

Economic Review



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Interest Rate Futures

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By Charles S. Morris

To protect themselves from interest rate volatility, many investors in bonds and other fixed income assets rely heavily on interest rate futures. Hedging with interest rate futures can be complex, however. Consequently, investors should thoroughly understand all aspects of interest rate futures before using them in a hedging strategy.

Federal Excise Taxes: Approaching Deficit Reduction from the Revenue Side 21

By Glenn H. Miller, Jr.

Moderate increases in federal excise taxes on alcohol, tobacco, and motor fuels could make a significant contribution to reducing the federal budget deficit. Such taxes have some drawbacks with regard to fairness; but they also have the off-setting virtues of encouraging energy conservation and other desirable changes in consumption patterns.

Managing Interest Rate Risk with Interest Rate Futures

By Charles S. Morris

Increased interest rate volatility in the 1970s and 1980s has led to greater volatility in the returns on bonds and other fixed income assets. Consequently, investors in bonds and financial institutions with fixed income assets and liabilities on their balance sheets are now exposed to much greater risks from capital gains and losses. The problem is compounded because managing risks caused by interest rate volatility has traditionally been difficult and costly.

During the last 15 years, however, many new financial instruments have been developed to help investors manage risks caused by increased interest rate volatility. One of the most popular types of instruments is interest rate futures contracts. Interest rate futures allow investors to protect the value of their fixed income invest-

ments by providing a hedge against interest rate changes. Interest rate futures are now an important tool for investors who want to protect themselves from interest rate volatility.

This article explains how interest rate futures, when properly used in a hedging strategy, allow investors to manage interest rate risk. The first section of the article defines interest rate risk, examines its impact on investors and institutions, and discusses how interest rate risk can be managed. The second section provides an introduction to interest rate futures and discusses why they are good assets for hedging interest rate risk. The third section shows how investors and institutions can use interest rate futures to manage interest rate risk and discusses some of the other risks involved in using interest rate futures.

Interest rate risk and interest rate risk management

Bonds and other fixed income assets have become riskier investments in recent years.

Charles S. Morris is a senior economist at the Federal Reserve Bank of Kansas City. Julia Reigel, a research associate at the bank, assisted in the preparation of this article.

These assets are riskier, not because issuers are more likely to default on their obligations, but because interest rates have become more volatile. This section explains why increased interest rate volatility has increased the risk of fixed income assets, provides some examples of investors and institutions affected by greater interest rate volatility, and discusses methods of managing interest rate risk.

What is interest rate risk?

Investments in fixed income assets, such as bonds, are risky because the volatility of their prices can lead to unexpected capital gains and losses. The risk of an asset can be measured by the volatility of its returns, which is the sum of the income flows from the asset plus any changes in its price. Since the income flows from a fixed income asset, such as the coupon payments and maturity value of a coupon bond, are fixed, the riskiness of the asset depends only on its price volatility. For example, as the volatility of a bond's price rises, the bond's riskiness rises because unexpected capital gains or losses are more likely.

The primary cause of volatility in the price of a fixed income asset is interest rate volatility.¹ Indeed, the volatility in prices due to interest rate changes is commonly termed "interest rate risk." For example, when interest rates fall, the price of a bond rises; when interest rates rise, the price of a bond falls. The sensitivity of a fixed income asset's price to

interest rates, that is, the degree of interest rate risk, depends largely on the asset's maturity. The longer to maturity, the larger the change in price due to a change in interest rates.²

Interest rate volatility has risen sharply in recent years. Chart 1 shows the volatility of interest rates on 1-year and 10-year Treasury securities from 1955 to 1988. Interest rate volatility in each year is measured by the standard deviation of the monthly interest rates during that year. The average standard deviation of 1-year interest rates over the 1979-88 period was more than twice that of the 1955-78 period, rising from 0.5 percent per month over the 1955-78 period to 1.2 percent over the 1979-88 period. The relative increase in the volatility of 10-year rates was even sharper. The average standard deviation of 10-year interest rates over the 1979-88 period was more than three times higher than that over the 1955-78 period, rising from 0.25 percent to 0.8 percent. The rise in interest rate volatility over those periods is not limited to 1-year and 10-year rates, but is typical of the volatility of interest rates at all maturities.

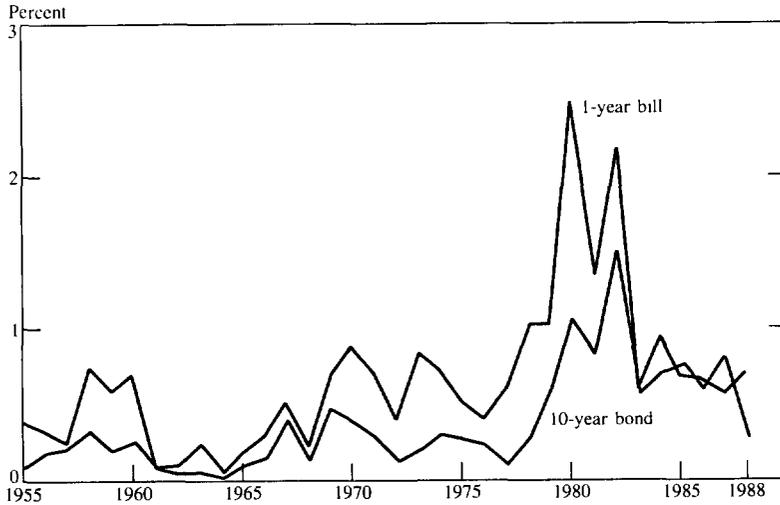
Who is affected by rising interest rate volatility?

Many investors and business firms are exposed to greater risks because of the increase in interest rate volatility in recent years. Examples include individual and institutional

¹ The riskiness of a fixed income asset also depends on the volatility of other factors that affect its price, such as the creditworthiness of the issuer and the liquidity of the asset.

² This assumes a uniform change in rates on all maturities. The interest rate sensitivity of a fixed income asset also depends on other factors, such as the size of the coupon payments and the dates the coupon payments are received.

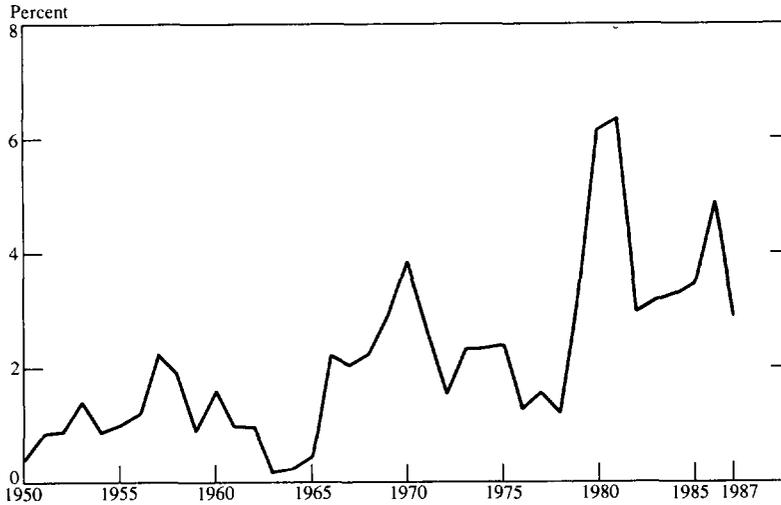
CHART 1
Interest rate volatility



Note: Annual standard deviations of monthly constant maturity rates for 1-year U.S. Treasury bills and 10-year U.S. Treasury bonds.

Source: Board of Governors of the Federal Reserve System.

CHART 2
Bond market volatility



Note: Annual standard deviations of total monthly returns on a long-term U.S. Treasury bond index.

Source: Center for Research in Stock Prices.

investors in government and corporate bonds, depository institutions such as banks and savings and loans, securities dealers, mortgage banks, and life insurance companies to name a few.

One group of investors exposed to greater risks is investors in bonds. The rising risk of holding bonds is clear from Chart 2, which shows the volatility of returns on U.S. Treasury bonds from 1950 to 1987. Bond market volatility in each year is measured by the standard deviation of the monthly percentage returns on a long-term U.S. Treasury bond index during that year.³ Bond market volatility rose from an average annual standard deviation of 1 percent per month over the period from 1950 to 1965 to 2.25 percent over the period from 1966 to 1978. Bond market volatility rose further from 1979 to 1987, averaging 4.1 percent per month.

Rising interest rate volatility has also increased the risk exposure of depository institutions, such as banks and S&Ls. When interest rates rise, the market value of their net worth generally falls; when interest rates fall, the market value of their net worth generally rises. The market value of an institution's net worth is the difference between the market values of its assets and liabilities. The effect of a change in interest rates on the market value of a firm's net worth depends on the relative interest rate sensitivities of its assets and liabilities, which primarily depend on their relative maturities.

³ Although the volatility of total returns is the same as price volatility for a given bond, the volatilities are not the same when the composition of a bond portfolio changes over time because the coupon payments change. Since the composition of the portfolio that underlies the index in Chart 2 changes, the volatility of total returns is shown.

Because the assets of banks and S&Ls generally take longer to mature than do their liabilities, the value of their assets is more sensitive to changes in interest rates than the value of their liabilities. As a result, when interest rates rise, for example, the net worth of a depository institution falls because the value of its assets falls more than the value of its liabilities.

Securities dealers are also exposed to greater risks due to rising interest rate volatility. When interest rates rise, securities dealers suffer losses like other bondholders because the value of the bonds they are holding in inventory falls.⁴ Securities dealers can also suffer losses when interest rates fall, however, because they often commit themselves to delivering bonds at a future date for a fixed price when they do not have the bonds in inventory or the funds to purchase them immediately. If interest rates fall before a dealer purchases the bonds, he will suffer a loss because the price he has to pay for the bonds he has to deliver will be higher than he had expected when he made the initial commitment.

Mortgage banks are also exposed to greater interest rate volatility. A mortgage bank originates mortgages and then sells them to other investors. In general, mortgage banks hold very few mortgages on their balance sheet. They can suffer losses if interest rates rise, however, because they typically commit to a mortgage

⁴ Securities dealers make a profit on their bonds when interest rates fall. Indeed, all investors in fixed income assets make a profit when interest rates move in one direction and suffer a loss when interest rates move in the other direction. In the remaining examples, the discussion will focus on how a change in interest rates in only one direction affects an investor. The direction of the change in interest rates that is used is the one that produces a loss for the investor.

rate before the mortgage is actually closed and sold. If interest rates rise between the time they commit to a rate and the time the mortgage is sold, the value of the mortgage will fall; and mortgage banks will get a lower price than they had expected when they made the initial commitment.

