercised if the price of the underlying futures contract is above the strike price. In this case, he loses the put premium. When the underlying futures price is below the strike price the put holder can exercise the option, sell the underlying futures con-

tract, and liquidate the resulting futures position at a profit. The put holder's net profit in this second case is the amount by which the strike price S exceeds the market price **F** of the underlying futures contract, minus the put premium.

As an example, suppose that a buyer pays a premium of $525 for a put option on December Treasury bill futures with a strike price of 95.00. If the price of the underlying futures contract is 94.90 the put holder can earn $250 (10 basis points x $25) by exercising the option, selling Treasury bill futures at 95.00, and then liquidating his position through an offsetting purchase at 94.90. His net profit (loss in this case) is $250-$525 = -$275.

Finally, Figure 3b shows the payoff at expiration earned by the seller of a put option. If the option is out-of-the-money (that is, if the market price of the underlying futures contract is above the strike price) at expiration, the seller earns a profit equal to the full put premium, **P.** Otherwise, the option will be exercised and the writer will be forced to buy the underlying futures contract at a price above the market price. Liquidating the resulting futures position results in a loss, which may more than offset the premium earned from writing the option.

As the payoff diagrams in Figures 2 and 3 make clear, buying a put does not offset a long call position. Instead, the holder of a call option can liquidate his position only by selling a call with the same expiration date and strike price. Similarly, the holder of a put can liquidate his position by selling a put with the same contract specification.

HEDGING WITH INTEREST RATE FUTURES OPTIONS

An option hedge combines an option with a cash position in the underlying instrument in such a way that either the underlying instrument protects the option against loss or the option protects the underlying instrument against loss. Buying a put option, for example, protects against a large loss resulting from a long position in the underlying instrument. Options on futures can be used to hedge cash market positions because futures prices tend to be highly correlated with prices of the deliverable securities. Some futures options, such as the IMM Eurodollar futures option, expire on the same day the underlying futures contract matures. Exercising a futures option on the maturity date of the underlying contract amounts to exercising an option on the actual cash instrument.

The Difference Between a Futures and an Options Hedge

The basic difference between hedging with options and hedging with futures is that options enable hedgers

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[2] The *IMM* index mice for Treasury bill futures is 100 minus the futures discount yield to be paid on the deliverable bill. Each one basis point change in the index price corresponds to a $25 change in the price of the deliverable bill.

to limit losses from adverse price movements while leaving open the opportunity to profit from favorable price changes. A futures hedge, in contrast, just fixes the price at which a planned future transaction takes place-the hedger is protected from the risk of loss if the value of his cash market holdings falls, but loses the opportunity to profit if those holdings appreciate.

Thus, options can be thought of as providing a form of price insurance. Like any other form of insurance, however, buyers are required to pay a premium for protection against loss, which means that although they have the opportunity to profit if the value of their underlying cash position rises the returns to a position hedged with options will be smaller on average than the returns to an unhedged position.

Over-the-counter put and call options on short-term interest rates are sometimes called *caps* and floors, terms that derive from descriptions of the basic hedging strategies each type of option can be used to structure. Buying an interest rate put option caps or establishes a maximum borrowing rate on a floating-rate loan tied to short-term interest rates. Buying a call option sets a floor or minimum yield on a future investment.

Interest rate caps and floors can also be created using options on interest rate futures, as is illustrated by the following two examples.

Creating Interest Rate Floors

A futures call option establishes a maximum purchase price for the underlying instrument. Since the price of an interest-bearing security varies inversely with market interest rates, establishing a maximum purchase price on an interest-bearing security amounts to fixing a minimum yield on the anticipated investment. The following example illustrates the mechanics of an options hedge undertaken to fix an investment floor.

On August 15 a corporate treasurer learns that his firm will receive a cash inflow of $1 million in three months. Such funds are typically invested in three-month Treasury bills. The treasurer can fix a minimum yield on the anticipated investment either by buying a Treasury bill futures contract or by buying a Treasury bill futures call option. Call options on December Treasury bill futures expire on November 14, which turns out to coincide exactly with the date the hedger in this example anticipates receiving the cash inflow.

IMM Treasury bill futures can be bought at a price of 94.71 on August 15, implying a futures discount yield of 5.29 percent. Treasury bill futures call options with a strike price of 94.75 (implying a discount yield of 5.25 percent) sell for a premium of 21 basis points, or $525. The results of a futures and an options hedge are compared below under two different assumptions about market rates of return prevailing on the date of the planned investment.

Results of the Futures Hedge First, consider the rate of return fixed by a futures hedge. If the corporate treasurer could buy a Treasury bill futures contract maturing on November 14, when he plans to invest in T-bills, the hedge would be perfect and the rate of return fixed by the futures hedging strategy would be known with certainty. However, the nearest maturity date for a Treasury bill futures contract falls in December. Uncertainty about the exact relationship between futures and spot Treasury bill prices on the date of the anticipated cash inflow introduces the risk, known as basis *risk,* that the yield produced by the hedge may differ from the expected yield.3 For the sake of simplicity this source of risk will be ignored in this example; specifically, it will be assumed that the futures discount yield always equals the actual yield on a thirteen-week Treasury bill on November 14. Under this assumption the futures hedge will always result in an effective discount yield of 5.29 percent on the planned investment. Although this convenient relationship could not be expected to hold in reality, the error this assumption introduces is unimportant for purposes of this simple example.

Calculating the Investment Floor Suppose that interest rates fall after August 15 and the discount yield on Treasury bill futures contracts declines from 5.29 percent to 5.00 percent on the November 14 expiration date. Since the resulting price of the underlying futures contract, 95.00, is above the strike price of 94.75, the option can be exercised and the resulting futures position liquidated at a profit of 25 basis points, or $625. This profit is partially offset by the 21 basis point call premium, reducing the net profit to 4 basis points. Again assuming no basis risk so that the discount yield on thirteen-week Treasury bills is 5.00 percent, the effective hedged discount yield in this case is 5.04 percent. This outcome produces a discount yield 4 basis points higher than the unhedged yield, but 25 basis points lower than the 5.29 percent yield that could have been fixed by the futures hedge.

Notice that in this example 5.04 percent is the minimum discount yield the hedger would face, no matter how low interest rates turn out to be on the expiration date. This is because-in the absence of basis risk-any additional decline in the Treasury bill discount yield below 5.00 percent would be exactly

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[3] See Kuprianov [1986] for a more detailed discussion of futures hedging and basis risk.

offset by additional profit from the hedge. In actual practice basis risk would make the calculation of an absolute floor impossible, although an expected floor could be estimated.

Results of the* Options *Hedge When Interest Rates Rise Now consider the rate of return produced by the option hedging strategy if interest rates rise before the planned investment date. Suppose that on November 14 the price of an IMM Treasury bill futures contract falls to 94.45, implying a discount yield of 5.55 percent. In this case the price of the underlying futures contract is below the strike price of 94.75, so the option will be permitted to expire unexercised. Assuming once more that the spot price equals the futures price, the discount yield for a thirteen-week Treasury bill bought in the spot market is 5.55 percent. For the hedger, the net effective yield is 5.34 percent (5.55 percent minus the 21 basis point call premium), which is 5 basis points higher than the yield that would have been earned using a futures hedge.

This second case illustrates the potential advantage an options hedging strategy has over a futures hedge. While the interest rate floor established by the options hedge is lower than the rate fixed by the futures hedge, the options hedge permits the hedger to earn a higher yield if interest rates rise by enough to offset the cost of the call premium.

Interest Rate Caps

Buying a put option on an interest rate futures contract sets a minimum price the cash security can be sold for at a future date. Fixing a minimum price on an interest-bearing security is equivalent to fixing a maximum interest rate, however, so that an interest rate futures put option can be used to fix a maximum borrowing rate, or cap. If interest rates fall before the loan is taken out, the hedger loses part or all of the put premium, but can borrow at the lower market rate.

To take a specific example, suppose that on October 15 a large corporation makes plans to take out a three-month, $1 million loan in two months. The firm's bank typically charges 100 basis points over the three-month LIBOR for such loans. The firm can protect itself against the risk of a rise in interest rates before the loan is taken out either by selling Eurodollar futures or by buying a Eurodollar futures put option.

For purposes of this example assume that options on Eurodollar futures expire on December 15, the exact date the planned loan is to be taken out. As of October 15, December Eurodollar time deposit futures trade at a price of 93.99 on the IMM, implying a futures LIBOR of 6.01 percent. A put option on December Eurodollar futures with a strike price of 93.75 sells for a premium of 6 basis points. The results of a futures hedge and a hedge structured using the put option are compared below.

Result of a Futures Hedge IMM Eurodollar futures mature on the same day options on those contracts expire. Thus, the firm in this example can put together a perfect futures hedge. Such a hedge would lock-in a borrowing rate of 7.01 percent (6.01 percent fixed by the sale of the futures contract plus the 100 basis point markup charged by the lending bank).

Calculating the Interest Rate Cap Now consider the result of the option hedge when interest rates rise before the loan is taken out. Suppose that the three-month LIBOR is 6.30 on the expiration date, so that the final settlement price for Eurodollar futures is 93.70. The underlying futures contract price is 5 basis points below the 93.75 strike price, so the option can be exercised and the underlying position settled in cash to earn a $125 profit. Since IMM Eurodollar futures options expire on the same day the underlying futures contract matures and that contract is cash settled, this profit is paid directly to the hedger. The profit from exercising the option is more than offset by the 6 basis point put premium, however. The net loss from the hedge is thus 1 basis point. The resulting effective borrowing rate is 7.31 percent (6.30 market LIBOR, plus the 1 basis point net hedging cost, plus the 100 basis point markup), 30 basis points higher than the effective borrowing rate that could have been fixed with a futures hedge and 1 basis point higher than the unhedged borrowing rate.

The interest rate cap of 7.31 percent is attained whenever the underlying contract settlement price hits the strike price. Notice that no matter how high interest rates were to rise, effective borrowing costs would never go above this level because any further increase in market rates would be exactly offset by the additional profits gained from exercising the put option.

Result of the Options Hedge When Interest Rates Full Finally, consider the effective borrowing cost resulting from the option hedge if the three-month LIBOR were to fall to 6.00 percent on the expiration date. If LIBOR is 6.00 percent the settlement price for December Eurodollar futures will be 94.00, which means that a put option with a strike price of 93.75 is out-of-the-money. The interest rate paid on the loan in this case is 7.00 percent, but the net effective cost is 7.06 percent because of the loss of the put premium.

Notice that in both of the cases considered above the

SELECTED EURODOLLAR FUTURES CALL OPTION PREMIUMS

Expiration Month	Strike Price	Premium	Futures Price	Intrinsic Value	Time Value
December	93.50	0.53	94.02	0.52	0.01
March	93.50	0.62	94.02	0.52	0.10
June	93.50	0.60	93.85	0.35	0.25

borrowing rate produced by the options hedge was higher than either the unhedged borrowing rate or the rate that could have been fixed with a futures hedge. This points to an important characteristic of options hedges. The premium paid on an option protects the hedger from heavy losses due to large price fluctuations while permitting gains in the form of lower borrowing costs or higher investment rates in cases where favorable price movements occur. When only small price movements occur, however, any benefit from holding the option may be more than offset by the cost of the option premium. Thus, unless large price movements are realized, an options hedge can easily prove to be more costly than a futures hedge.

Although options on interest rate futures have only been actively traded for a short time, a large number of interest rate option hedging strategies have been developed. At present, the heaviest commercial users of money market futures options are commercial and investment banks that write caps and floors for their customers and then hedge their resulting net over-the-counter positions with standardized interest rate futures options. [4]

PRICE RELATIONSHIPS BETWEEN FUTURES OPTIONS AND FUTURES CONTRACTS

As noted earlier, an out-of-the-money option will typically have value before the expiration date because of the possibility that the option could go in-the-money before it expires. The difference between the strike price and the market price of the underlying instrument is called **the intrinsic value** of the option. An option's intrinsic value, is the gain that could be realized if it were exercised. Any excess of the option premium above its intrinsic value is called the **time value** of the contract. The time value of an option is greater the longer the time to expiration because an option with a longer life has a greater chance of going deeper in-the-money

before it expires. As the expiration date draws nearer time value declines; once the expiration date arrives, the time value of an option is zero and the only value the option has is its intrinsic value.

To illustrate, the table above presents call prices, underlying futures prices, and time values for IMM Eurodollar futures options with different expiration dates as of the end of trading on November 6, 1986. The first row in the table gives data for options on December Eurodollar futures. As of the end of trading on November 6, a Eurodollar call option on a December 1986 futures contract with a strike price of 93.50 sold for a premium of 53 basis points. The price of the underlying futures contract at the end of the same trading session was 94.02, so this option was in-the-money. The intrinsic value of the December option was 52 basis points; thus, the difference between the call premium and its intrinsic value is one basis point, or $25. As noted above, the time value of the options for successively distant expiration dates grows larger.