A final example of a group of firms exposed to greater risks due to rising interest rate volatility is life insurance companies. For example, changes in interest rates affect life insurance companies because when interest rates fall the spread earned on Guaranteed Interest Contract (GIC) commitments falls. In recent years, life insurance companies have become heavy issuers of GICs, which are securities that guarantee a fixed interest rate on invested funds over a several-year period. GICs are generally purchased by long-term investors, such as pension funds and company thrift plans. Often, a life insurance company will commit to a rate on a GIC for a short time period before it receives the funds. Life insurance companies can suffer losses if interest rates fall during the commitment period because when they receive the funds from the GIC, they will have to invest the funds at a lower rate than they had expected when they committed to the GIC rate. As a result, the spread earned on the GIC falls.⁵

What is risk management and hedging?

Investors and business firms manage risk by

⁵ Viewed another way, a GIC commitment is a fixed rate liability that is not matched by an asset. When interest rates fall, the value of the GIC commitment rises, but there is no asset whose value also rises. Therefore, the insurance company's net worth falls when interest rates fall.

choosing the amount of risk to which they want to be exposed. The choice of how much risk to bear varies with every investor. For example, some investors will choose to accept the increased price volatility of fixed income investments of recent years, while others will take actions to reduce the riskiness of their fixed income investments. In general, though, investors will not choose to minimize risk because there are costs to reducing risk. The most important cost is that the expected return on their investment also falls when risk is reduced.

Traditionally, investors have found it difficult and costly to reduce risks caused by interest rate volatility. Investors in bonds, for example, typically could reduce interest rate risk only by selling some of their bonds and buying short-term money market instruments. Financial institutions exposed to interest rate risk had to rely on balance sheet restructuring to reduce the mismatch between the maturities of their assets and liabilities.

In recent years new financial instruments—such as interest rate futures, options on interest rate futures, and interest rate swaps—have been developed that allow investors in fixed income assets to manage interest rate risk at a relatively low cost by hedging. In general, hedging is a risk management strategy in which investors choose assets such that changes in the prices of the assets systematically offset each other. Fixed income investors can hedge the interest rate risk of an asset, such as a Treasury bond, by buying or selling hedging assets whose values change in the opposite direction to the value of the Treasury bond when interest rates change. The interest rate riskiness of a hedged Treasury bond is lower than the interest rate riskiness of the unhedged bond because the change in the value of the hedging asset due

to a change in interest rates offsets at least some of the change in the value of the bond. It is important to realize, however, that hedging reduces price volatility because it offsets increases as well as decreases in the price of the Treasury bond.

For any given fixed income asset, the best hedging instrument for reducing interest rate risk is the one whose price is most closely related to the price of the asset when interest rates change. The more closely the prices are related, the larger the reduction in risk that is possible because changes in the price of the hedging asset are more likely to offset changes in the price of the asset being hedged.

While hedging can reduce risk, it generally cannot completely eliminate risk. Hedging will completely eliminate risk only if the values of the portfolio and hedging asset are perfectly related. However, the prices of the assets being hedged and the hedging asset are rarely perfectly related because of differences in factors such as credit quality, liquidity, maturity, and call or prepayment options. Thus, as a practical matter, hedging is an activity that permits investors to manage, but not eliminate, risk.⁶

⁶ The risk that remains after a portfolio has been hedged is called *basis risk*. If the riskiness of a portfolio is measured by the standard deviation of the change in its value, the minimum level of basis risk that can be achieved through hedging is

$$\sigma_h = \sigma_p \sqrt{1 - \rho^2},$$

where σ_p is the standard deviation of the change in the value of the unhedged portfolio, and ρ is the correlation coefficient between the changes in the values of the portfolio and the hedging asset. The maximum percentage reduction in risk is

$$100(\sigma_p - \sigma_h) / \sigma_p = 100(1 - \sqrt{1 - \rho^2}),$$

which depends only on ρ , and risk will be completely eliminated only if ρ equals 1 or -1 .

An introduction to interest rate futures

Of the variety of financial instruments used to hedge interest rate risk, one of the most popular is interest rate futures. This section describes interest rate futures, discusses the types of interest rate futures available, and explains why they are good hedging instruments.

What are interest rate futures?

An interest rate futures contract is an agreement between two parties to buy or sell a fixed income asset, such as a Treasury bond or Treasury bill, at a given time in the future for a predetermined price. For example, if in January a person buys March Treasury bond futures, he is simply agreeing to buy Treasury bonds in March. On the other hand, if in January he sells March Treasury bond futures, he is simply agreeing to sell Treasury bonds in March. Nothing is exchanged when the futures contract is written because it is only an agreement to make an exchange at a future date. The price of a futures contract is the price the buyer agrees to pay the seller for the asset when it is delivered.⁷

⁷ The delivery dates for most interest rate futures are in March, June, September, and December. The actual delivery date varies with the contract. For example, the seller of a Treasury bond contract at the Chicago Board of Trade can deliver Treasury bonds on any day in the contract month, although the last trading day is seven business days prior to the last business day of the month. Although some interest rate futures have contract months that extend out to three years, most of the contracts traded are contracts with the nearest delivery month.

Delivery of the asset in a futures contract rarely occurs, however. The reason is futures traders can always close out the contracts they have bought or sold by taking an offsetting position in the same futures contract before delivery occurs. For example, rather than taking delivery, a buyer of ten March Treasury bond futures can settle his position by selling ten March Treasury bond futures. Similarly, a seller of ten March Treasury bond futures can settle his position by buying ten March Treasury bond futures. In 1988, Treasury bonds were delivered in less than 0.1 percent of all Treasury bond futures traded at the Chicago Board of Trade, which are one of the most widely traded interest rate futures.⁸

Since a futures trader who has settled an initial position has both bought and sold futures, his profit depends on the prices of the futures he has bought and sold. Just like any other trader, futures traders make a profit when they buy futures at a price lower than they sell futures, and they suffer a loss when they buy futures at a price higher than they sell futures. Whether a person makes a profit or suffers a loss, therefore, depends on two conditions: first, whether he initially bought or sold futures, and second, whether the price of the futures rises or falls between the time he enters the initial contract and the time he takes an offsetting position.

A buyer of futures makes a profit when the futures price rises and suffers a loss when the

futures price falls. Suppose, for example, on January 10 a person buys a March Treasury bond futures contract for \$95 per \$100 face value of Treasury bonds, and on February 15 he settles his position by selling a March Treasury bond futures contract for \$97. Under these circumstances, the person would make a profit of \$2 per \$100 face value of Treasury bonds because he has one agreement to buy Treasury bonds in March for \$95 and another agreement to sell Treasury bonds in March for \$97. On the other hand, if the price falls to \$92 on February 15, he would lose \$3 per \$100 because he has one agreement to buy Treasury bonds for \$95 and another agreement to sell Treasury bonds for \$92.

In contrast, a seller of futures suffers a loss when the futures price rises and makes a profit when the futures price falls. This time, suppose on January 10 a person sells a March Treasury bond futures contract for \$95, and on February 15 he settles his position by buying a March Treasury bond futures for \$97. The person would suffer a loss of \$2 because he has one agreement to sell Treasury bonds in March for \$95 and another agreement to buy Treasury bonds in March for \$97. On the other hand, if the price falls to \$92 on February 15, he would make a profit of \$3 because he has one agreement to sell Treasury bonds for \$95 and another agreement to buy Treasury bonds for \$92.

Interest rate futures are relatively new financial instruments. While futures on commodities have been trading on organized exchanges in the United States since the latter half of the 1860s, the first interest rate futures contract did not start trading until October 1975, when the Chicago Board of Trade (CBT) introduced futures on Government National Mortgage

⁸ For some interest rate futures, such as the Eurodollar time deposit futures on the International Monetary Market exchange, all contracts must be settled by taking an offsetting position. That is, delivery of the underlying instrument is not allowed.

Association (GNMA) certificates.⁹ Since then, futures on many different fixed income assets have been developed. However, there are still many fixed income assets, such as corporate bonds, on which no futures are traded.

The assets on which interest rate futures are traded span the maturity spectrum—interest rate futures on short-term, medium-term, and long-term assets are traded on several futures exchanges in the United States and abroad. The first futures contract on a short-term asset was the Treasury bill futures contract, which was introduced on the International Monetary Market (IMM) exchange in 1976. Since then, interest rate futures on other short-term assets, such as Eurodollar time deposits and 30-day interest rates, have begun trading on several exchanges, with the IMM Eurodollar futures being the most popular.¹⁰ Interest rate futures on medium-term assets, such as Treasury notes, are also traded on several exchanges.¹¹ Finally, there are interest rate futures on long-term assets, such as Treasury bonds and a municipal bond index, with the CBT Treasury bond futures being the most popular.¹²

⁹ Although the GNMA futures contract was initially successful, it stopped trading in December 1984.

¹⁰ Treasury bill futures are also traded on the MidAmerica Commodity Exchange in Chicago. Eurodollar futures are also traded on the London International Financial Futures Exchange. The 30-day interest rate futures contract is traded at the Chicago Board of Trade.

¹¹ Treasury note futures are traded on the Chicago Board of Trade exchange, the MidAmerica Commodity Exchange in Chicago, and the Financial Instrument Exchange, a division of the New York Cotton Exchange.

¹² Treasury bond futures are also traded on the MidAmerica Commodity Exchange in Chicago and the London International Financial Futures Exchange. Futures on the municipal bond index are traded at the Chicago Board of Trade.

The success of interest rate futures is shown in Chart 3. One measure of activity in a futures market is a contract's open interest—the number of contracts not yet offset by opposite transactions or delivery. Chart 3 shows the open interest in the CBT Treasury bond futures contract from 1978 to 1988. Although open interest in Treasury bond futures is fairly volatile, the trend is clearly upward. Chart 3 also shows open interest rose sharply in 1980 and 1981—the two peak years in bond market volatility (Chart 2)—suggesting that investors took advantage of the futures market for managing risk.

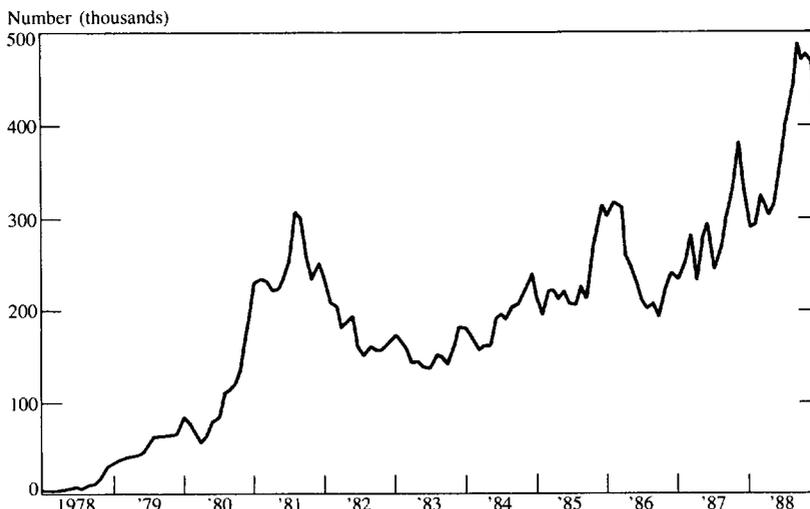
Why are interest rate futures good hedging assets?

Interest rate futures are good hedging assets for two reasons. First, the transaction costs of buying and selling them are relatively low. Second, interest rate futures prices are closely related to the prices of many fixed income assets when interest rates change.

The transaction costs of establishing a futures position are low because nothing is really being bought or sold—the contract is just an agreement to make a trade at a future date. When a position is established, the only outlays are broker fees and commissions and an initial margin deposit with the broker.¹³ The fees paid to brokers and traders are quite small. For example, the cost of establishing and settling a position in a CBT Treasury bond futures con-

¹³ The margin on a futures contract is "good faith" money deposited with a broker to assure him that losses can be covered in the event of adverse price movements.

CHART 3
Treasury bond futures open interest



Note: Values are monthly averages of daily open interest in the nearest Chicago Board of Trade Treasury bond futures contract with at least one month until expiration.

Source: Data Resources Inc.

tract, which is based on \$100,000 face value of bonds, is about \$41.¹⁴ The initial margin is also very small—the margin on a CBT Treasury bond futures used for hedging purposes is \$2,000—and the margin generally earns a market rate of interest.¹⁵

¹⁴ See Arnold Kling, "Futures Markets and Transaction Costs," in Myron L. Kwast, ed., *Financial Futures and Options in the U.S. Economy: A Study by the Staff of the Federal Reserve System* (Washington, D.C.: Board of Governors of the Federal Reserve System, 1986), pp. 41-54.

¹⁵ The minimum initial margin a person must deposit when establishing an open position in a futures contract and the minimum level that must be maintained is set by the exchanges and is changed from time to time. The margin level depends on factors such as the volatility of the price of the underlying instrument and the maximum daily change in the futures price the exchange allows. Margins also may

Interest rate futures hedge the interest rate risk of many fixed income assets successfully because interest rate futures prices are closely related to the prices of many fixed income assets. The prices are closely related because interest rate futures prices are sensitive to changes in interest rates just like fixed income asset prices. The price of any futures contract—whether it is an interest rate, exchange rate, commodity, or any other type of futures contract—is always very closely related to the

depend on whether a person is just buying or selling futures alone or is buying or selling futures to establish a hedge. The margin on an outright purchase or sale of CBT Treasury bond futures is \$2,500. Although interest is generally paid on the initial margin, interest is not paid on additions to the margin account because additions represent losses that have been transferred to the accounts of parties that have gained from price movements.

price of the underlying asset.¹⁶ Since interest rate futures are based on fixed income assets and the prices of these assets move in the opposite direction of interest rates, interest rate futures prices move in the opposite direction of interest rates.

Like any other hedging asset, though, the extent to which a given interest rate futures contract will provide an effective hedge for a fixed income asset depends on how closely the futures price is related to the price of the asset being hedged. Chart 4, for example, shows that the prices of a 30-year Treasury bond and the CBT Treasury bond futures are nearly identical.¹⁷ The small differences that do exist are shown at the bottom of the chart. Because of this close

relationship, Treasury bond futures should be very effective at hedging Treasury bonds against interest rate volatility.

In contrast, the price of the CBT Treasury bond futures is not as closely related to the price of a 30-year corporate bond as to the price of the 30-year Treasury bond (Chart 5). The difference between the corporate bond price and the futures price is clearly more variable than the difference between the Treasury bond price and the futures price.

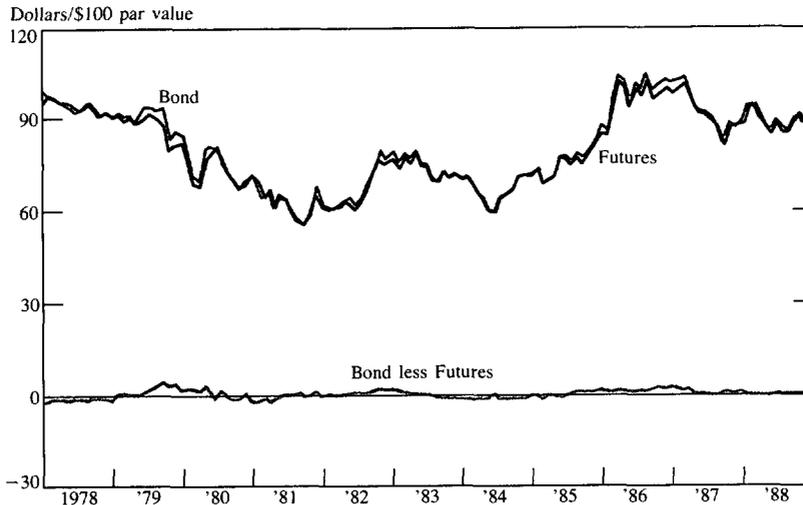
The prices of corporate bonds and Treasury bond futures are less closely related because corporate bond prices can change for a variety of reasons other than changes in the general level of interest rates. For example, the price of a corporate bond would fall if the issuer's credit rating fell or if adverse general economic conditions led investors to believe the chances of default were more likely. The price of a corporate bond could also fall if a large investor decided to sell his share of an issue. Since these factors would not affect the price of a Treasury bond, a Treasury bond futures contract would not hedge an investor against these price changes. As a result, Treasury bond futures should be a less effective hedge for a corporate bond than for a Treasury bond.¹⁸

¹⁶ The relationship between the price of a futures contract and the price of its underlying asset is most easily seen on the last day of trading for a particular contract, at which time the two prices must be exactly equal. In general, if there are no transaction costs and capital markets are perfect, the difference between a futures price and the price of the underlying asset can be no larger than the net cost of holding the underlying asset in inventory—inventory costs less income flows from the asset—until the futures contract expires. This relationship between the price of a futures contract and the price of its underlying asset is known as the cost of carry theory of futures prices. Prices do deviate slightly from cost of carry, though, because of transaction costs and capital market imperfections. For a detailed discussion of the relationship between interest rate futures prices and bond prices, see James M. Little, "What are Financial Futures?" in Nancy H. Rothstein and James M. Little, eds. *The Handbook of Financial Futures* (New York: McGraw-Hill Book Company, 1984), pp. 35-66.

¹⁷ The closeness of these two prices should not be surprising. The CBT Treasury bond futures price should be very closely related to the price of its underlying asset, which is an 8 percent 20-year Treasury bond. Since 30-year Treasury bond prices and 20-year Treasury bond prices are closely related, the futures price, and the bond price in Chart 4 are closely related.

¹⁸ Viewed another way, Treasury bond futures are less effective in hedging the *total* risk of a corporate bond than a Treasury bond because (1) Treasury bond futures only hedge interest rate risk, and (2) interest rate risk accounts for a smaller share of the total risk of a corporate bond than of a Treasury bond. In terms of hedging only the interest rate risk of a corporate bond—that is, changes in the price of the corporate bond due to changes in interest rates—Treasury bond futures should be fairly effective.

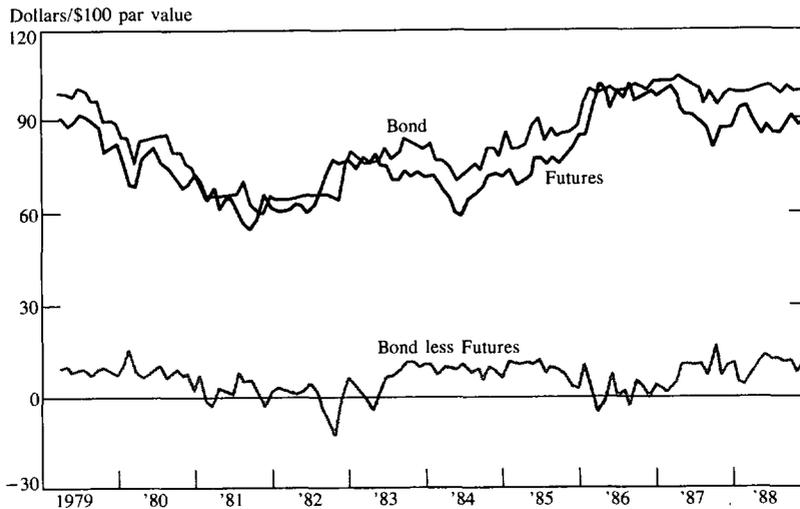
CHART 4
Treasury bond futures price and treasury bond price



Note: The bond price is the price of the 9 ¼ percent 30-year Treasury bond that matures in November 2007. The futures price is the price of the nearest Chicago Board of Trade Treasury bond future with at least one month until expiration.

Source: Data Resources Inc.

CHART 5
Treasury bond futures price and corporate bond price



Note: Corporate bond is an A-rated 9 ½ percent 30-year bond of a U.S. industrial firm. The futures price is the price of the nearest Chicago Board of Trade Treasury bond future with at least one month until expiration.

Source: Data Resources Inc.

Managing interest rate risk with interest rate futures

Businesses and investors use interest rate futures in a variety of ways to manage interest rate risk. Hedging strategies can be complex, however, and this can expose investors to new risks. This section provides some specific examples of how interest rate futures are used to hedge interest rate risk and then discusses some of the other risks involved in hedging with interest rate futures.

Hedging interest rate risk with interest rate futures

Investors can hedge interest rate risk by selling or buying interest rate futures. Whether an investor sells or buys futures depends on how changes in interest rates affect the value of his portfolio.

In general, an investor who suffers losses on his investment portfolio when interest rates *rise* hedges interest rate risk by *selling* interest rate futures.¹⁹ When interest rates rise, interest rate futures prices fall. If an investor loses money on his portfolio when interest rates rise, then, he needs to make a profit from falling futures prices. That is, he needs the gain on his futures contract to offset the loss on his original investment portfolio. Since sellers of futures make a profit when futures prices fall, the investor would hedge by selling futures. Similarly, when interest rates fall, the losses on the futures off-

¹⁹ Of course, an equivalent statement of this rule is that an investor who makes profits on his investment portfolio when interest rates fall hedges interest rate risk by selling interest rate futures.

set the profits on the original investment portfolio.