A comprehensive discussion of factors determining options prices is beyond the scope of this article. However, two concluding observations are in order. First, the deeper an option is in-the-money, the greater the proportion of the option premium is due to intrinsic value and therefore the more closely price movements in the underlying futures contracts are reflected by changes in the option premium. Thus, in-the-money options provide hedgers with greater risk reduction than out-of-the-money options. Second, all other things equal, the time value of an option is greater the more volatile are underlying futures prices. This is because more volatile underlying futures prices make it more likely an option will go deeper in-the-money before it expires.

Readers interested in a formal theoretical development of the pricing formula for options on futures contracts are referred to Black [1976]. Less technically oriented readers will find Koppenhaver's [1986] introductory exposition useful. Emanuel [1985] shows how to apply the Black formula to the pricing of Eurodollar futures options.

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[4] For a more detailed description of the development of interest rate options markets see Bank for International Settlements [1986, chapter 3].

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JAPANESE MONETARY POLICY,
A COMPARATIVE ANALYSIS

Michael Dotsey

I.
INTRODUCTION

This paper presents an analysis of Japanese monetary policy, and concentrates on the operating mechanisms used by the Bank of Japan in conducting policy. References are made to U.S. monetary policy in an attempt to highlight the major similarities and differences between the respective monetary policies. The major conclusion is that although there are some interesting differences, the two central banks' daily operating procedures are very similar. Both monetary authorities basically use the interbank market interest rate as their policy instrument. Therefore, any major differences in Japanese and U.S. macroeconomic performance that can be attributed to the behavior of the two monetary authorities are not due to dissimilar operating procedures. Profitable research attempting to discover reasons for differences in monetary policy should concentrate on understanding the political nature of the monetary institutions and the political constraints that are associated with each country's institutional framework. Such considerations, however, are far beyond the scope of this paper, which focuses chiefly on comparable operating procedures and macroeconomic performance.

The conclusion that both the United States and Japanese central banks use similar operating procedures casts doubt on the importance of many criticisms directed at the Federal Reserve. These criticisms often emphasize poorly constructed operating procedures as being responsible for perceived failures of U.S. monetary policy. For example, Friedman [1982] states that one of the five major points of monetarist policy is that "monetary authorities should avoid trying to manipulate either interest rates or exchange rates." The basic idea

that is often stressed in many criticisms of this type is that an interest rate instrument is inconsistent with the objectives of long-term monetary control and price stability. Further, the Japanese experience is often cited as the shining example among advanced economies of achieving monetarist objectives. Yet, as it is shown below, the Bank of Japan uses an interest rate instrument in achieving the objectives of its monetary policy. While there may exist differences in the relative efficiency of various operating procedures, these differences do not account for the variation in performance between the central banks of the United States and Japan. Concentrating on operating policies is probably counterproductive in trying to understand the relative performance of each monetary authority.

The structure of the paper is as follows. In Section II, the macroeconomic performances of the United States and Japan over the last decade are compared and contrasted. Japan is observed to have had lower, although not less variable, inflation and to have had higher and less variable real output growth. In Section III interest rates are examined. With the exception of the behavior of the long-term government bond rate, interest rate behavior in both countries appears quite similar. Section IV includes a detailed look at the Japanese interbank market and discusses some of the operations conducted by the Bank of Japan. The behavior of this market is quite similar to the behavior of the U.S. federal funds market. Section V discusses Japanese monetary policy in more depth, while Section VI presents a simple model that captures a number of essential characteristics of Japanese monetary policy: The model is similar in spirit to McCallum's [1981] investigation of interest rate pegs and McCallum and Hoehn's [1983] investigation of various U.S. operating procedures. Section VII contains a brief summary and conclusions.

II.
COMPARATIVE MACROECONOMIC PERFORMANCES OF THE UNITED STATES AND JAPAN (1975-I 985)

In this section a brief overview of the macroeconomic performance of the United States and Japan is present-

Chart 1
INFLATION RATE AND REAL GNP GROWTH
a. Japan
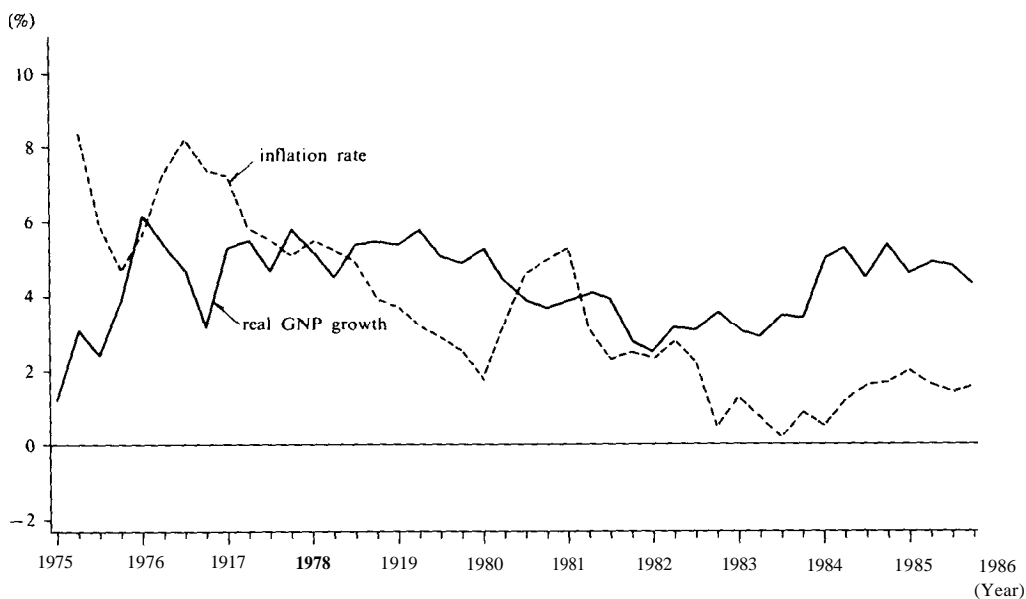
b. U.S.
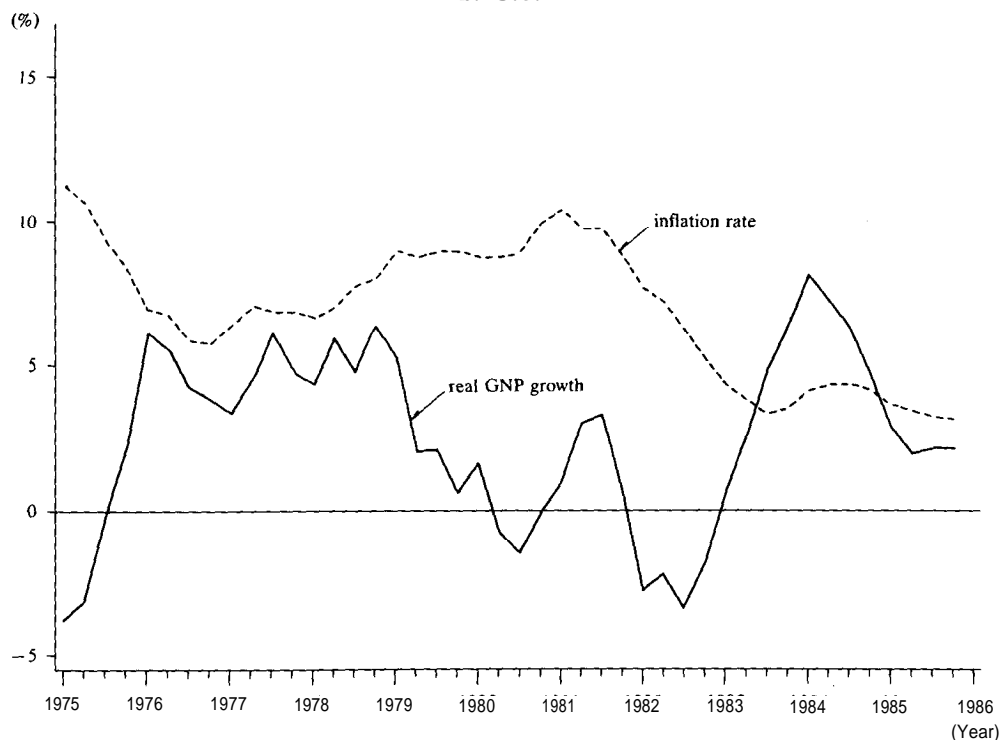
ed for the period 1975-1985. This sample is chosen to avoid the contaminating influence of the first oil price shock which had a differential impact on the two countries. Also, it was not until the mid-1970s, with the creation of large government bond issues, that the

Bank of Japan could initiate monetary policy in a manner comparable to policy in the United States. Prior to the 1970s, the money market in Japan was not nearly as active or diversified as in the United States.

Charts la, lb, and 2 and Table I depict the relevant

Chart 2

MONETARY GROWTH AND INFLATION
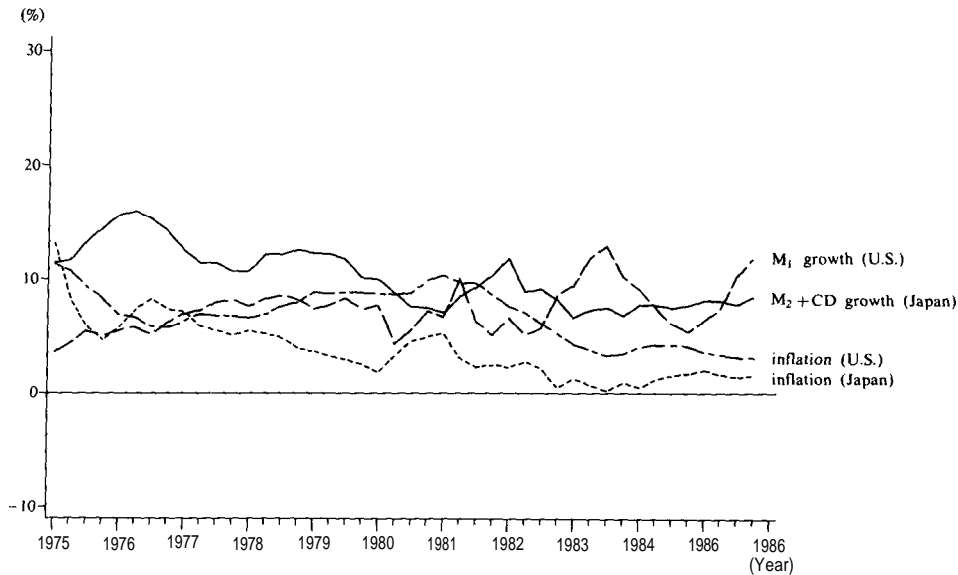
data. In comparing monetary aggregates, U.S. Ml is compared with Japanese M2 + CD, although Japanese Ml statistics are given in parenthesis in Table I. The different aggregates are used for two reasons. One reason is that these are the aggregates that each

central bank pays the closest attention to and generally uses as an intermediate target. The other reason is that in terms of controllability and the implications for a well-defined price level, Japanese M2 and U.S. Ml are quite similar (the CD component in Japan is under quantity restrictions and is relatively small). Specifically, most of the components of these two aggregates are subject to reserve requirements and binding interest rate ceilings. Unlike Japanese M2, U.S. M2 contains many components that have market determined interest rates and no reserve requirements, implying that U.S. M2 does not meet the requirements given in Patinkin [1961] and Fama [1983] for determining a well-defined aggregate price level.

The data shows that Japanese money growth has been less erratic than U.S. money growth. 'This is visible in the charts and is confirmed by the standard deviations of money growth in Japan and the United States of 1.19 and 2.39 over the second half of the sample, a period reflecting extremely low Japanese inflation rates of less than 2 percent on average. The standard deviation for the entire sample in **some** sense overstates Japanese monetary variability, since Japan was following a gradual reduction in its rate of money growth. Therefore, differences in money growth from its mean indicate variability some of which is merely a reflection of a gradual disinflationary policy.

This gradual slowdown in money growth is reflected by lower inflation rates in Japan than in the United States of 3.78 versus 6.86 for the entire sample and 1.78 versus 5.48 over the last five years. The reduction in inflation was accomplished without significantly af-

Table I

MACROECONOMIC DATA

Sample 1975:1 - 1985:4 (Quarterly Data)

	Japan	U.S.
Average real output growth (percent)	4.30	2.52
Standard deviation of real output growth	1.10	3.06
Average inflation (percent, using GNP deflator)	3.78	6.86
Standard deviation of inflation	2.63	2.31
Average monetary growth (percent)[1]	10.26 (6.79)	7.36
Standard deviation of money growth	2.54 (4.53)	2.08

Sample 1981:1 - 1985:4

	Japan	U.S.
Average real output growth (percent)	3.94	2.35
Standard deviation of real output growth	.87	3.21
Average inflation (percent)	1.78	5.48
Standard deviation of inflation	1.12	2.40
Average monetary growth (percent)	8.28 (4.30)	8.19
Standard deviation of money growth	1.19 (2.87)	2.39

1. Money growth for Japan is M2 + CD, while for the United States it is Ml. The Ml figure for Japan is included in parenthesis.