Conversely, an investor who suffers losses on his portfolio when interest rates *fall* hedges by *buying* interest rate futures. When interest rates fall, interest rate futures prices rise. If an investor loses money on his portfolio when interest rates fall, he needs to make a profit from rising futures prices. Since buyers of futures make a profit when futures prices rise, the investor would hedge by buying futures. Similarly, when interest rates rise, the losses on the futures offset the profits on the portfolio.

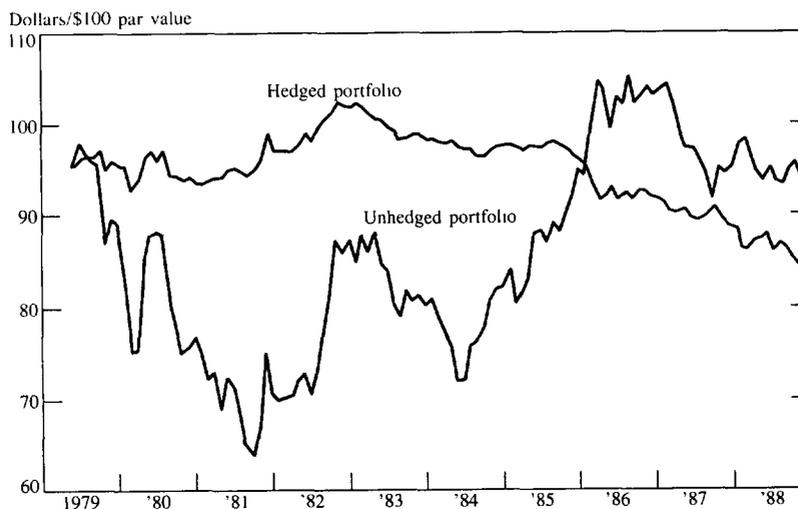
Hedging a Treasury bond portfolio. Treasury bond prices fall when interest rates rise, so an investor in Treasury bonds would hedge his portfolio against changes in interest rates by selling interest rate futures. In this way, a gain or loss on the Treasury bonds would be offset by a loss or gain on the futures contracts.

An example of the reduction in price volatility that can be achieved by hedging is shown in Chart 6. This chart shows the price of a portfolio of unhedged Treasury bonds and the price of a hedged portfolio. The unhedged portfolio contains 30-year and 10-year U.S. Treasury bonds. The bonds are hedged using the CBT Treasury bond futures.²⁰ The value of the

²⁰ This example assumes the investor wants to minimize risk. For simplicity, the value of the hedged portfolio ignores the effects of margin requirements, transaction costs, taxation, accounting practices, and regulatory requirements, all of which could affect the value of the hedge and the hedging strategy. The prices are end-of-month data, and the futures price is on the nearest contract with at least one month until expiration.

The example does not account for the possibility that risk could be reduced further by (1) using futures with contract months that are farther out, and (2) estimating the number of contracts to sell over shorter time periods and then

CHART 6
Hedging treasury bonds



Note: The bond portfolio is an equally weighted portfolio of the 30-year U.S. Treasury bond that matures in November 2007 and the 10-year U.S. Treasury bond that matures in May 1989. The hedged price is the price of the minimum risk hedged portfolio of bonds using the nearest futures contract with at least one month until expiration.

Source: Data Resources Inc.

hedged portfolio of bonds is clearly less variable than the value of the unhedged portfolio. The volatility of the price of the hedged portfolio, measured by the standard deviation of the change in price, is 60 percent lower than the volatility of the price of the unhedged portfolio.

Hedging a corporate bond. An investor in corporate bonds would hedge his portfolio against changes in interest rates by selling interest rate futures because corporate bond prices fall when interest rates rise. Corporate

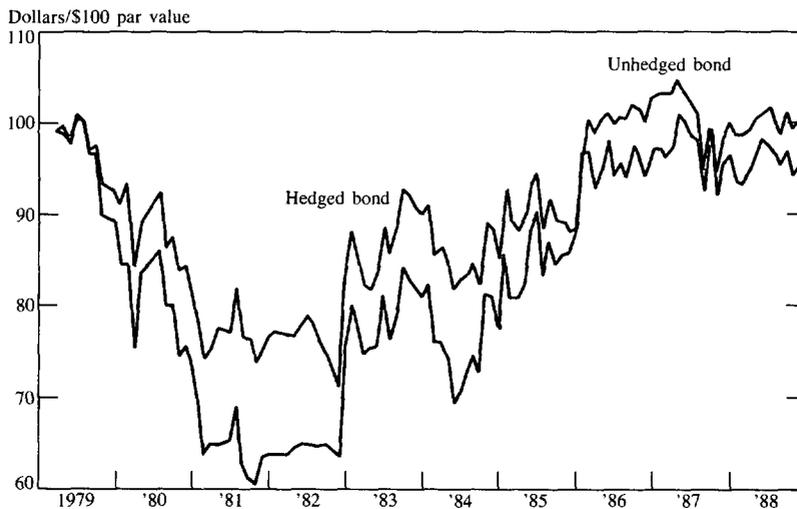
bond futures do not exist, so the investor would use Treasury bond futures as a hedge. Treasury bond futures should be a less effective hedge for corporate bonds than for Treasury bonds, however, because Treasury bond futures prices are not as closely related to corporate bond prices as to Treasury bond prices.

An example of the reduction in the price volatility of a corporate bond that can be achieved by hedging is shown in Chart 7. This chart shows the prices of an A-rated 9-1/2 percent 30-year bond of a U.S. industrial company and the value of the hedged bond.²¹

adjusting the number of contracts to account for the changes. On the other hand, the example could be overstating the degree of risk reduction because the number of contracts sold is estimated from actual price data over the hedging period, whereas investors must estimate the number of contracts using data from periods prior to the hedging period.

²¹ The qualifications and assumptions that applied to the hedge of the Treasury bond portfolio also apply to this example (see footnote 20).

CHART 7
Hedging corporate bonds



Note: Corporate bond is an A-rated 9½ percent 30-year bond of a U.S. industrial firm. The hedged price is the price of the minimum risk hedged bond using the nearest futures contract with at least one month until expiration.

Source: Data Resources Inc.

The value of the hedged bond is still quite variable, but less variable than the unhedged portfolio. The standard deviation of the change in the value of the hedged bond is 8 percent lower than that of the unhedged portfolio. As expected, Treasury bond futures are a less effective hedge for corporate bonds than for Treasury bonds.²²

²² Although Treasury bond futures did not provide a good hedge for a single corporate bond, they should provide a better hedge for a portfolio of corporate bonds. The corporate bond in this example had an A rating, which suggests that credit risk is at least partly responsible for the relatively poor relationship between the bond price and the futures price. A diversified portfolio of corporate bonds, however, would be exposed to less credit risk, and therefore its price would be more closely related to the futures price.

Depository institutions. Depository institutions, such as banks and S&Ls, would hedge net worth against changes in interest rates by selling interest rate futures because their net worth generally falls when interest rates rise.²³

²³ The best futures contract for hedging a depository institution's net worth is one whose price sensitivity to interest rate changes is as close as possible to the sensitivity of the institution's net worth to interest rate changes. The sensitivity of the institution's net worth to interest rate changes rises with the extent to which its asset and liability maturities are mismatched. Thus, institutions whose maturity structure is only slightly mismatched would choose futures contracts based on short-term assets, such as Treasury bills or Eurodollar time deposits. On the other hand, institutions whose maturity structure is highly mismatched would choose futures contracts based on longer term assets, such as Treasury bond and note futures.

When interest rates rise, the net worth of a typical depository institution falls because the value of its assets falls by more than the value of its liabilities. For example, suppose an S&L has assets with a market value of \$100 million and liabilities with a market value of \$90 million, resulting in a net worth of \$10 million. If interest rates rise, the value of the assets might fall by, say, \$5 million to \$95 million. Since the liabilities have shorter maturities, their value would fall by only, say, \$4 million to \$86 million, resulting in a net worth of \$9 million. But interest rate futures prices also fall when interest rates rise. So if the S&L sells interest rate futures, the gain on the futures when interest rates rise would offset some of the \$1 million decline in net worth due to the rise in interest rates.²⁴

Securities dealers. Securities dealers hedge interest rate risk by selling interest rate futures sometimes and buying them at other times. Securities dealers would hedge the bonds they have in inventory against changes in interest rates like any other bondholder by selling interest rate futures. On the other hand, securities dealers would hedge bonds they are committed to deliver at a future date for a predetermined price against changes in interest rates by buying interest rate futures.

To understand when securities dealers would buy futures, consider the following example. Suppose a securities dealer has agreed to deliver \$10 million face value of Treasury bonds for \$90.00 per \$100 face value of bonds in two months, and the current price of the bonds is \$89.50 per \$100. If the dealer had the bonds in inventory or the funds to buy them, he would make a profit of \$0.50 per \$100, or \$50,000. If not, though, he faces the risk that interest rates will fall and bond prices will rise. For example, if interest rates fall and bond prices rise \$0.25, he would have to pay \$89.75 per \$100 for the bonds, and the profit on the commitment would fall 50 percent to \$25,000. However, if interest rates fall, the futures price should rise. Since a person who buys a futures contract makes a profit when its price rises, the profit on the futures should offset much of the decrease in the profit on the commitment when interest rates fall.

Mortgage banks. Because the value of mortgage commitments falls when interest rates rise, mortgage bankers would hedge mortgage commitments against changes in interest rates by selling interest rate futures. For example, suppose a mortgage banker commits to a 10 percent interest rate on a \$100,000 mortgage. If the mortgage closes in two months and interest rates do not change, the mortgage banker could sell the mortgage for \$100,000. However, if interest rates rise, the value of the mortgage will fall. If, for example, the mortgage value falls to \$98,000, the value of the mortgage commitment would fall \$2,000. But since interest rates rose, interest rate futures prices would have fallen. Therefore, if the mortgage banker sells interest rate futures, the profit on the futures he sold would offset the loss on the mortgage commitment when interest rates rise.

²⁴ Of course, when interest rates fall, the value of the S&L's assets will rise more than the value of its liabilities, but the gain in net worth will be offset by a loss on the futures. In other words, like any other hedging asset, futures offset capital gains as well as capital losses. In the remaining examples, the discussion will focus on how hedging with futures offsets capital losses, but it is important to remember that futures hedges also offset capital gains.