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fecting real output growth. In contrast the United States reduced its money growth from 6.9 percent in 1979-1980 to 2.4 percent in 1980-1981.[1] This resulted in a slowdown in inflation and a severe decline in output growth. Also, real activity is much less variable in Japan than in the United States as measured by standard deviations of 1.10 and 3.06, respectively. When comparing the relative performance of the two economies, it is clear why many regard Japan as an outstanding example of sensible monetary policy.

III.

A COMPARISON OF INTEREST RATE BEHAVIOR

The basic behavior of interest rates is depicted in Charts 3a and 3b and Table II. Regarding the short-term money market, overall interest rate behavior in both countries appears to be quite similar. Rates in the United States are somewhat higher and more variable reflecting higher levels of inflation and perhaps more variable monetary policy. The rates in both countries show a good deal of flexibility and are characterized by similar correlation coefficients.

The lower variability of Japanese money market rates may also be due to greater restrictions on movements in rates in the call market and bill discount markets prior to 1979.[2] Many of these restrictions prohibited interbank rates from changing on a daily basis, but still allowed for flexibility on a biweekly basis. The use of quarterly data may effectively mask these rigidities since the money market rates in Japan show even less variability over the 1981:1-1985:4 period when interbank rates fluctuated freely. Also, in the 1970s the Bank of Japan probably used its interest rate instrument more aggressively to bring down money growth and inflation than did the Federal Reserve.[3] This would tend to offset the effects of institutional rigidities on short-term Japanese interest rates when analyzing quarterly data.

Although the behavior of money market rates shows great similarity in the two countries, the behavior of long-term yields on government bonds is quite different. In the United States, long-term bond yields fluctuated a good deal more, as depicted by a standard deviation of 2.30 versus a standard deviation of .89 for Japan. Also, these yields are much more highly corre-

lated with other interest rates in the United States than in Japan. Again, one may conjecture that the high degree of regulation that existed in the Japanese bond market during the 1970s is responsible. Prior to 1975 there were relatively few long-term government bonds and during the late 1970s long-term bonds were marketed entirely to financial institutions who were "requested" not to resell them in the secondary market.

Gradually as the government tried to market more debt it was forced to liberalize subscription rates and resale arrangements if entire issues were to receive subscriptions. For instance, in April 1977, members of the government bond purchasing syndicate were permitted to resell bonds after holding them for one year and in 1978 the Bank of Japan repurchased bonds on an auction basis. In May 1980, government bonds could be resold after they were listed on the securities exchange, amounting to a holding period of seven to nine months, and in 1981 the holding period was shortened to 100 days. Furthermore, the initial subscription yield was gradually liberalized and the difference between this yield and the yield in the secondary market has become virtually nonexistent. Moreover, if one examines only the last five years of the sample the comparative statistics are quite similar. Long-term bonds have a standard deviation of .75 in Japan as compared to 1.51 in the United States and have a correlation coefficient with the three-month market rate of .47 as compared to .88 for the United States.

With the loosening of regulations in both domestic and foreign exchange markets and the large increase in government debt, the Japanese bond market has become the second most active bond market in the world. This growth is also reflected in the money markets giving Japan well diversified and deep markets for borrowing and lending. Although these markets are not as large or diversified as markets in the United States, the differences in the money and bond markets can not be responsible for difference in the performance of the Japanese and U.S. monetary authorities.[4]

IV.

THE JAPANESE INTERBANK MARKET

Overview

In order to understand Japanese monetary policy it is essential to examine the workings of the Japanese

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[1] These figures are for effective Ml growth and are taken from Broaddus and Goodfriend [1984].

[2] For more detail see Cargill [1985] and Fukui [1986].

[3] For a detailed discussion concerning the Federal Reserve's operating procedures in the 1970s see Hetzel [1981].

[4] The above discussion has concentrated on deregulation in the long-term government bonds market. However, many other liberalization measures have taken place in this same period, e.g., the liberalizations in the markets of CDs, BAs and the conversion of foreign currency into yen. The working of the interbank market is strongly affected by the working of these new markets, and it might be useful to examine this interaction. However, this point is not discussed explicitly here since several papers are already available on this issue. See Cargill [1985] and Fukui [1986], among others.

Chart 3

INTEREST RATES

a. Japan

(%)

call rate

10 year bond

gensaki(RP)

discount rate

1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986

(Year)

b. U.S.

(%)

10 year bonds

Federal funds rate
discount rate
3 month bill

1912 1973 1974 1975 1976 1911 1978 1979 1980 1981 1982 1983 1984 1985

(Year)
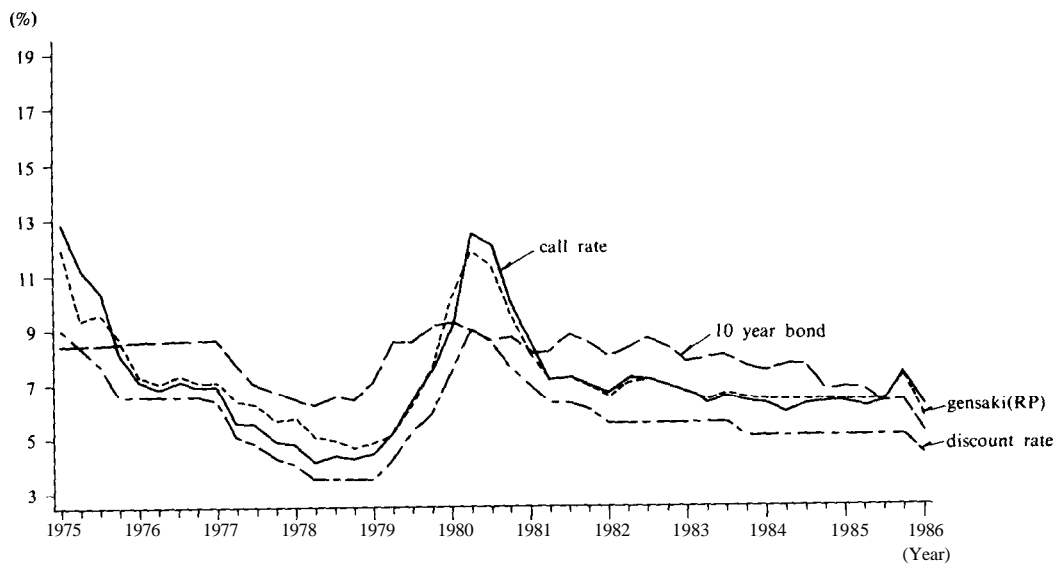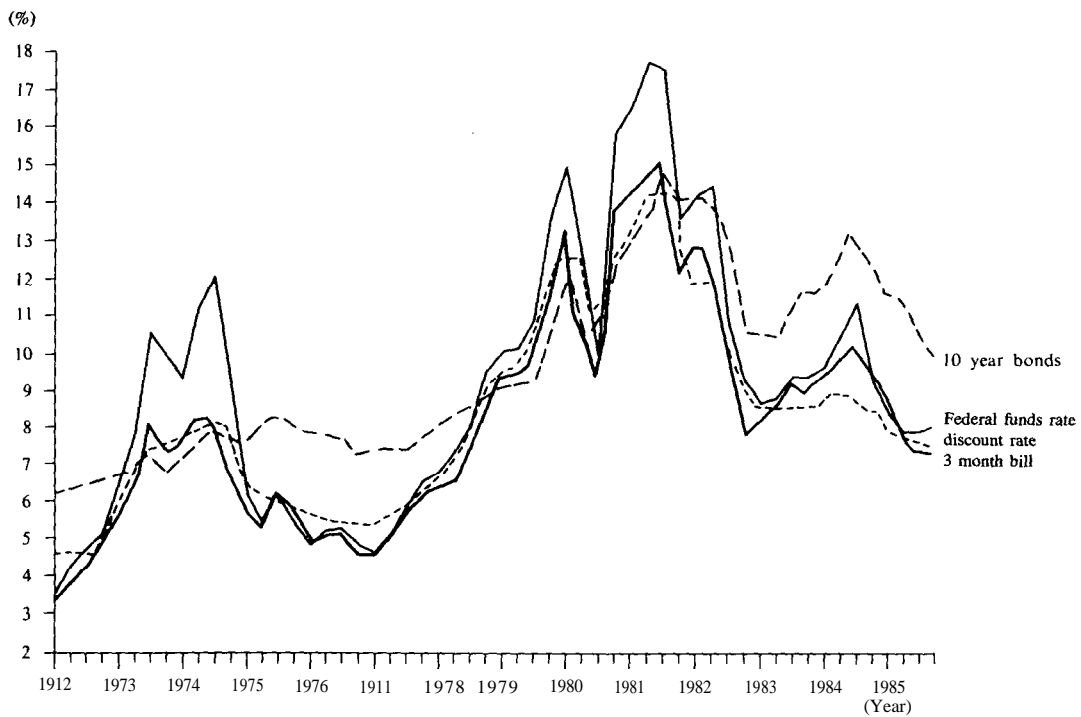
	Japan	U.S.
Average discount rate (percent) (d)	5.74	8.74
Standard deviation discount rate	1.40	2.61
Average interbank rate (percent)[1] (i)	7.07	9.54
Standard deviation interbank rate	2.09	3.67
Average 3-month rate (percent)[2] (r_3)	7.14	8.67
Standard deviation 3-month rate	1.73	2.96
Average lo-year bond rate (percent) (r_{10})	7.85	10.31
Standard deviation 10-year bond rate	.89	2.30

CORRELATION COEFFICIENTS

	Japan				United States		
	d	i	r_3		d	i	r_3
i	.96			i	.97		
r_3	.95	.98		r_3	.96	.99	
r_{10}	.73	.61	.61	r_{10}	.92	.94	.95

1. The interbank rate in Japan is the overnight call market rate while in the United States it is the overnight Federal funds rate.
2. The 3-month rate for Japan is the Gensaki or RP rate, while for the United States the 3-month Treasury bill rate is used. There is no comparable Treasury bill in Japan.

interbank market, since this is the market in which the Bank of Japan performs daily operations. Currently there are two markets in which Japanese banks exchange reserves. There is the call market, which is a short-term market analogous to the federal funds market, and there is a bill discount market where commercial bills are discounted. The maturity of loans in the call market varies from one-half day to three weeks, while the maturity of bills traded in the bills discount market varies from 30 to 180 days.[5]

Over the period from 1975 to present, there have been a number of changes liberalizing the movements of rates in these markets. Prior to 1978, both the call rate and bill discount rate were based on a quotation system in which the rate was determined by a consensus of major borrowers and lenders. During this period the call rate was changed only once or twice a month while the bill rate fluctuated less frequently. Also, participants in the bill market were prohibited from rediscounting bills. Starting in June 1978, however, quotations on the call rate were changed more frequently and permission was given to resell bills freely one month after their purchase. In October 1978 seven-day call money with a freely determined rate was introduced, while in November one-month bills were

introduced at an unregulated rate. Also, rates on three-month bills were liberalized. The process of liberalizing the interbank market was largely concluded in 1979. In April the quotation system in the call market was abolished and call money with terms between two and six days was introduced. In October rates on two-month bills were also liberalized. Thus from late 1979 until the present, rates in both the call and bill market could fluctuate on a daily basis and interdaily fluctuation, although infrequent, did occur.[6] However, rates do not fluctuate quite as freely as in the federal funds market. This may be due to the fact that interest rates are used as an operating target. Specifically, the Bank of Japan stands ready to supply or absorb funds at its target rates in order to achieve equilibrium in the short-term money markets.

The volume of trading in the call and bill markets has increased threefold over the last decade with monthly volume in June of 1985 reaching ￥13.4 trillion. The market is therefore quite active in allocating funds among banks.

Detailed Organization of the lnterbank Market

Call Market The major participants in the call market are the Bank of Japan, the six Tanshi Kaisha or dealers, city banks, long-term credit banks, regional banks, mutual loan and savings banks, trust banks, foreign bank branches, Norin Chukin Bank (the central cooperative of agriculture and forestry credit unions), and insurance companies. Also, beginning in November 1980, securities companies that are authorized to underwrite public and corporate debentures have gradually been allowed to take funds in this market.' City banks are the major takers (demanders of funds) in the call market while the major placers are Norin Chukin Bank, trust banks, regional banks, and life insurance companies. Regarding the Nor-in Chukin Bank, proceeds from the rice crop and other agricultural products flow into this institution making its supply of funds vary seasonally. The supply of funds originating with regional banks is also significant but fluctuates seasonally. These regional banks are particularly big suppliers when central government subsidies are paid to local governments.