Life insurance companies. Life insurance companies would hedge GIC commitments against changes in interest rates by buying interest rate futures. For example, suppose a life insurance company commits to a 10 percent interest rate on a GIC but will not receive the funds for two months. In addition, suppose the life insurance company expects to invest the funds in an 11 percent corporate bond. If interest rates do not change in the two-month period, the life insurance company would earn a spread of one percentage point. But if interest rates fall and the corporate bond rate falls to, say, 10.5 percent, the spread earned on the GIC would fall 50 percent to 0.5 percentage points. When interest rates fall, though, interest rate futures prices rise. Therefore, by buying futures, life insurance companies can offset declines in the spread on GIC commitments when interest rates fall.²⁵

The risks of hedging with interest rate futures

Although hedging with interest rate futures allows investors to reduce interest rate risk, it generally cannot completely eliminate risk. All hedges generally contain some residual, or basis, risk. Moreover, hedging also introduces some new risks. Some of those risks are credit risk, marking to market risk, and managerial risk.

Basis risk. The risk that remains after an

²⁵ Recall that a GIC commitment is a fixed rate liability that is not matched by an asset. Therefore, net worth falls when interest rates fall because the increase in the value of the GIC commitment is not offset by an increase in the value of an asset. Since net worth falls when interest rates fall, the GIC commitment can be hedged against changes in interest rates by buying interest rate futures.

investor hedges his portfolio is called basis risk. An investor who hedges his portfolio with interest rate futures bears basis risk because, when interest rates change, the change in the price of the futures contract does not perfectly offset the change in the price of the asset being hedged. Fixed income asset prices can change for reasons other than changes in interest rates. As a result, the basis risk in a hedge will be relatively high when factors other than interest rates are an important source of the changes in the price of the asset being hedged.

For example, an asset's price will fall if the issuer's credit rating falls or if the asset is relatively illiquid and a large amount is sold. Since these factors would not affect the prices of interest rate futures, such as Treasury bond futures, interest rate futures cannot offset price changes caused by such factors. In fact, that is why Treasury bond futures proved to be a less effective hedging instrument for the corporate bond than for the Treasury bond portfolio in the examples used in the preceding section.

Credit risk. The credit risk in an interest rate futures hedge is not that the opposite party in the futures contract will default, but that the opposite party in the asset being hedged will default. Individuals do not have to be concerned about the opposite party defaulting on a futures contract because every futures exchange has a clearing organization that is a party to every futures contract in order to guarantee the integrity of the contract.²⁶ That is, the clearing house is the seller in every contract bought

²⁶ The exchanges are also protected because many exchanges have limits on the amount a futures price can change within a day. The limits are equal to the minimum margin deposit that individuals must have on deposit with their broker.

and the buyer in every contract sold. But the risk remains that an investor will end up with an unhedged open futures position if there is a default on the asset being hedged.

For example, suppose an investor in corporate bonds hedges his portfolio against changes in interest rates by selling interest rate futures. If interest rates fall, the prices of the bond and futures will rise. Since futures were sold, the investor would suffer losses on the futures, but those losses would be offset by the gains on the bonds. If the bond issuer defaults, though, the investor would have the losses on his futures position but no gains to offset the losses.

Marking to market risk. Marking to market risk is the risk investors will have to cover futures losses when the contract is marked to market at the end of each day. All futures exchanges require every unsettled futures position to be marked to market every night and settled daily. That is, at the end of each day, funds are transferred from individuals who lose on their contracts to individuals who gain on their contracts so that buyers and sellers actually realize the gains and losses from daily price changes as they occur. A problem could occur for those who suffer losses on their futures position, though, because they must make immediate cash outlays. Although losses on futures contracts are generally offset by gains on the asset being hedged, investors usually do not receive those gains as they occur. Therefore, investors would either have to liquidate other investments and lose the associated income flows or pay interest on borrowed funds to cover their futures losses as they occur.

Managerial risk. Managerial risk, broadly defined, is the risk futures will be used inappropriately and result in greater, rather than less, risk. This is really a "catch all" category

that accounts for anything else that can go wrong with a hedging program. One major reason managerial risk arises is interest rate futures can be used for speculative purposes. In addition to being good assets for hedging, futures are also good assets for speculating on price movements for two reasons. First, it costs very little to open a futures position, and second, an open unhedged futures position is as risky as the underlying asset. While speculators play an important and useful role in futures markets, an institution that wants to hedge with futures must have internal controls to make sure those responsible for hedging are not speculating.

Managerial risk also arises because futures hedging strategies are complicated. Because they are complicated, it is possible for managers to make incorrect decisions that significantly lower a firm's value. For example, suppose a manager wants to minimize the interest rate risk of his bond portfolio, but he overhedges by selling too many futures contracts. If interest rates were to fall, the losses on the futures position could be much greater than the gains on the bonds. Thus, when overhedged, the riskiness of a portfolio is greater than the minimum level of risk and the return is less than that associated with the minimum level of risk. In fact, the riskiness of an overhedged portfolio can be even greater than the riskiness of the unhedged portfolio. To control this risk, it is important that managers understand the complexities of hedging with interest rate futures, the capabilities and limitations of a hedging program, and the need to continually monitor hedging programs.

Conclusion

The riskiness of investments in bonds and

other fixed income assets has increased in recent years because of increased interest rate volatility. The lack of traditional low-cost methods for managing this increase in interest rate risk led to the development of many new financial instruments that can be used to hedge interest rate risk. One of the most popular types of instruments is interest rate futures contracts. Interest rate futures are now trading on exchanges around the world, and they have become an important part of virtually every

portfolio manager's tool kit for managing interest rate risk.

This article showed how interest rate futures can be used to manage interest rate risk. In many cases, interest rate risk can be substantially reduced. It must be remembered, though, that hedging with interest rate futures can be complex, and investors must thoroughly examine all aspects of interest rate futures and hedging techniques before implementing a hedging strategy.

Federal Excise Taxes: Approaching Deficit Reduction from the Revenue Side

By Glenn H. Miller, Jr.

The U.S. budget deficit has recently followed a downward course, yet some projections still show large deficits through 1994 if no fiscal policy changes are made. Many analysts believe the deficit is impairing the prospects for future U.S. economic growth and threatening the outlook for the U.S. standard of living. The failure to take steps to ensure further deficit reduction reflects the difficult choices facing fiscal policymakers.

In debates over which deficit reduction options to adopt, some persons emphasize the role of economic growth and federal spending restraint. Others insist that tax increases must play a role in reducing the deficit. Many of those supporting tax increases favor increases in narrow-based consumption taxes, especially the federal excise taxes on alcohol, tobacco, and motor fuels. Such increases would do more than

raise revenue, however. They would also affect consumption patterns and the distribution of the tax burden.¹

This article reviews estimates of the revenue-raising power of moderate increases in federal excise taxes on alcohol, tobacco, and motor fuels, and examines the major drawbacks and offsetting virtues of such increases. The first section documents the need for deficit reduction. The second section shows how moderate increases in federal alcohol, tobacco, and motor fuels taxes could significantly contribute to deficit reduction. The third and fourth sections evaluate increases in those excise taxes against the objectives of a good tax system: equity, neutrality, and simplicity. The article maintains that if revenue increases are deemed an appropriate part of a deficit reduction package, then

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¹ Excise tax increases would also likely influence the level of output and the general price level. This article does not discuss those macroeconomic effects.

higher taxes on alcoholic beverages, tobacco products, and motor fuels deserve serious attention.

Reducing the federal budget deficit

The Congressional Budget Office (CBO) projects that the budget deficit will decline slowly through fiscal year (FY) 1994 with current budgetary policies unchanged. Yet even with this projected decline, a sizable deficit is still projected for FY 1994. Many persons agree that further deficit reductions are needed to help increase savings and investment in the United States and thereby improve the outlook for future U.S. living standards. Disagreement remains, however, on what fiscal policy actions should be taken to further reduce the deficit.

After rising through the mid-1980s, the federal budget deficit now appears to be set on a slow downward course. The deficit in FY 1980 stood at \$74 billion. After soaring to \$221 billion in FY 1986 and falling sharply to \$150 billion in FY 1987, the deficit edged back up to \$155 billion in FY 1988. The CBO projects that with current tax and spending policies (the baseline deficit projections), the deficit will decline to \$122 billion in FY 1994 (Table 1).²

Projected deficits for each year from now through FY 1993 fall short of reaching the Gramm-Rudman (G-R) deficit targets. Those targets fall steadily from \$100 billion for FY 1990 to zero (or budget balance) for FY 1993

(Table 1). In the absence of faster economic growth than projected by the CBO, further fiscal policy actions appear needed to close the gap between the G-R targets and the projected current policy deficits.

Reducing the deficit: Why?

Federal Reserve Chairman Alan Greenspan, remarking on "the long-term corrosive impact of the deficit," has argued that "the case for bringing down the deficit is compelling."³ The large deficits of the 1980s have dampened saving and investment in the United States and lessened the expected growth of the U.S. standard of living. Federal budget deficits absorb savings, leaving less available for private investment. Heavy borrowing to finance deficits also puts upward pressure on interest rates, raising the cost of capital and further inhibiting investment spending.

The negative effects of the deficit have been mitigated by inflows of foreign capital, but those inflows have been associated with large trade deficits, leading many economists to view the budget deficit and the trade deficit as twin problems. Some economists argue that the ultimate effects of the twin deficits will be a further reduction in U.S. living standards relative to other industrial nations, due to weaker U.S. investment spending and the need to meet large foreign debt obligations.⁴

² The deficit as a share of gross national product is projected to decline even faster as the deficit itself shrinks and GNP grows. Given the CBO projections of GNP growth, the deficit is expected to be 1.7 percent of GNP in FY 1994 compared with 3.4 percent in FY 1987. The size of the deficit relative to GNP would remain high by historical standards, however.

³ Alan Greenspan, "Statement to the National Economic Commission," November 16, 1988, reprinted in *Federal Reserve Bulletin* (January 1989), p. 15.

⁴ C. Alan Garner, "Policy Options to Improve the U.S. Standard of Living," *Economic Review*, Federal Reserve Bank of Kansas City (November 1988), pp. 9-16.

TABLE 1
Deficit projections and targets, fiscal years 1988-94
 (billions of dollars)

	Actual	Projections					
	1988	1989	1990	1991	1992	1993	1994
Baseline deficit projections	155	155	141	140	135	129	122
Gramm-Rudman deficit targets	144	136	100	64	28	0	—

Source: Congressional Budget Office, *The Economic and Budget Outlook: Fiscal Years 1990-1994*, January 1989.

In short, economists generally agree that deficit reduction is needed because the budget deficit is harmful to the U.S. economy. In Chairman Greenspan's words, "The deficit already has begun to eat away at the foundations of our economic strength. And the need to deal with it is becoming ever more urgent."⁵

Reducing the deficit: How?

While there is broad agreement on the need for deficit reduction, there is less agreement on how to do it. Assuming that economic expansion alone will not let the country grow out of the deficit, fiscal policymakers have few options.⁶ They can either cut expenditures or

increase revenues.⁷

Revenue increases for deficit reduction could come from higher taxes on consumption, personal income, or business income. People are reluctant to propose major changes in personal and business income taxes, however, because the Tax Reform Act of 1986 has been in effect for only a short time. Furthermore, taxing income reduces the net rate of return on saving and thus inhibits saving, investment, and economic growth more than taxing consumption does. In contrast, a consumption tax favors saving relative to consumption when compared with an income tax. Some economists argue that

⁵ Greenspan, "Statement to the National Economic Commission," p. 15.

⁶ Assumptions that would allow enough economic expansion to permit growing out of the deficit were called "very unlikely" by Chairman Greenspan, according to a published report of his testimony to the National Economic Commission. *Congressional Quarterly Weekly Report*, November 26, 1988, p. 3385.

⁷ A large number of different deficit reduction packages may be put together. For a detailed listing of options for both spending cuts and revenue increases, see CBO, *Reducing the Deficit: Spending and Revenue Options*, (CBO, February 1989). For discussion of one set of judgments on reaching budget balance, see Joseph J. Minarik and Rudolph G. Penner, "Fiscal Choices," *Challenge to Leadership: Economic and Social Issues for the Next Decade*, Isabel V. Sawhill, ed. (Washington, D.C.: The Urban Institute Press, 1988).

an income tax taxes savings twice. All income is taxed when earned, and then interest on saved income is taxed again. Because consumption taxes do not tax savings, it is argued that with such taxes people will consume less and save more—providing savings that could then be used for investment to enhance productivity and living standards.

A consumption tax may be either broad-based or narrow-based. A broad-based consumption tax, in turn, may be either a direct tax or an indirect tax. Direct taxes are levied on those meant to bear the tax burden, while indirect taxes are imposed elsewhere but then shifted to those who finally bear the burden. An example of a direct, broad-based consumption tax is a personal expenditure tax, which taxes an individual on his income less his savings, making his consumption the expenditure tax base. An indirect, broad-based consumption tax, on the other hand, is levied on commodities or transactions. In the United States, the most familiar tax of this kind is the retail sales tax. Less familiar, though essentially equivalent except in the method of administration, is the value-added tax (VAT).⁸

Selective excise taxes on specific transactions, commodities, or groups of commodities are indirect, narrow-based consumption taxes.

⁸ For further information on an expenditure tax, see Glenn H. Miller, Jr., "Alternatives to the Current Individual Income Tax," *Economic Review*, Federal Reserve Bank of Kansas City (September/October 1984), pp. 11-14, and references cited there. For a detailed discussion of the VAT, including a comparison with a retail sales tax, see Glenn H. Miller, Jr., "The Value-Added Tax: Cash Cow or Pig in a Poke?" *Economic Review*, Federal Reserve Bank of Kansas City (September/October 1986), pp. 3-15.

TABLE 2
Federal excise tax receipts,
fiscal year 1988
(billions of dollars)

Tax	Receipts
Alcohol	5.7
Tobacco	4.6
Gasoline and diesel fuel	11.9
All other	13.0
Total	35.2

Source: Office of Management and Budget, *Budget of the United States Government, Fiscal Year 1990*, (OMB, 1989).

Over the past 75 years, the federal government has levied excise taxes on a wide range of items, including cigarettes and the matches to light them, telephone service, admissions to movies, leasing of safe-deposit boxes, jewelry, and furs. Most federal excises, however, were eliminated by the Excise Tax Reduction Act of 1965.

In FY 1988, total federal excise taxes were \$35.2 billion, or about 3.9 percent of total federal receipts (Table 2). Taxes of about \$5.7 billion on alcohol and about \$4.6 billion on tobacco accounted for approximately 29 percent of total excise receipts. Receipts from motor fuels taxes contributed \$11.9 billion to the Highway Trust Fund and accounted for about 34 percent of all excise receipts.

Admittedly, excise tax receipts are a small part of total federal receipts. However, moderate increases in a small set of excises could perhaps make a significant contribution to deficit reduction.

Revenue increases from federal excises

Discussions of using higher federal excise taxes as a revenue source to reduce the budget deficit generally focus on increasing the taxes on alcohol, tobacco, and motor fuels. Moderate increases in these narrow-based consumption taxes could produce a significant addition to revenues.

U.S. excise tax rates have changed little over the past three decades. As a result, excise tax revenues have declined substantially as a share of total receipts. As product prices have risen through the years, the burden of these taxes has fallen sharply when expressed as a proportion of the prices of the taxed items.

Alcohol and tobacco taxes

Since the 1950s, excise tax rates on alcohol and tobacco products have remained relatively constant in the United States and are well below those in other industrial countries. In 1951, the tax on a pack of cigarettes was 8 cents. The tax was increased to 16 cents in 1983, but its share of the price remained far below what it was in the 1950s. The tax on distilled spirits was increased slightly in 1985, but taxes on beer and wine have not been raised since 1951. Moreover, the rates charged on beer, wine, and distilled spirits vary significantly according to alcoholic content.⁹

Increases in alcohol and tobacco excises would restore a considerable part of the real

value of these taxes. The CBO estimates that increasing the tax on distilled spirits from \$12.50 to \$15.00 per proof gallon would raise about \$0.4 billion a year in revenue, or about \$2 billion from 1990 through 1994. Doing so might add about 40 cents to the price of a 750 milliliter bottle of 80-proof liquor. Raising the tax on beer and wine to a level equivalent to that on distilled spirits per ounce of alcohol content would raise nearly \$5 billion a year in revenues from 1990 through 1994. Such an increase would raise the federal excise tax on a 750 milliliter bottle of wine from 3 cents to 54 cents, and that on a six-pack of beer from 16 cents to 63 cents. A doubling of the cigarette tax to 32 cents a pack would provide additional revenue of nearly \$3 billion a year from 1990 through 1994.¹⁰

Motor fuels tax

The federal government has levied gasoline taxes and other automobile-connected excise taxes for over 50 years. Although already viewed implicitly as user charges, in the late 1950s such taxes were earmarked for the Highway Trust Fund as construction of the Interstate Highway System got under way.

In FY 1988, total Highway Trust Fund receipts were about \$14.1 billion. Taxes on gasoline and diesel fuel used on highways made up about \$11.9 billion, or 84 percent, of the total. The gasoline tax is currently 9.1 cents per gallon and the diesel fuel tax is 15.1 cents per gallon.

⁹ Present excises are estimated to be about 10 cents an ounce of alcohol for distilled spirits, 5 cents for beer, and 1 cent for wine.

¹⁰ All estimates of projected revenues from tax increases are from CBO, *Reducing the Deficit: Spending and Revenue Options* (CBO, February 1989).

The real value of motor fuels taxes has not eroded since the 1950s as much as that of alcohol and tobacco taxes; however, moderate increases in motor fuels taxes would bring the taxes closer to their real values of the early 1980s. The CBO estimates that a 12-cent-per-gallon increase in the federal excise tax on both gasoline and diesel fuel for highway use would yield additional revenue of between \$11 billion and \$12 billion per year from FY 1990 through FY 1994.¹¹ This estimate produces the widely used rule of thumb that each one-cent-per-gallon increase in the gasoline excise tax would yield about \$1 billion per year in additional revenue. With the average national price of gasoline at about a dollar a gallon, raising the federal excise tax by 12 cents would still leave the price at the pump below its peak in the early 1980s and well below gasoline prices in other industrial countries.¹²

¹¹ Increases in energy taxes other than the motor fuel taxes are sometimes suggested as means of deficit reduction. Additional revenues of about \$9 billion a year are projected for a \$5 per barrel fee on imported oil. Other more broadly based energy taxes would provide more revenue. A tax of \$5 per barrel on both domestic and imported oil is projected to produce about \$21 billion a year in additional revenue, while a 5 percent tax on total domestic energy consumption is estimated to raise just under \$15 billion a year. For a detailed discussion of oil taxes and deficit reduction, see CBO, *The Budgetary and Economic Effects of Oil Taxes* (CBO, April 1986); see also Tim R. Smith, "U.S. Energy Policy in a Changing Market Environment," *Economic Review*, Federal Reserve Bank of Kansas City (September/October 1986), pp. 16-30.

¹² The U.S. average national price of gasoline reached about \$1.40 per gallon in the early 1980s. Gasoline prices in western Europe and Japan, including tax, range from about \$2.25 to about \$3.75 per gallon. The tax share ranges from about one-half to about three-fourths of the total price in those countries, compared with about one-third in the United States.

When taken as a whole, the projected revenue increases from higher excise taxes on alcohol, tobacco, and motor fuels are significant.¹³ The increases described above together could produce almost \$20 billion a year on average over the next five years, when current policy deficits are estimated to average about \$133 billion a year (Table 3).¹⁴

Objectives of a good tax structure

As shown in the previous section, moderate increases in excise taxes on alcohol, tobacco, and motor fuels could raise significant amounts of revenue. Such tax increases may be supported on grounds besides their revenue raising capacity, and may also be opposed for reasons other than just wanting to avoid any tax hikes. Several of the arguments for and against excise tax increases may be examined in light of the objectives of a good tax structure.

While tax systems develop as a result of many influences, economists have set forth some guidelines to taxation. Such guidelines are often

¹³ Strictly speaking, the amounts of deficit reduction from the separate options prepared by the CBO cannot simply be added together to give totals. The effects of each option were calculated separately and there would be interactions between them if many were enacted. Such interaction effects are probably small when estimates are summed for just the excise taxes discussed here.

¹⁴ These excise tax increases would be close to the projected receipts from a 5 percent surcharge on the individual income tax. Imposition of a broad-based consumption tax could be more revenue productive than these selective excise tax increases. For example, a VAT levied at a 5 percent rate with exemptions for food, housing, and medical care could produce more than \$70 billion a year in added revenues when fully operational.