With respect to the actual workings of the markets, the Tanshi Kaisha are the pivotal figures both with regard to the implementation of the Bank of Japan's

[5] The maximum term of call loans was extended from seven days to three weeks in August 1985 while the maximum term in bill discount market was extended from 120 days to 180 days in June 1985.

[6] Another movement toward liberalization occurred in November 1980 which allowed institutions to simultaneously borrow in one market and lend in the other.

[7] For a more detailed listing and description of institutions participating in this market see *Short-Term Fund Market in Japan* [1983].

monetary policy and the movement of funds among the various participants. This is because almost all call fund transactions must involve a Tanshi Kaisha as a counterparty. Also, the link between the Tanshi Kaisha and the Bank of Japan is much closer than the link between U.S. dealers and the Federal Reserve. The Tanshi Kaisha, in some instances, seem to operate as if they were under the direct supervision of the Bank of Japan.[8] At the beginning of each day, the Tanshi Kaisha quote the placers' rate (takers' rate is usually l/16 higher). Placers and takers then submit orders with the Tanshi Kaisha. Unlike the federal funds market, each repaid transaction, with the exception of half-day calls (i.e., call loans that are initiated and repaid on a particular morning or afternoon), requires collateral.[9] At the initially quoted rate demand and supply may not be equalized and the rate may change (an occasional occurrence), or the Bank of Japan may enter the market late in the day and supply or absorb funds as needed. There are primarily four means for absorbing funds in the call market. One is the sale of Treasury bills to the market at a rate that is based on the mean of the bill discount rate and the Gensaki rate (the Japanese equivalent of the rate charged on long-term repurchase agreements in the United States).[10] A second method is through the sale of bills drawn on the Bank of Japan (Bank of Japan bills), while a third method is the sale of commercial bill in the Bank of Japan's portfolio directly to city banks. A fourth method, which accounts for roughly 30 percent of the absolute volume of monthly reserve operations, is the use of the discount window to change the volume of outstanding loans to banks. In the case of absorbing funds the volume of loans would be decreased. Supplying extra funds to the call market is accomplished by reversing the transactions just described.

In employing the various methods of reserve operations the Bank of Japan tries to take into account the nature of the reserve deficiency or excess. If it appears that conditions in the reserve market will persist, the Bank of Japan conducts operations with long-term government bonds. Seasonal, or short-term reserve fluctuations, are primarily met through the use of

commercial bills when there is a need to add reserves and by selling Treasury bills or Bank of Japan bills when there is a desire for draining reserves. Discount window lending is the major avenue for supplying or absorbing reserves in response to daily fluctuations. Thus, the type of transaction conducted by the Bank of Japan in response to reserve market conditions may serve as a valuable source of information to participants in the interbank market. For example, an excess demand for reserves that is met by a purchase of long-term bonds could indicate that the prevailing level of interest rates is consistent with the long-run policy objectives of the Bank of Japan. The use of different operations as a potential signal and the effects that signaling has on the equilibrium conditions in the interbank market is explored in more detail in Section VI.

The types of call loans are quite varied and provide a great deal of funding flexibility. Transactions are generally in multiples of y-100 million and range in term from one-half day to three weeks. There are also unconditional calls that are automatically renewed if no notice is given prior to 1:00 p.m. (11:30 a.m. on Saturday). The rate applicable to the renewed call is the rate prevailing at the time of reserve settlement. Half-day calls are of two types, morning and afternoon. A morning call fund begins at 9:00 a.m. and lasts until the first daily clearing settlement at 1:00 p.m. (11:30 a.m. on Saturday). An afternoon call fund begins at the end of the first settlement and ends at final settlement (3:00 p.m. on weekdays and 1200 noon on Saturday). These calls are used when a bank expects large withdrawals or deposits that will be reversed later in the day and are a direct result of twice a day settlement of reserve balances.

Bill Discount Market The bill discount market is also an active market for transferring interbank funds over a longer time interval and is analogous to the term market in federal funds, although the bill discount market may be somewhat deeper. Currently there are four terms of bills that are transacted with the transaction size in multiples of 100 million. The shortest term is 30 days while the longest term is 180 days with terms of maturity varying anywhere between 30 and 180 days. Bills may also be rediscounted after they have been held for one month, and there is no minimum holding time for future rediscounts. Also, when rediscounting, the Tanshi Kaisha involved in the original discount is usually given priority in buying the bill back.

Bills that may be used in this market are original bills which consist of commercial bills, prime industrial bills, trade bills, prime single-name papers, and yen denominated export/import usance bills. Cover bills, which are bills that financial institutions draw on themselves and that are secured by original bills, are also used and currently constitute almost all of the transactions.

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[8] The exact nature of the relationship between the Tanshi Kaisha and the Bank of Japan is not clearly defined, but there is certainly a much more detailed flow of information and consultation between these parties than exists between the corresponding institutions in the United States.

[9] Starting in July 1985 noncollateralized call loans of all maturities have been allowed. They still represent a small portion of overall call market volume.

[10] Treasury bills are sold by the government at yields well below market. Consequently the Bank of Japan purchases all Treasury bills.

Bill discount rates are quoted each day by each Tanshi Kaisha. As with call money rates, these rates may not clear the market. The rate may change during the day, but the usual practice is for the Bank of Japan to enter the market and supply or absorb the necessary funds. The Bank of Japan participates in the bill market by drawing bills for sale on the Bank of Japan, buying and selling original or cover bills through Tanshi Kaisha, or directly dealing with financial institutions. The initial use of Bank of Japan bills was to provide collateral to Tanshi Kaisha in the call market, but with the growth of the bill market the Tanshi Kaisha may also be authorized to rediscount these bills. Regarding the use of cover bills, the Bank of Japan informs the Tanshi Kaisha of its intentions and the Tanshi Kaisha acting as brokers find institutions willing to participate in the transaction.

From the above description it is evident that the call and bill discount markets constitute active, deep, and well-diversified markets that allow financial institutions to allocate funds among themselves. It is also clear that this market gives the Bank of Japan flexibility in terms of using open market operations for the purpose of administering monetary policy.

V.
MONETARY POLICY

Overview

Over the last decade the Bank of Japan has successfully implemented a monetary policy that has been less inflationary than the policies of most developed nations. It has accomplished this with daily operating procedures that are not based on procedures that many monetarists advocate. For example, the Bank of Japan uses the interbank market rates as its operating target rather than total reserves. Further the reserve accounting regime is not contemporaneous, but is a mixture of contemporaneous and lagged reserve accounting. Specifically, the deposit base used to calculate required reserves for a given month is based on deposits for that month. Average reserve balances used to meet this requirement are held from the 16th day of that month to the 15th day of the next month. Also, the Bank of Japan does not place a great deal of weight on short-term movements in money but seems to be quite concerned with producing a low inflationary environment for the economy. While the long-run policy of the Bank of Japan appears to take seriously some monetarist proposals, its method of operation does not seem to be that prescribed by mainstream monetarists.

In comparison the Federal Reserve also uses interbank market rate (i.e., the federal funds rate), either directly on indirectly through a borrowed reserve targeting scheme, as its operating instrument.[11] The Federal Reserve does, however, basically use a system of contemporaneous reserve accounting which is generally recommended by monetarists. Also, the Fed, like the Bank of Japan, does not target total reserves nor does it seem to be overly concerned with short-term movements in monetary aggregates. Over the long run, as evidenced by the data in Section II, the Federal Reserve seems less committed to price stability than the Bank of Japan.

The description of the Bank of Japan's operations in the interbank markets is certainly consistent with the use of an interest rate instrument. Call rates do not frequently fluctuate on an intraday basis.[12] The Tanshi Kaisha, with close informational contact with the Bank of Japan, set the rates at the opening of the markets and the Bank of Japan stands willing to supply or absorb the necessary funds.

Discount Window Lending

While direct open market operations in the call and bill discount markets form an integral part of monetary policy, the Bank of Japan has another extremely important and flexible means of influencing conditions in the interbank markets. This instrument is the discount window and it operates in a very different manner from the discount window in the United States.

In Japan, the discount window is an extremely important avenue for supplying funds to banks. As shown in Chart 4, the level of discount window borrowing frequently exceeds the level of required reserves.[13] By comparison, in the United States the ratio of borrowed reserves to required reserves rarely exceeds 5 percent.

The administration of the discount window is also very different in the two countries. In the United States banks initiate the decision to borrow and the borrowing privilege is subject to a complex non-price rationing scheme.[14] In Japan, the Bank of Japan decides on the level of bank borrowing up to a predetermined quarterly ceiling, the term of the borrowing, and therefore the effective interest rate associated with borrowing. Also,

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[11] For a detailed introduction to monetary policy see Goodfriend [1982] or Goodfriend and Whelpley [1986].

[12] However, there is a trend of increasing intraday fluctuations. This is especially so since the mid-1980s.

[13] In Japan, some of the large fluctuations in discount window lending are due to the large fluctuations in currency holdings by the public. Currency is supplied elastically by lending the needed reserves to banks.

[14] For a detailed analytical model of the discount window and bank borrowing behavior in the United States see Goodfriend [1983].

Chart 4

DISCOUNT WINDOW BORROWINGS/REQUIRED RESERVES

(%)

3

1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986

(Year)
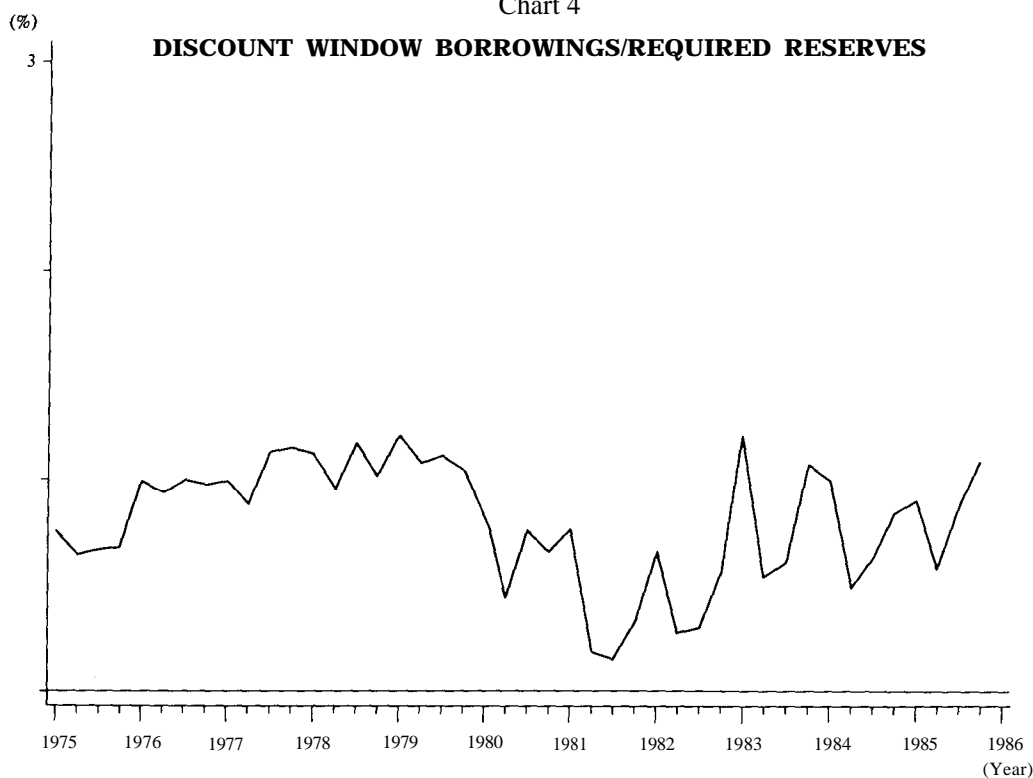
the interaction between city banks and the Bank of Japan through the discount window constitutes an important line of communication between banks and the monetary authority.

Borrowings from the Bank of Japan are usually at a subsidized rate, although the amount of the subsidy varies with the term of the loan. The variation in subsidy occurs, because accounting practices at the discount window require an extra day's interest payment on any loan. Thus a one-day loan requires two days' interest and is therefore usually associated with a penalty rate, while a nine-day loan requires ten days' worth of interest and thus is made at a subsidized rate. Therefore, as the length of the loan increases the effective interest rate approaches the official discount rate and the amount of subsidy increases. This procedure makes it undesirable for a bank to be caught with a severe shortage of reserves near the end of a reserve maintenance period, since any discount window loans (if the loans are forthcoming) would by definition be for a short period of time. Further, if a bank should fail to meet its reserve requirement, it must borrow at a one-day rate or pay a penalty of 3.75 percent above the official discount rate on the amount of the reserve deficiency. Given the accounting practices, this would amount to a severe penalty and banks, therefore, are rarely in this position.