TABLE 3
Estimated cumulative five-year
addition to revenues from selected
excise tax increases,
fiscal years 1990-94
(billions of dollars)

Tax increase	Additional revenues
Cigarette tax ¹	14.2
Tax on distilled spirits ²	2.2
Taxes on wine and beer ³	24.2
Motor fuels tax ⁴	57.8
Total⁵	98.4
Addenda	
Impose a value-added tax ⁶	281.9
Add a 5 percent surtax to the individual income tax	121.4
Footnotes:	
¹ From 16 to 32 cents per pack.	
² From \$12.50 to \$15 per proof gallon.	
³ To alcohol-equivalent rate on distilled spirits.	
⁴ By 12 cents per gallon, from 9 cents for gasoline and 15 cents for diesel fuel.	
⁵ See text footnote 13.	
⁶ At a 5 percent rate, with exemptions for food, housing, and medical care.	
Source: Congressional Budget Office, <i>Reducing the Deficit: Spending and Revenue Options</i> , (CBO, February 1989).	

expressed in terms of several generally accepted objectives of a good tax structure. These objectives may then be used as criteria for evaluating tax systems or individual taxes.

A good tax structure includes three generally accepted objectives: equity, or fairness in the distribution of the tax burden; neutrality,

or minimum interference with economic decisions and behavior in otherwise efficient markets; and simplicity, or effective and understandable administration of a tax.¹⁵

The good tax structure described by these objectives is an ideal, which cannot be fully attained in practice. For example, attainment of an objective may depend on the assumption of pre-tax conditions not present in the real world. Moreover, the individual objectives themselves may be in conflict. In other words, the pursuit of equity may interfere with neutrality, or achieving equity may be possible only with less simplicity. In practice, then, tradeoffs between the objectives may be required. Evaluating taxes against the generally accepted objectives of a good tax structure is still a useful exercise, however, as policymakers and other citizens decide what tradeoffs are acceptable.

Equity

The equity objective calls for the burden of taxation to be distributed fairly among taxpayers. Three approaches to achieving equity in taxation are the ability-to-pay principle, the benefit principle, and the sumptuary principle.

According to the ability-to-pay principle, the burden of taxation should be distributed on the basis of some measure of taxpayers' economic conditions. Thus, taxpayers would contribute to the cost of government according to their economic capacities.

¹⁵ Richard A. Musgrave and Peggy B. Musgrave, *Public Finance in Theory and Practice*, 2d ed. (New York: McGraw-Hill Book Co., 1976), pp. 210-11.

Fairness in taxation under the ability-to-pay principle is usually evaluated in terms of vertical equity and horizontal equity. Vertical equity requires that people in different situations are treated differently. Horizontal equity requires that people in similar situations are treated similarly. Income is generally accepted as the measure of a taxpayer's economic condition to be used in judgments about the equitable distribution of tax burden.¹⁶ With regard to vertical equity, a tax is progressive when those in higher income classes pay a larger share of their incomes in taxes than those in lower income classes. A tax is regressive when those in lower income classes pay a larger share of their incomes in taxes. A tax is proportional when people in all income classes pay the same share of their incomes in taxes.

The second approach to achieving equity, the benefit principle, calls for the tax burden to be distributed on the basis of taxpayers' benefit from, or use of, public services. Such an approach is fair because taxpayers contribute to the cost of government according to the benefits received from government activities.

The third approach to achieving equity, the

sumptuary principle, allows society to tax behavior or activities that it deems immoral or antisocial. Sumptuary taxes to penalize and discourage such activities are thus not inequitable. Those taxpayers finding the burden too heavy can escape it by voluntarily ceasing the activity, while those who choose to continue it are properly and fairly contributing to the cost of government.

Most contemporary discussions of equity in taxation involve the ability-to-pay principle, rather than the sumptuary or benefit principles. Few object to the horizontal equity standard, and progressivity is widely accepted as the standard for vertical equity. The sumptuary principle is frequently condemned and is not widely accepted as a means toward equity in taxation. The benefit principle as a standard of fairness is best represented by user fees for public services that directly benefit clearly identifiable users.

Neutrality

The neutrality objective calls for minimal interference of taxation with economic decisions and behavior. Important to this objective is the concept of efficient resource allocation by a competitive market system, which uses the economy's resources and technology to produce the most goods and services possible to meet consumers' desires. In considering the effects of taxes on taxpayers' decisions and behavior, such an efficient allocation of resources is usually implicitly assumed to exist before imposition of a tax. In such a situation, nearly all taxes interfere with the allocation of resources because they lead taxpayers to change their behavior. For example, if consumers were satisfying their preferences before imposition

¹⁶ Consumption expenditures are sometimes suggested as an alternative measure, however. The rationale is that total expenditures reflect long-time incomes and are thus better indicators of taxpayers' economic situations than are incomes for a single year. This view implies that questions about the equitable distribution of tax burden should be answered by looking at the share of total expenditures paid in taxes by each income group. Significantly different results may be obtained when the distributional effects of taxes are measured relative to expenditures than when measured relative to incomes. This is demonstrated for federal excise taxes in CBO, "The Distributional Effects of an Increase in Selected Federal Excise Taxes," Staff Working Paper, January 1987.

of a tax, their new after-tax consumption patterns bring reduced satisfaction. The change in consumer purchases that occurs causes resources to be reallocated following imposition of the tax, therefore the tax is not neutral.

Only one tax, a lump-sum head tax, or poll tax, is neutral with regard to all economic choices, such as choices between income and leisure, between present and future consumption, and between various consumer goods. Paying a head tax does not interfere with a taxpayer's economic behavior because he cannot avoid or reduce it by changing his consumption, production, or work patterns.

In a market economy, efficient resource allocation depends on competition assuring that the output produced fits consumers' preferences. Firms seek to maximize profits by producing at least cost what consumers desire. Efficient resource allocation by such a system may be hindered in practice by deviations from the ideal. For example, efficiency may be lessened by markets that are imperfectly competitive, or by what are called externalities, or spillover effects.

Externalities are side effects of activities that affect the well-being of others, bringing to others incidental benefits or costs not paid for by those responsible for them. These spillover effects are not reflected in market transactions and interfere with the market system's efficient allocation of resources.

External costs of production or consumption not accounted for by the market are imposed on society rather than being properly allocated to the producers or consumers responsible for them. For example, a factory's emission of pollution into the air may impose health care costs on those around it. While they are real costs for society, the producer may disregard

these social costs because he does not pay for them. They enter neither his costs of production nor the market price for his product. Thus, while social costs may be greater than private costs, the market system only takes account of the latter and an inefficient allocation of resources results. Similar results may occur when consumption generates external costs.

Charging external costs to the producers or consumers responsible for them would internalize those costs and help improve an inefficient resource allocation. Government may intervene to internalize social costs in order to improve resource allocation, and taxes may be the instrument chosen to correct the inefficiencies. For example, charging spillover costs by taxing the consumers responsible for them would likely reduce the consumption. And, the revenues could be used to help remedy the impact of the negative externality.

Taxes used to correct inefficiencies due to externalities are not neutral because they interfere with economic decisions and behavior. But the neutrality objective generally assumes the introduction of taxes into an otherwise efficient market. When negative externalities are already interfering with efficient resource allocation, however, taxes may help correct those other inefficiencies and move the economy toward overall efficiency.

Sumptuary taxes and benefit taxes are sometimes viewed as special cases when judged against the neutrality objective. Both cases may be seen as situations involving externalities.

Sumptuary taxation, which changes consumption patterns and resource allocation from a nontax situation, is justified because society views consumption of the taxed goods as contrary to the public interest. Thus, the changes in consumption are viewed not as a cost but as

a gain. This case for sumptuary taxation, when more explicitly made, is really an example of using taxation as a remedy for the presence of negative externalities. Consumption of the taxed goods gives rise to social costs not included in their prices. Sumptuary taxes are intended to internalize those costs by placing them on the consumers of the taxed goods, thus reducing consumption and providing revenues to help pay for the social burden created.

Benefit taxes, or charges for public services that directly benefit clearly identifiable users, appear to conflict with the neutrality objective by curtailing consumption and altering resource use. Benefit taxes are collected where a specific publicly financed service is provided. The public expenditure reduces the cost of the service to consumers by subsidizing the activity and thus introduces an inefficient allocation of resources. Efficiency is reduced as more resources are drawn into the activity than are warranted. The benefit tax, or user charge on the service, acts to offset the subsidy and improves efficiency rather than worsening it. Thus, public expenditures may subsidize certain activities by providing external benefits that interfere with efficient resource allocation. In such cases, benefit taxes may help redress the balance toward efficiency. While apparently at odds with the neutrality objective, such use of benefit taxes helps secure more efficient resource use.

Simplicity

A good tax structure should be simple, understandable to the taxpayer, and as free as possible from arbitrary administration. Cost of administration and compliance should be minimal, given the other objectives.

Appraising the effects of excise tax increases

Moderate increases in taxes on alcohol, tobacco, and motor fuels would have effects in addition to their revenue-raising capacity. Consumption patterns would likely change as a result of such tax increases, and the burden of the tax hikes would probably not be distributed evenly. Raising more revenue by increasing these taxes should be relatively easy and efficient, since the means for doing so already exist.

Equity

The question of who finally pays excise taxes needs to be considered when judging how excises measure up to the equity objective. Excise taxes are normally passed on to consumers through price increases.¹⁷ The tax is typically collected by the seller, and the amount of the tax is included in the price charged to the consumer. Thus, the consumer bears the burden of the tax.

The ability-to-pay principle is most often used in evaluating how taxes measure up to the equity objective. Appraising the vertical equity of an excise tax—whether it is progressive or regressive—depends on expenditures on the taxed good relative to income, for different income classes. Since excises are generally levied at the same rate for all purchases of the taxed good, the distribution of purchases of the

¹⁷ “On the whole, the common assumption of complete forward shifting of an excise tax is in most cases close enough to reality to be a useful approximation, if the tax rate is moderate and the industry is growing.” Carl S. Shoup, *Public Finance* (Chicago: Aldine Publishing Co., 1969), p. 275.

good across income classes determines the distribution of an excise tax burden. Average expenditures for most goods subject to federal excise taxes are a much larger share of income for lower income groups than for higher income groups.¹⁸ The present set of federal excise taxes is regressive overall, and most individual excises are also regressive. Such taxes thus violate the objective of vertical equity.

Excise taxes also tend to compromise the objective of horizontal equity. All taxpayers within an income class are not likely to have the same preferences for taxed goods, and those who buy more will be taxed more heavily than others in a similar economic condition. The burden of the present federal excise taxes varies considerably within income classes, more so for some taxes than for others.