The large volume of discount window borrowings means that the Bank of Japan is able to confer substantial subsidies to individual banks. This practice may also give the Bank of Japan some leverage in influencing bank behavior, a process referred to as "window guidance," although the extent and effectiveness of this activity is open to debate. [15]

In administering the discount window, the Bank of Japan basically has the ability to call up each city bank and tell it how much it will borrow on any given day. The length of the borrowing need not, and is not generally, specified. However, since borrowing usually amounts to a subsidy, city banks never refuse the amount offered. A refusal could end up reducing future subsidization as well. The basic elements involved in the use of the discount window seem somewhat arbitrary. However, the actual use of discount window borrowing in the conduct of monetary policy is performed in a more subtle manner.

A member of the banking division of the Bank of

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[15] There are two distinct usages of the term window guidance. One refers to directing the credit expansion of banks on a quarterly basis, while the other refers to shorter term behavior in the interbank market. It will be shown that the former interpretation is difficult to understand as a means of controlling credit in an equilibrium context (for a more detailed critique of the first definition see Horiuchi [1984].

Japan is given oversight responsibilities of each city bank. Officials at each bank communicate their expected funding needs over a reserve maintenance period and they also have close contact with the members of the Bank of Japan. The Bank of Japan usually gives them very general information concerning its outlook on money market conditions and on the method of fund supply (bills purchase, loans, etc.). This communication is not exact and is not a commitment by the Bank of Japan. If for some unexpected reason the reserve positions of banks are not behaving in a manner consistent with policy objectives, discount window lending is adjusted.

The Bank of Japan has the ability to use the term of loans to signal expected future money market conditions. In an effort to maximize profits, banks attempt to satisfy their reserve requirements by holding higher than average reserve balances when the call rate is relatively low just as they seek to economize on reserve balances when they believe that the call rate is relatively high. By suggesting the amount of lending that will be forthcoming and the future looseness or tightness that can be expected in the interbank market, the Bank of Japan can influence the expectations of future call rates. In doing so the pattern of reserve accumulation can be changed without movement in the current call rate.

This communication of information to the banking system may be an important component of window guidance. There are many different views of window guidance in Japan and there is debate over the extent to which it is used. One interpretation is that since the Bank of Japan is able to confer subsidies on city banks who are regular borrowers, it has power to influence bank behavior without resorting to market mechanisms. While there may be some truth to this claim, it is difficult to see in any equilibrium context why such a policy would be useful in obtaining the objectives of price stability or desired long-run money growth. In the case of money, equilibrium of the demand for and supply of money is achieved through movements in interest rates and prices. Since the targeted level of money must lie on the demand curve for money, market rates must adjust so that the demand for money is consistent with the target. Moral suasion with respect to banks can not alter this.

Another interpretation of window guidance is given by Yasuda [1981]. In his view, because loan supply is determined by both today's call rate and the future path of call rates, the movement of today's call rate will not have a large immediate effect on bank behavior. This lack of sensitivity by banks to current call market conditions implies that the Bank of Japan would have to initiate drastic movements in the call rate in order to generate a contemporaneous response. Rather than actually doing so, the Bank signals (or threatens) that it will do so if banks do not alter their behavior. The signal is a rise in the official discount rate. City banks, upon observing this signal, find it optimal to lower their supply of loans thus preventing the Bank of Japan from following through on its threat. Technically, this behavior is viewed as part of a cooperative game. The cooperative nature of the game results from direct communication between banks, although it would be possible for the Bank of Japan to transmit information.

The implicit assumption in this theory is that banks have fairly static expectations of future call rates. For instance, if banks (1) had the same information set as the Bank of Japan, (2) knew the policy objective, and (3) formed expectations rationally, they should be able to discern the effects of any deviations from policy objectives on the expected future path of the call rate. Thus, if a rise in the call rate is called for because money is growing too fast, banks' expectations of future call rates should rise as well and no dramatic swings in interest rates are needed to generate a contemporaneous response. There is therefore no need for moral suasion.

The position taken here is that what is normally called window guidance is largely a signaling process in which the Bank of Japan communicates some information that it alone possesses. This information may result from observations of aggregate reserve balances or aggregate money balances that would not be observed by individual banks. The seeming complexity of the relationship between the Bank of Japan and individual banks may indicate that more than just a signaling process is going on, but signaling is certainly an important part of the relationship.

VI.
A MODEL OF DISCOUNT WINDOW GUIDANCE[16]

General Set Up

In this section the effects of signaling through window guidance (and similarly through different types of reserve supply procedures) are investigated. Particular attention is given to the way in which signaling affects the behavior of the call market rate. It is shown that signaling can lower the variance of the call rate forecast error but that it also raises the variance of the call rate. Since the Bank of Japan may be interested in lowering both variances, signaling implies a tradeoff that could result in the use of a noisy signal.

The model used to investigate the effects of window

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[16] The material in this section is quite technical and the reader may wish to skip to the summary.

guidance is one in which the Bank of Japan pegs the interest rate. Detailed studies of an interest rate instrument are found in McCallum [1981, 1984], Dotsey and Ring [1983, 1986], and Canzoneri, Henderson, and Rogoff [1983]. In all these studies the interest rate is used as a policy instrument and the pegging scheme is related to a money supply rule.

For the purpose of this article, the exactness of detail found in these papers is not necessary. Rather the Bank of Japan's objective is postulated in terms of a price level target, while its instrument is the interbank rate. Casting the analysis in terms of money supply targets (or growth rates) would not alter the qualitative results of the model. Further, it is unclear whether the Bank of Japan uses long-term money growth as an intermediate target or merely as an information variable for achieving a desired price level or inflation rate. For example, the Bank of Japan does not announce any monetary targets, but merely gives a forecast of money growth that is consistent with its policies. Also, over the past four years when prices have been fairly stable, money growth rates have fluctuated more than prices, varying between annual growth rates of 7.1 and 9.6 percent while inflation has only varied between 0.8 and 1.65 percent. On the basis of the data it would be difficult to discriminate between which policy is actually in effect.

The basic model used for analyzing the signaling effects of window guidance is a somewhat standard rational expectations macro-model. However, in this model decisions in the interbank market are assumed to be made over a shorter time interval than decisions in the output market. Specifically, the interbank market period is assumed to be half that of the output market.

The log of output supply (y^s_t) is positively related to unanticipated movements in the log of the price level (p_t) and is depicted by:

$$(1)\ y^s_t = a^s_1(p_t - E^*_{t-1/2}p_t) + u_t$$

where $E^*_{t-1/2}$ is the conditional expectations operator based on the information set $I^*_{t-1/2}$. $I^*_{t-1/2}$ contains all prices, quantities, and disturbances dated $t - 1/2$ and earlier. The disturbance u_t is a random walk that reflects technological innovations and is equal to $u_{t-} i + v_t$ where v_t is a mean zero serially uncorrelated normally distributed random variable with variance of ϱ^2

The log of output demand (y^d_t) is negatively related to the expected real rate of interest, $i_t + p_t - E^*_{t-1/2}p_{t+1}$, where i_t is the one period nominal rate. This relationship is given by

$$(2)\ y^d_t = a_0 - a^d_1(i_t + p_t - E^*_{t-1/2}p_{t+1}) + w_t$$

where $w_t = \rho w_{t-1} + n_t$ and n_t is a mean zero serially

uncorrelated normally distributed random variable with variance ϱ^2_n It is also uncorrelated with v_t. Output demand disturbances have some persistence but gradually dampen over time.

The timing of the model works in the following manner. At each half period ($t - 1/2$, t, $t + 1/2$, etc.) the interbank market meets and the call rate ($r_{t-1/2}$, r_t, $r_{t+1/2}$) is determined. The one period nominal rate i_t is related to the call rate by the arbitrage condition $i_t = r_t + E_t r_{t+1/2}$ where the information set I_t contains the information in $I^*_{t-1,2}$ plus observation of r_t, i_t, and p_t. Output markets also meet at the beginning of each half period, but prices and output are determined for a period one unit in length. The model is, therefore, similar to Fischer's [1977] overlapping contracts model and is schematically, depicted in the figure below.

Fischer's Overlaping Contracts Model
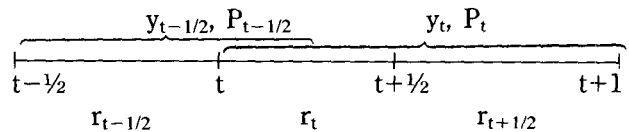
The policy of the Bank of Japan is to target the price level, p^*, and therefore produce stable prices. While this is a simplification of the actual policy process it is a convenient device for examining the role of signaling. The instrument used for implementing policy is the call market rate. In order to investigate the effect of signaling, the model will be solved with and without signaling. It is assumed that the Bank of Japan possesses full current information and that in the case of signaling it accurately communicates this information to market participants.

The Solution without Signaling

Given the assumptions concerning the information possessed by the Bank of Japan (i.e., it knows v_t and n_t) it can set the call rate r_t so that the price level will equal p^* exactly. This rate is given by:

$$(3)\ r_t = (1/a^d_1)[a_0 - a_1 p^* - a^d_1 E_t r_{t+1/2}$$
$$+ a^s_1 E^*_{t-1/2}p_t + a^d_1 E^*_{t-1/2}p_{t+1}$$
$$+ \rho w_{t-1/2} + n_t - u_{t-1/2} - v_t]$$

where $a_1 = a^d_1 + a^s_1$.

Because this procedure produces a price of p^* each period, expectations of the current and future price level will be p^*. Therefore, (3) can be rewritten as

$$(4)\ r_t = a_0/a^d_1 - E_t r_{t+1/2} + (1/a^d_1)(\rho w_{t-1/2} + n_t - u_{t-1/2} - v_t).$$

Using the method of undetermined coefficients yields

the reduced form expression for interest rates

$$(5)\ r_t = \frac{a_0}{2a_1^d} - \frac{1}{2a_1^d} u_{t-1/2} - \frac{2 - \theta(1 - \rho)}{2a_1^d(1 + \rho)} v_t$$

$$+ \frac{\rho}{a_1^d(1 + \rho)} w_{t-1/2} + \frac{2 - \theta(1 - \rho)}{2a_1^d(1 + \rho)} n_t$$

where $\theta = \dfrac{\sigma_v^2}{\sigma_v^2 + \sigma_n^2}$.

Analogously, if the Bank of Japan accurately reveals v_t and n_t to the market, then

$$(6)_t = \frac{a_0}{2a_1^d} - \frac{1}{2a_1^d} u_{t-1/2} - \frac{1}{2a_1^d} v_t$$

$$+ \frac{\rho}{a_1^d(1 + \rho)} w_{t-1/2} + \frac{1}{a_1^d(1 + \rho)} n_t.$$

Equations (5) and (6) can be updated and used to calculate the conditional forecast error of next period's call rate under conditions of signaling and no signaling (see Appendix). One observes that the accuracy of the forecast in terms of the conditional variance of the forecast error generally improves with signaling, implying that providing information is desirable from the standpoint of improving market forecasts. However, the ability of the Bank of Japan to control the price level is not affected by whether or not it provides additional information to the market.[17] Therefore, the effects of signaling are not a major determinant in determining the success or failure of monetary policy.

A more exact treatment of this process would endow the monetary authority with superior rather than complete information. One might reasonably believe that observing aggregate reserve behavior would only transmit a signal to the Bank of Japan that was a linear combination of real and money demand disturbances. This would imply that the price level would deviate from its targeted value as a result of expectational errors on the part of the Bank of Japan. This would make the agent's signal extraction problem more complex but would not alter the basic result that the communications involved in window guidance reduce the forecast error variance of future call rates.

In general the type of signaling that occurs through window guidance is not precise. This is in part due to

the fact that the Bank of Japan does not possess complete information. However, it may also in part be due to a desire to smooth movements in the call rate by reducing the variance of $r_{t+1/2} - r_t$. Analysis of U.S. monetary policy indicates that this is an objective of Federal Reserve behavior (see Goodfriend [1986a], [1986b], and Dotsey [1986]), and it also may be important to the Bank of Japan. If so, one can show that signaling increases the variance of $r_{t+1/2} - r_t$ and hence a desire to smooth interest rates would make signaling undesirable. The presence of a desire for both better forecasting and smoother interest rates would imply the use of a noisy signal.

VII.
SUMMARY

This article gives a description of operating procedures used by the Bank of Japan and concludes that it is not operating procedures that distinguish the different macroeconomic outcomes of monetary policy in Japan and the United States. In fact, Japan achieves results that are monetarist in nature without using the procedures frequently advocated by monetarists. This indicates that attempts to understand the general behavior of monetary authorities should be focused on areas other than operations.

In analyzing Japanese monetary policy, the article presents a description of the environment in which policy is implemented and finds that this environment is quite similar to that of the United States. One major difference, however, is the discount window and it is analyzed in detail. A model is derived based on the premise that an important aspect of window guidance is its use as a signaling device. This behavior is shown to affect the forecastibility and variance of call rate movements, two subjects that are likely to concern any monetary authority. The use of a noisy signal is consistent with a tradeoff between improving the forecast error variance of future call rates and smoothing the variability of interest rates. However, while window guidance is an interesting and important part of Japanese monetary policy it does not appear to account for the lower inflation experienced by the Japanese economy.

APPENDIX

To calculate the conditional variance of the forecast error of next periods call rate, $r_{t+1/2}$, first update equations (5) and (6) and subtract $E r_{t+1/2}$ where the information set depends on whether or not the Bank of Japan signals the value of v_t and n_t. Without signaling,

[17] This result would also apply to monetary targeting. It would also apply to situations where the Bank of Japan had imperfect knowledge of current shocks, but where the information set of market participants was a subset of the information possessed by the Bank of Japan.

$$(A1) \quad r_{t+1/2} - E_t r_{t+1/2} = -\frac{1}{2a_1^d}((1-\theta)v_t + \theta n_t)$$

$$+ \frac{\rho}{a_1^d(1+\rho)}(\theta n_t + (1-\theta)v_t)$$

$$- \frac{2-\theta(1-\rho)}{2a_1^d(1+\rho)}v_{t+1/2} + \frac{2-\theta(1-\rho)}{2a_1^d(1+\rho)}n_{t+1/2}.$$

Let the conditional variance of the forecast error without signaling be denoted by CV. With signaling,

$$(A2) \quad r_{t+1/2} - E_t r_{t+1/2} = -\frac{1}{2a_1^d}v_{t+1/2}$$

$$+ \frac{1}{a_1^d(1+\rho)}n_{t+1/2}.$$

Denote the conditional variance of the forecast error with signaling by CV*. Then using (Al) and (A2) it can be shown that $CV > CV^*$ if and only if $(1-\rho)\theta > 0$. For $\rho = 0$ or 1, $CV \approx CV^*$. Therefore, signaling is likely to improve the quality of market forecasts.

With respect to the variance of $r_{t+1/2} - r_t$, using (5) yields

$$(A3) \quad r_{t+1/2} - r_t = \frac{(1-\theta)(1+\rho)}{2a_1^d(1+\rho)}v_t$$

$$- \frac{2-\theta(1-\rho)}{2a_1^d(1+\rho)}v_{t+1/2} - \frac{\rho(1-\rho)}{a_1^d(1+\rho)}w_{t+1/2}$$

$$+ \frac{\theta(1-\rho)-2(1+\rho)}{2a_1^d(1+\rho)}n_t + \frac{2-\theta(1-\rho)}{2a_1^d(1+\rho)}n_{t+1/2}.$$

The signaling case employs (6) to give,

$$(A4) \quad r_{t+1/2} - r_t = -\frac{1}{2a_1^d}v_{t+1/2} - \frac{\rho(1-\rho)}{a_1^d(1+\rho)}w_{t-1/2}$$

$$- \frac{1-\rho}{a_1^d(1+\rho)}n_t + \frac{1}{a_1^d(1+\rho)}n_{t+1/2}.$$

It can be shown that the variance of $r_{t+1/2} - r_t$ is greater under signaling if and only if $\theta(\rho - 2) < 0$, which is the case for finite variances of output supply and demand shocks and for $-1 \leqq \rho \leqq 1$.

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SHORT-TERM MUNICIPAL SECURITIES

John R. Walter

Introduction

Short-term municipal securities are defined by two characteristics. First, they are issued by state and local governments and the special districts and statutory authorities they establish. Second, they either have original maturities of less than three years or have longer final maturities but include features which, from the investor's point of view, shorten their effective maturities to less than three years.[1] During 1985 approximately $82 billion in short-term municipal securities were issued.

The interest income received by holders of municipal securities is generally exempt from federal income tax. The federal tax-free status of municipal debt was firmly established in the 1895 Supreme Court case Pollock v. Farmers' Loan and Trust Company and was reaffirmed by the first federal income tax law, passed in 1913 following the ratification of the Sixteenth Amendment. Since 1913, each new tax law has included a clause exempting interest income on most municipal securities from federal income taxes. As federal income tax rates increased, the importance of this exemption to investors and to municipal issuers grew. Because the interest income received by holders of most municipal securities is tax-exempt, the securities carry a lower rate of interest which in turn considerably lowers the borrowing costs of states and municipalities.[2,3]

States and municipalities borrow to finance their own expenditures, to provide funds to be used by private firms and individuals (although changes to the Tax Code

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[1] Municipal market participants generally call securities short-term if they have maturities less than three years, or if they have features shortening their effective maturities to less than three years. Most major data-collecting firms, however, consider municipal securities short-term if they have maturities of no more than 12 or 13 months, or have features making their effective maturities no more than 12 or 13 months. As a result, the figures quoted throughout the article are based upon this criterion.

[2] Because tax law prohibitions or limitations have eliminated or restricted the ability of certain municipal issuers to issue tax-exempt debt, or may do so in the future, some municipal issuers have recently issued taxable securities.

[3] In this article the term municipality refers to local governments and the special districts and authorities created by state and local governments. Some writers also use the term to refer to state governments.

in 1986 will significantly limit this borrowing), and to provide funds to some tax-exempt entities such as private nonprofit hospitals, colleges, and universities. Because municipal security issuers vary greatly in size and motivation for borrowing, the methods and instruments chosen to meet funding demands vary considerably. While a small city may sell a fixed-rate note directly to a local bank to finance the purchase of a snowplow until bonds are issued, a waste management agency may sell, through a municipal underwriter, numerous large denomination variable-rate securities to mutual funds and corporations to raise funds to build a solid waste disposal project.

Until 1980 almost all short-term tax-exempt securities had fixed interest rates and maturities of less than three years. Since then two new instruments have been developed and have grown rapidly: tax-exempt commercial paper and variable-rate demand obligations. These instruments have enabled state and municipal issuers to fund long-term projects at short-term rates. Issuers have had the incentive to raise funds at short-term rates because historically the yield curve in the tax-exempt market has been upward sloping.

In the past, state and local governments, school districts, public power and water authorities, and transportation authorities were the major issuers of short-term tax-exempt debt. In recent years agencies and authorities of municipal governments, such as housing, pollution control, and economic and industrial development authorities, have been growing in importance. Since the newer districts and authorities are more frequent users of the new instruments, the increase in the importance of these types of borrowers in the municipal market accounts for some of the growth in these instruments.

Characteristics of Short-Term Municipal Securities

Definition and Features Municipal securities are promises made by state and local governments and the districts and authorities they create to pay either one interest and principal payment on a particular date or a stream of interest payments up to maturity and a principal payment at maturity. They are backed by the issuer's ability to tax and borrow, by certain sources of funds, or by collateral. Municipal securities with original

maturities of greater than three years are generally called bonds, and those with maturities of three years or less are called short-term securities or notes.

Short-term municipal securities are issued in coupon or discount form. Coupon securities, the most prevalent by far, pay a stated tax-exempt interest rate, called the coupon rate, at maturity or on specified dates. This rate varies over the life of the issue in the case of variable-rate instruments. Discount securities are issued at a price less than their face value. The difference between the issue price and face value is tax-exempt interest income.

Short-term municipal securities are issued in either bearer or registered form. The 1982 tax law included a provision requiring all municipal securities issued after January 1, 1983 with maturities of greater than one year to be issued in registered form.

Short-term municipal securities are normally issued in denominations of $5,000 or more. The denomination chosen depends upon the issuer's assessment of who the purchasers are likely to be. If the issuer is trying to sell to individuals, it will use a smaller denomination than if the issue is intended for institutional investors. Smaller denominations increase the average cost of marketing a new issue.

Short-term municipal securities can be either general obligation securities or revenue securities. General obligation securities are backed by the full faith and credit of the issuer, which uses its ability to tax and any other possible source of income to meet debt payments. The ability to tax may be limited by statute or constitution, in which case the general obligation security is called a limited tax security. Revenue securities are backed by revenues generated by the project the securities finance and not by the full faith and credit of the issuer. The revenues are usually future earnings on projects such as tolls from roads or rental income from a facility leased to a business. In some cases, however, the revenues can be funds from specific taxes, receipts from bond sales, or transfers from the federal government.

Most of the securities issued by special districts and statutory authorities are revenue securities backed by revenues from the projects the securities finance. Many districts and authorities cannot tax, so they do not have the ability to make a general obligation pledge. At times, however, the securities of such a district or authority are backed by a general obligation pledge from the state or local government that founded it. Table I lists the major issuers of municipal debt and the types of securities they normally issue.

Traditional Instruments Traditionally, short-term municipal securities have been issued to meet short-

TABLE I

ISSUERS OF SHORT-TERM MUNICIPAL SECURITIES AND TYPES OF DEBT ISSUED

Issuer	Types of Debt Generally Issued
State government	G.O. and revenue
Local government:	G.O. and revenue
City	G.O. and revenue
County	G.O. and revenue
Authorities, districts, and agencies created by state and local governments:	
Public school	G.O. and revenue
Higher education	G.O. and revenue
Public power	Revenue
Water or sewer	Revenue
Transportation	Revenue
Health facilities	Revenue
Student loan	Revenue
Housing finance	Revenue
Pollution control	Revenue
Industrial development	Revenue
Waste management	Revenue

Note: G.O. denotes general obligation.

term demands for cash and have paid fixed interest rates. The popular traditional issues are revenue anticipation notes (commonly called RANs), tax anticipation notes (TANs), grant anticipation notes (GANs), tax and revenue anticipation notes (TRANs), and bond anticipation note (BANs). Each receives its name from its source of repayment. These issues have minimum denominations of $5,000 and their maturities are fixed with repayment coming from funds available at. or before the maturity date. Traditional notes remain significant in the short-term municipal market (Chart 1).

Funds from such sources as taxes, grants, and project revenues are often received as large payments a few times a year, while expenditures must be made continually. In order to make expenditures before funds are received, states and municipalities issue notes that are paid back by future receipts. Funds from future bond issues are used to repay bond anticipation notes. Here, states and municipalities construct projects to be financed with bonds but require immediate funds for payrolls and purchases. Rather than issuing bonds before a project is finished and the final costs are certain, states and municipalities may first sell notes that are retired with the proceeds of bonds issued upon completion of the project. For example, a county recently issued $32 million of one-year fixed-rate bond anticipation notes to finance part of the construction of a waste water treatment facility. The notes were revenue securities, backed by funds to be received from future bond sales.

Chart 1

SHORT-TERM MUNICIPAL SECURITIES
Volume Issued During Year
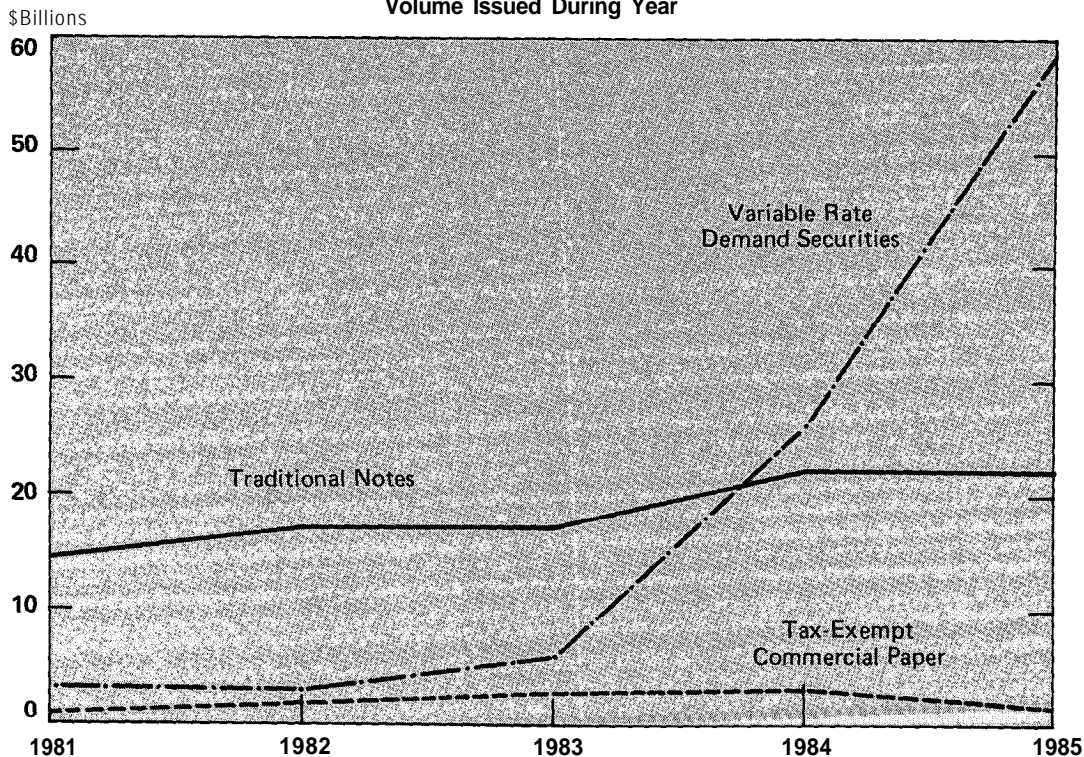
Source: Securities Data Company. Inc.; Standard & Poor's

There are other uses for bond anticipation notes. For example, at certain times states and municipalities may expect to be able to sell long-term securities in the future at lower rates than are available currently, so they issue notes and retire them with future bond proceeds. Also, municipalities frequently finance several projects with one bond issue. Short-term notes can be issued to pay for the completion of the individual projects, after which the notes are retired with one long-term bond issue. Despite the various uses to which bond anticipation notes may be put, they have become fairly uncommon in recent years as frequent tax law changes have made issuers wary that changes in the law could eliminate their ability to issue bonds needed to repay these notes.