Excise taxes on alcohol and cigarettes perform poorly with regard to vertical equity. These taxes are generally regressive relative to income. Average expenditures on distilled spirits, wine, beer, and tobacco, all decline as a percent of income as income rises. The tobacco excise is clearly the most regressive of the four; the excises on distilled spirits and beer are more regressive than the tax on wine, which is about proportional.¹⁹

The principle of horizontal equity is also violated by the excise taxes on alcohol and cigarettes. In any income class, families with

strong preferences for these products are taxed more heavily than other families with similar incomes who spend their incomes differently. Some families make no purchases of alcohol and tobacco products. Moreover, the proportion of families that do purchase alcohol and tobacco varies within each income class. In addition, the amount of purchases may vary widely among those families in any income class that do make expenditures. These patterns suggest the absence of horizontal equity for alcohol and tobacco excises generally. The CBO concludes, "The incidence of [such] tax increases would vary the most within the lowest income classes."²⁰

Taxes on alcohol and tobacco products are sumptuary taxes and may also be evaluated against the sumptuary principle of equity, which says that taxes on actions deemed immoral or antisocial are fair. These taxes penalize consumption of alcohol and tobacco, but their success in discouraging consumption is open to question. Consumption of alcohol and tobacco is generally not very responsive to changes in income or relative prices. As a result, alcohol and tobacco taxes are better at raising revenue than at discouraging consumption of these products.

Motor fuels excise taxes are fair according to the benefit principle of the equity objective. Motor fuels taxes are paid into the Highway Trust Fund. Expenditures are made from the trust fund for the construction and maintenance of the nation's roadways, to the benefit of the highway users who pay the taxes. These taxes

¹⁸ Estimates of tax burden distribution used in this article are from CBO, "The Distributional Effects"

¹⁹ The tobacco excise is also regressive relative to expenditures, but the three alcohol excises are close to being proportional relative to expenditures.

²⁰ CBO, "The Distributional Effects . . . ," p. 2.

thus meet the standard of fairness represented by collecting user fees for public services that directly benefit clearly identifiable users.

Excise taxes on motor fuels do not measure up well to the ability-to-pay principle of the equity objective. Like selective excises generally, the gasoline tax fails the vertical equity test. Average expenditures for gasoline as a share of income decline steadily and substantially as incomes increase, making the federal excise tax on gasoline significantly regressive relative to income.²¹

The horizontal equity criterion for the gasoline tax, as for other excise taxes, depends on the distribution of spending on the taxed item within income classes. On a national average basis, spending for gasoline apparently varies little among families in the same income class, for incomes of \$10,000 or more. The divergence in spending for gasoline is greater among families in the lower income groups. A smaller share of these families buy any gasoline at all, and 20 percent of them account for more than 70 percent of all gasoline purchased by families in these income groups. Thus, with regard to the gasoline tax, horizontal equity appears to be less well served among low-income groups than among higher income groups.

There is also a geographic aspect to how the motor fuels tax measures up to the horizontal equity standard. The burden of the tax does not fall evenly on different parts of the country.

²¹ Relative to expenditures, however, the burden of the gasoline tax is greater for families in the middle-income ranges than for those with either larger or smaller incomes. This distribution of the burden reflects the fact that purchases of gasoline as a share of total expenditures are highest in the middle-income ranges.

State per capita motor fuel consumption is greater than the national average in the southern and western parts of the United States. Motor fuel taxes thus fall more heavily on people living in larger and less heavily populated states, that is, on drivers who typically travel greater distances than those living in smaller, more urbanized states, even when their income situations are similar.

Neutrality

Appraising excise taxes in light of the neutrality objective requires examining taxpayers' responses to the taxes. Paying excise taxes does affect consumer decisions and behavior. The higher price for the taxed good relative to the prices of other goods leads consumers to shift their purchases from taxed to untaxed goods. With new, higher prices for the taxed goods, consumers also have less disposable income and must reduce their saving, their consumption, or both. Consumers may reduce their purchases either of the taxed good or untaxed goods. If demand for the taxed good is highly elastic—that is, if the amount consumed of the taxed good responds significantly to price changes—consumption of the taxed good is more likely to be curtailed. If demand for the taxed good is highly inelastic, consumption of other goods is more likely to be curtailed.

Excise taxes on alcohol and tobacco may be justified in order to change consumers' decisions and behavior, because of negative externalities associated with consumption of those products. But the highly inelastic demand for alcohol and tobacco has implications for the outcome of such an approach.

The externalities case for alcohol and tobacco

taxes rests on the external costs associated with their consumption. Use of alcohol and tobacco endangers the health of consumers as well as the health and safety of others, and creates social costs not reflected in product prices. Taxing consumption of these products is thus an example of charging external costs to the consumers responsible for them. Alcohol and tobacco taxes both internalize the social costs of their consumption and provide revenue to help compensate for some of the adverse effects of that consumption. While such taxes interfere with consumer decisions and behavior by changing consumption patterns, those changes result in a gain to society. Inefficiencies already present due to negative externalities are corrected by the imposition of the taxes. But due to the inelastic demand for alcohol and tobacco, the internalization of costs that occurs is likely reflected more in increased revenues than in reduced consumption.

The motor fuels tax is an example of a benefit tax, or user fee, which appears to conflict with the neutrality objective but improves efficiency. Public highway expenditures by themselves would subsidize automobile transportation and interfere with efficient resource allocation. Charging the users who benefit from the highway system by collecting motor fuels taxes redresses the balance toward efficiency.

Some opponents of using the motor fuels excise taxes for deficit reduction say that doing so would break the user charge link between those taxes and highway construction and maintenance. And without that link, the benefit principle of taxation would no longer serve as a rationale for the tax increase. For example, the National Conference of State Legislatures (NCSL) commented as follows in testimony before Congress: "The proposal to employ

gasoline taxes to finance nontransportation activities of the federal government represents a departure from the user fee philosophy and an abrogation of the state-federal partnership."²² Similarly, the National Governors' Association asserted, "To increase the federal motor fuels taxes as a way to help reduce the deficit would be contrary to [the] user fee principle and would harm the funding for transportation programs."²³

The argument implies that using a motor fuels tax increase to reduce the deficit means allocating the additional receipts to the general fund rather than to the Highway Trust Fund. The additional receipts could be held in the trust fund, however, as some unspent funds are now. Such balances, temporarily serving as contributions to deficit reduction, could later be released to be spent for their traditional purposes when the overall fiscal situation improves. An argument against this approach is that singling out drivers and highways to contribute to deficit reduction lessens the pressure for spending restraint in other programs.

Opponents of a motor fuels tax increase for deficit reduction also argue that changes in consumption patterns due to such an increase would reduce both national and state and local revenues available for highway construction and maintenance at a time when such infrastructure

22 "Proposal to Increase the Federal Gasoline and Diesel Taxes for Deficit Reduction Purposes," hearing before the Subcommittee on Surface Transportation of the House Committee on Public Works and Transportation, 1987, p. 83.

23 "Increasing Federal Excise Taxes to Reduce the Deficit," hearing before the Subcommittee on Surface Transportation of the House Committee on Public Works and Transportation, 1987, p. 121.

is in need of substantial improvement. If motor fuels purchases were reduced due to price increases resulting from increasing the federal excise tax, the revenues of both the Highway Trust Fund and of state and local governments would be reduced. According to the NCSL testimony, “The loss of trust fund and state revenue implies a reduction of some \$6 to \$8 billion in funds available over the next five years for construction and maintenance of highways and other transportation systems across the nation.”²⁴

Those favoring a motor fuels tax increase to help reduce the federal deficit often point to associated benefits due to tax-induced changes in consumption patterns. Conservation of energy, especially oil, is likely to be increased as fuel prices rise and consumption declines. At the same time, such changes in consumption patterns would enhance economic welfare by putting more of the burden of the spillover costs of automobile travel on its consumers.²⁵

Gasoline price increases due to a rise in the

federal excise tax would enhance energy conservation in two ways. Higher gasoline prices would lead to less driving, and hence to reduced purchases of gasoline. And in the longer run, automobile purchasers would be led to buy more fuel-efficient cars and trucks, thus slowly improving the fuel efficiency of the stock of motor vehicles in operation. The impact of higher gasoline taxes would help preserve conservation gains made since the oil price shocks of the 1970s, gains which have tended to weaken in the face of lower oil prices in recent years. Preservation of those gains—and a possible enhancement of them—would help reduce U.S. dependence on foreign oil supplies, thus reducing the nation’s vulnerability to supply disruptions.

The motor fuels tax, by changing consumption patterns, can also improve resource allocation by correcting for some external costs of fuel consumption. Costs of air pollution and road congestion due to driving motor vehicles are social costs of highway travel not fully borne by its consumers. Increased motor fuels taxes would shift more of the burden of those social costs to highway users responsible for them.

Simplicity

Excise taxes are generally viewed as relatively easy to administer and collect. Raising additional revenue through increases in excise taxes on alcohol, tobacco, and motor fuels would be especially simple and efficient because the means for collecting them are already in place. In contrast, collecting a federal VAT would require a long lead time and relatively high administration and compliance costs.

²⁴ “Proposal to Increase . . . ,” hearing before the Subcommittee on Surface Transportation of the House Committee on Public Works and Transportation, p. 89.

²⁵ Discussion of changes in the motor fuels tax often lead to discussion of other energy tax changes such as imposition of an oil import fee, a tax on all domestic and imported oil, and a tax on all domestic energy consumption. Increasing any of these taxes would raise energy prices and thus increase conservation. Energy taxes generally are regressive relative to income, but the regional impact would likely be quite different for different taxes. Domestic oil producers and oil-producing states would benefit from an oil import fee, but all industries using oil or energy generally in production could be adversely affected by higher costs due to the imposition of these alternative energy taxes.

Conclusion

Increases in federal excise taxes on alcohol and tobacco products and motor fuels have been suggested as means to help reduce the federal budget deficit. Moderate increases in these federal excise taxes could make a significant contribution to reducing the deficit. There are tradeoffs, however, between the other effects of such tax increases. Admittedly, these taxes generally do not do well in terms of vertical and horizontal equity, yet other benefits are

likely to accompany increases in these taxes due to their effects on consumption patterns. Additional revenues from consumers of motor fuels, alcohol, and tobacco may be viewed as helping to offset social costs associated with their consumption, and the higher price of motor fuels due to a tax hike would likely enhance conservation of oil. Overall, inclusion of increases in these taxes in a deficit reduction package that incorporates revenue changes merits serious attention.



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