New Instruments *Since* 1980 two new instruments have become prominent: tax-exempt commercial paper and variable-rate demand or put obligations. A number of factors contributed to the development of these instruments. The volatile interest rates of the late 1970s and early 1980s lead to greater demand by investors for short-term and variable-rate investments. Issuers were also interested in relying more on short-term debt to meet their demand for longer-term funds because the tax-exempt yield curve was strongly and persistently upward sloping. Issuers were unwilling, however, to use the traditional short-term instruments to raise long-term funds because of the high legal, administrative, and marketing costs of issuing and reissuing these securities for an extended period. Finally, the ability of issuers to sell the new instruments was greatly facilitated by the rapid growth of tax-exempt money market mutual funds which expanded the market for these instruments considerably by increasing the ability of investors to purchase them.

Tax-exempt commercial paper, which began to grow in late 1979, is short-term fixed-rate paper, normally issued with the intention of redeeming maturing paper with funds from newly issued paper. Almost all maturities are between 1 and 270 days and are determined by negotiation with investors. Tax-exempt commercial paper is used to fund both short- and long-term projects. When funding long-term projects, maturing paper is replaced with new issues at current market rates.

The tax-exempt commercial paper market is a highly sophisticated market requiring the issuer to maintain

daily contact with the market and good communication with its marketing agent. This is necessary because tax-exempt commercial paper issuers generally allow investors to choose from a span of maturities so that some paper is maturing almost every day and therefore must be replaced with new paper on a daily basis. The frequent involvement of issuers and their agents in the market imposes a significant cost on issuers. Because of this cost states and municipalities do not find it attractive to issue commercial paper unless they are borrowing $15 to $25 million or more.

Minimum denominations generally range from $50,000 to $100,000. Money market funds are the major investor in tax-exempt commercial paper. Some tax-exempt commercial paper also is purchased directly by corporations, bank trust departments, and wealthy individuals. While there is no developed secondary market in commercial paper because of its extreme short-term nature and its individualized maturities, dealers will as a rule buy back paper they have sold.

As an example of a commercial paper issue, one state has been using a tax-exempt commercial paper program for four or five years to finance its capital projects. The amount outstanding in the program varies with funding demands and is authorized by the state government to be as much as $90 million. Denominations range between $50,000 and $5,000,000 with the securities typically sold in $1,000,000 lots. Maturities are between 3 days and 210 days depending upon investors' desires. Most of the commercial paper has been purchased by money market funds. This program will be continued unless the state decides that bonds can provide lower cost funds.

Variable-rate demand obligations began to grow in 1981.[4] They can be either general obligation or revenue securities, but the majority are revenue securities. Minimum denominations range from $5,000 to $100,000. Variable-rate demand obligations now come in many forms with almost as many variations as there are dealers in the tax-exempt money market. They share certain characteristics, however. Fist, while these instruments may have final maturities from short-term up to forty years, they all include features which allow for periodic interest rate adjustments. Second, they include a feature known as a demand option which gives the investor the right to tender the instrument to the issuer or a designated party on a specified number of days' notice at a price equal to the face amount (par value) plus accrued interest. The length of the notice period normally corresponds with the frequency of interest rate adjustment. For example, if the interest rate is adjusted on a weekly basis, the variable-rate security will generally have a seven-day notice period.. If in the investor's judgement the new rate is too low or if the investor wants his money back for some other reason, he exercises his demand option. In this case the instrument is resold to another investor. Third, many of these securities contain a provision allowing the issuer, after properly notifying all holders and allowing them the opportunity to tender their holdings, to convert the variable-rate security into a fixed-rate security with no demand feature. For example, a higher education authority issued $9 million of variable-rate revenue bonds, in $100,000 minimum denominations, to finance campus construction and renovation. These securities have a 25-year final maturity but include a weekly demand feature. Most of the securities are in the portfolios of tax-exempt money market funds.

Variable-rate demand obligations have one important advantage for states and municipalities over tax-exempt commercial paper. When commercial paper matures and is replaced with new commercial paper, the new security is legally defined as a new debt issue and is subject to regulations in place at the time of its issue. Since Congress has been imposing and shrinking limits on certain types of issues in recent years, issuers wishing to borrow for an extended period by using commercial paper face the danger of having a newly imposed or tightened limit eliminate their source of funds. In contrast, because new debt is not issued when an investor exercises his demand option, variable-rate demand obligation issuers are not faced with this danger. This advantage of variable-rate demand obligations over tax-exempt commercial paper may explain their rapid growth compared with commercial paper (Chart 1).

The length of the notice period on a variable-rate demand obligation determines its effective maturity from the investor's point of view and therefore strongly affects the interest rate which must be paid on the instrument. The most common notice periods are one day, seven days, and thirty days. As a result of a fairly consistently upward sloping yield curve in the municipal market, it is generally true that the shorter the notice period the lower the rate paid.[5]

Information on each of the commonly used 'short-term municipal instruments is provided in Table II.

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[4] The terms "demand" and "put" are used interchangeably in the municipal security market. In this paper "demand" is used.

[5] For a more detailed discussion of tax-exempt commercial paper and variable-rate demand obligations see Smith Barney, Harris Upham and Company, Incorporated [1986, pp. 10-14].

TABLE II

INSTRUMENTS COMMONLY USED IN THE SHORT-TERM MUNICIPAL MARKET

Security Name	Types of Pledge	Features
TRADITIONAL NOTES		
Revenue Anticipation Note	G.O. or revenue	Fixed maturity of a few weeks to one year, fixed interest rates
Tax Anticipation Note	G.O. or revenue	Fixed maturity of a few weeks to one year, fixed interest rates
Grant Anticipation Note	G.O. or revenue	Fixed maturity of a few weeks to three years, fixed interest rates
Tax and Revenue Anticipation Note	G.O. or revenue	Fixed maturity of a few weeks to one year, fixed interest rates
Bond Anticipation Note	G.O. or revenue	Fixed maturity of a few weeks to three years, fixed interest rates
NEW SECURITIES		
Variable Rate Demand Obligation	G.O. or revenue; Liquidity facility, Credit facility	May be tendered to issuer or designated party on a specified number of days' notice, floating or variable interest rate. Many include features which allow conversion to a fixed rate long-term maturity.
Tax-Exempt Commercial Paper	G.O. or revenue; Liquidity facility, Credit facility	Maturities of a few days to one year depending on investor and issuer preference; interest rate fixed to maturity; continuously offered.

Note: G.O. denotes general obligation.

Dealers

Most large banks and securities firms, along with some firms specializing only in municipal securities trading, act as dealers in the short-term municipal market. Municipal securities dealers underwrite and market new security issues and provide a secondary market for outstanding securities. With a few exceptions, banks are limited by the Glass-Steagall Act of 1933 to underwriting only general obligation securities.

Underwriting is the purchase of securities from the issuer with the intention of reselling them to investors. Once the underwriter has purchased the securities it bears the risks of marketing them. Security issues may be underwritten by one dealer if the issue is small or by a group of dealers, called a syndicate, if the issue is larger than one dealer would like to handle. In a syndicate one dealer acts as the lead dealer in the group, taking the largest proportion of securities and managing the sale of the issue. Syndicates are used to spread the market risk among more dealers and to enlarge the number of possible investors. As compensation the underwriter receives the spread between the price paid the issuer for the securities and the price received from investors. The risk faced by the under-

writer is that the security issue will not sell at a price that will earn a profit. A major source of this risk occurs when interest rates unexpectedly rise before the underwriter has sold the issue to the public.

Municipalities that choose a public offering must decide whether to sell their securities by competitive bidding or by a negotiated sale. In competitive bidding the issue is advertised for sale and then sold to the underwriting dealer or syndicate of dealers offering the highest price. In a negotiated sale an issuer chooses one dealer or syndicate without soliciting bids from other firms. Variable-rate municipal securities are most frequently sold through negotiated deals, while tax-exempt commercial paper is always sold in this manner.

In a traditional note issue the dealer's responsibility to the issuer is limited to the initial sale of the securities. For variable-rate and commercial paper issues the lead dealer's responsibility is more extensive. When variable-rate obligations are used, the lead dealer generally becomes the remarketing agent and has the responsibility of resetting the interest rate on interest rate adjustment dates and reselling any securities which are tendered by investors. When commercial paper is issued, the dealer is involved in the daily

setting of rates and in selling new paper to replace maturing paper.

Dealers generally will make a secondary market in the short-term securities they have sold, which means they will stand ready to buy and sell these securities at any time. Dealers are kept informed of securities being offered and rates being paid through several electronic services and daily publications. Due to the heterogeneous nature of municipal issues, the secondary market in municipal securities is not nearly as developed as that for corporate and government debt issues.

Brokers in the municipal market line up dealers selling particular issues with dealers who are interested in buying these issues. Brokers deal only with large volumes and charge a small fee for their middleman services.

Providers of Credit and Liquidity Enhancements

In order to improve the credit ratings and marketability of their securities, municipal issuers frequently get credit or liquidity enhancing agreements. Under these agreements banks, corporations, and insurance companies promise, for a fee, to provide funds if an issuer is unable or unwilling to make payment to the holders of the issuer's debt. Such an agreement substitutes the credit or liquidity of the bank, corporation, or insurance company for that of the municipal security issuer.

These agreements fall into one of two categories. The first is the credit substitution agreement. This is simply a contract made with the municipal security issuer to make payment if the issuer does not. Under this contract the security holder has a claim against the promising party if the issuer defaults. The second category is the liquidity substitution agreement. This is a promise, generally made by a bank, to provide a loan to the municipal issuer or its agent to redeem maturing or tendered securities, or to itself purchase such securities outright. The liquidity agreement is activated when the remarketing agent cannot resell the maturing or tendered securities at an interest rate below some maximum set by the issuer or when it cannot resell them at all.

Banks are the most common providers of credit substitution agreements in the short-term municipal market. Banks provide the agreement, for a fee, by means of an irrevocable letter of credit. Insurance companies provide the same type of promise through municipal bond insurance. Also, a corporation that benefits from a project often guarantees payment of principal and interest for the related securities. Since only municipal issues with top ratings are purchased by the money market mutual funds, issuers wishing to sell less than top rated securities to these funds must obtain a credit substitution promise.

Most liquidity substitution agreements are provided by large U.S. and foreign banks. The agreements come in the form of either a bank line, a standby letter of credit, or a standby purchase agreement. The liquidity substitution promise provides the investor with the assurance that funds will be immediately available when he redeems his security.

The traditional short-term municipal securities typically do not require liquidity promises, while variable-rate demand obligations and commercial paper issues almost always require such promises. Variable-rate obligations require liquidity substitution backing because of the danger that the security holders will exercise their demand option at a time and in sufficient numbers that the remarketing agent will not be able to resell the securities and the issuer will not have sufficient funds to redeem them. Institutional investors, the biggest purchasers of such securities, require that this risk be covered. Similarly, there is some danger that when existing paper matures the commercial paper issuer's marketing agent will be unable to sell new paper and that the issuer will not have sufficient funds to redeem them. Issuers of commercial paper must back their issues with liquidity facilities to assure investors that funds will be immediately available at maturity.

Investors

An investor's decision whether to purchase a taxable or tax-exempt security depends largely on his marginal tax rate and the rates being paid on tax-exempts and taxables. The after-tax return on a taxable security is $r(1-t)$ where r is the before-tax rate of return on the taxable security and t is the investor's marginal tax rate. Yields on tax-exempt securities are frequently stated in taxable equivalent terms, or in terms of what taxable interest rate would be necessary to provide the same after-tax interest rate. The taxable equivalent formula is

$$r_T = r_{TF}/1-t,$$

where r_{TF} is the rate paid on the tax-free instrument and r_T is the equivalent yield of a taxable instrument for investors with a marginal tax rate of t. For example, if an investor in the 33 percent marginal federal tax bracket purchases a tax-exempt security paying 6.7 percent, then a taxable security paying 10 percent would yield this investor the same after-tax rate as the tax exempt security. If the investor's taxable equivalent yield on municipal securities is greater than the yields he can earn on taxable securities of comparable risk he will profit by investing in tax-exempt securities.

The value of the tax exemption to the investor is increased when the income earned also is exempt from state income tax. This is true for investors purchasing securities issued by their home state or by municipalities located in their home state. In this case the security is "double tax-exempt" for the investor and the relevant taxable equivalent formula is

$$r_T = r_{TF}/1 - [t_F + t_S(1 - t_F)],$$

where t_F is the marginal federal tax rate of the investor and t_S is the marginal state tax rate of the investor. This formula takes into account that state income taxes are deductible on the federal return. Suppose the above investor in the 33 percent federal tax bracket has a 10 percent state income tax rate. The total tax rate faced by the individual is .33 + .10(1 − .33)=.40. If the municipal security being considered is exempt from state income taxes and is paying a 6.7 percent rate of return then the taxable equivalent yield for this investor is 11.1 percent.

Chart 2 graphs the implicit marginal tax rate that equated the after-tax yields on six-month maturity Treasury securities and six-month maturity prime tax-exempt notes from 1978 through mid-1986. This tax rate averaged 49.4 percent from January 1978 through September 1981, fell to an average 45.4 percent from October 1981 through April 1985, and then fell further to an average 33.6 percent from May 1985 through June 1986. The reasons for the decline in the period after September 1981 are not entirely clear. The 1985 decline probably resulted from the massive issue of new short-term debt brought on by municipal issuers' fears of tax law changes taking affect after the end of 1985.

Individuals Most individuals investing in short-term municipal securities do so through tax-exempt money market funds, which held approximately 50 percent of all short-term municipal debt at the end of 1985 (Chart 3). Tax-exempt money funds allow smaller investors to diversify their portfolios of municipal secu-
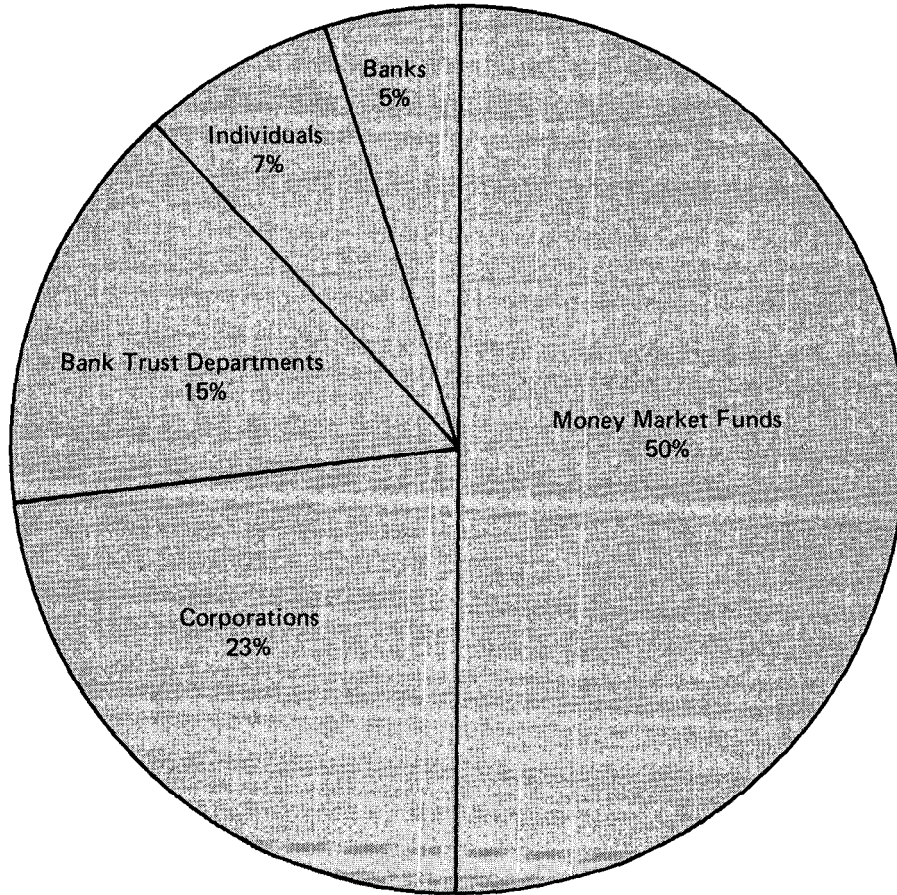
Chart 2

TAX RATE EQUATING AFTER-TAX YIELDS ON TREASURY BILLS
AND PRIME TAX-EXEMPT HOUSING NOTES
(Six-Month Maturities)
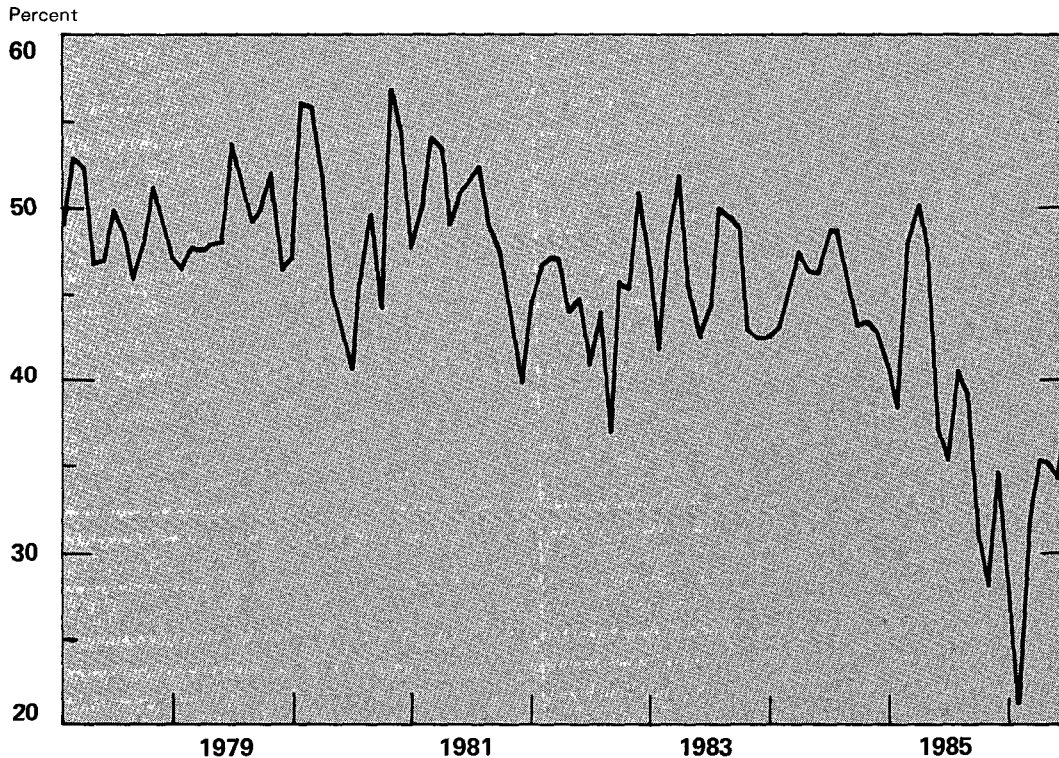
Source: Yield series are from Salomon Brothers, *An Analytical Record of Yields and Yield Spreads.*

Chart 3

HOLDINGS OF SHORT-TERM TAX-EXEMPT SECURITIES

Source: *Smith Barney, Harris Upham & Co. Incorporated, Public Finance Division.*

rities, which would not otherwise be possible for most of these investors because minimum denominations of short-term tax-exempts start at $5,000. Some individuals do invest in short-term securities directly, either through a securities dealer or through a bank with a dealer department. Chart 3 shows that approximately 7 percent of outstanding short-term municipal debt was held by individuals investing directly.

Individuals can invest in short-term tax-exempt securities through a bank trust department. Bank trust departments held 15 percent of short-term municipal debt outstanding at the end of 1985. Bank trust departments also often invest their customers' funds in tax-exempt money funds, which show up in Chart 3 as investment by money funds.

Corporations At the end of 1985, corporations directly held about 23 percent of the outstanding short-

term municipal securities. In addition they indirectly held some short-term municipal securities through money market funds. Corporations invest in these securities because their corporate federal and state tax rates together generally have been high enough to make tax-exempts profitable. Corporations invest in short-term municipal debt mostly as a repository for their short-term operating reserves or seasonal reserves.

Commercial Banks At the end of 1985 banks held about 5 percent of all short-term municipal debt. Banks' holdings of municipal debt as a percentage of their total assets declined from 1980 through 1984. This decline can be explained by two factors. First, aggregate bank profits consistently fell over those years, which diminished banks' incentive to protect income from taxes. Second, the Tax Equity and Fiscal Responsibility Act

(TEFRA) of 1982, eliminated part of the interest deduction of municipal security carrying costs, and therefore lowered the effective return banks could earn on tax-exempts beginning in 1983.[6] In 1985, however, banks' holdings of municipal securities as a percent of total assets grew to slightly more than it was in 1980. This growth was the result of banks' concern over the possibility of enactment of legislation in 1986 making municipal securities purchased after 1985 less attractive and because of somewhat higher income in 1985.

As it turned out, banks' concern about the 1986 tax law was well-founded. The new tax law will in most cases eliminate banks' ability to deduct the interest expense of funds used to carry municipal securities purchased after August 7, 1986. Before the change, banks were allowed to deduct from their taxable income an amount equal to 80 percent of the interest expense of funds used to carry municipal securities. The elimination of this tax deduction has already caused banks to reduce their investments in municipal securities and will significantly diminish their importance as purchasers of municipal securities.

Banks will be allowed to continue to deduct 80 percent of the interest expense for funds used to purchase municipal securities financing traditional governmental projects or hospital and university projects if the issuer expects to issue less than $10 million in debt per year. This will enable these small issuers to continue to sell securities to some banks, but will largely eliminate banks as purchasers of other issuers' securities.

Regulatory and Legislative Effects

Regulation has only a limited direct effect on the municipal securities market. Issuers' debt offerings are not regulated except by general financial regulations. For instance, conditions under which tax-exempt commercial paper can be issued are set by the Securities and Exchange Commission (SEC). The Municipal Securities Rulemaking Board (MSRB) was established in 1975 to develop and update regulations by which dealers, dealer banks, and brokers in the municipal market are to operate. These regulations are enforced by the SEC, the federal bank regulators, and the National Association of Securities Dealers.

The regulation of money funds by the SEC indirectly affects the short-term municipal market significantly since municipal money funds are such important purchasers in the market. SEC regulations governing money market funds' purchases and holdings have been important in promoting certain types of short-term municipal securities. (See the chapter on money market funds.)

Federal tax legislation can result in significant changes in the municipal market. In particular, the repeal or proposed repeal of the tax-exempt status of certain types of issues can drive the market to extreme reactions. Such a reaction was seen at the end of 1985 when Congress' proposed restrictions on tax-exempt borrowing produced a record volume of municipal issues. The Tax Reform Act of 1986 should have a number of effects on the municipal market. Banks should become less active investors in municipals because of the loss, in most cases, of their interest cost deduction. The ratio of tax-exempt to taxable yields may rise because the act lowers marginal tax rates for many individuals and corporations. And many private use issuers will lose their ability to issue tax-exempt debt, while others will have caps imposed on the amount of tax-exempt debt they are allowed to issue.

State legislation can also cause changes in the municipal market by limiting the amount or type of tax-exempt debt that may be issued. For example, following California's Proposition 13 the volume of general obligation debt issued by California municipalities fell significantly.

Conclusion

Short-term municipal securities have become important instruments of the money market. Traditional notes such as revenue anticipation notes, tax anticipation notes and bond anticipation notes, remain important to issuers wishing to borrow funds for short-term purposes, but these notes have been responsible for only a small portion of the recent growth of the short-term municipal market. Most of the growth in this market has resulted from states' and municipalities' use of variable-rate securities and tax-exempt commercial paper. The newer instruments have augmented the traditional short-term notes to provide the investor with securities having little interest rate risk, while enabling issuers to gather funds for long-term projects at short-term rates.

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