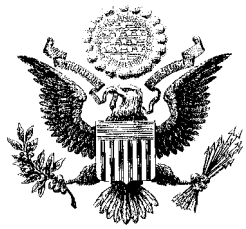
ECONOMIC BENEFITS FROM U.S. TREASURY SECURITIES



Chairman Jim Saxton (R-NJ)

Joint Economic Committee
United States Congress

February 2002

Executive Summary

While economists have published many empirical studies on the macroeconomic effects of a large supply of U.S. Treasury debt securities (Treasuries) relative to U.S. gross domestic product (GDP), economists have only recently begun to examine its microeconomic effects.

Because liquidity constraints may cause firms to terminate otherwise profitable investments, asset liquidity is valuable. As a result, financial market practitioners pay liquidity premia over net present value to obtain liquid financial assets, especially Treasuries.

As the world's most liquid debt security, Treasuries lubricate global financial markets. A large supply of Treasuries relative to U.S. GDP allows financial market practitioners to develop a true credit-risk free yield curve, fund their portfolios efficiently through repos, and hedge interest rate risk effectively.

During an economic expansion, Treasuries enhance the efficiency of financial markets and lower the financing costs for making investments. During a recession or a financial crisis, Treasuries provide financial markets with a unique, exogenous source of liquidity that the privately generated debt securities cannot duplicate. The liquidity provided by Treasuries is qualitatively different than the liquidity provided by privately generated debt securities because Treasuries are ultimately based upon the coercive taxing power of the U.S. government. Thus, a large, liquid Treasury market ameliorates the contraction of U.S. employment, investment, and output that would otherwise occur during a recession or a financial crisis.

The microeconomic liquidity benefits associated with a large supply of Treasuries relative to U.S. GDP provides serendipitous macroeconomic benefits as well. Within limits, increasing the supply of Treasuries alleviates private sector liquidity constraints, increases private investment, and accelerates long-term real GDP growth.

International comparisons with Hong Kong and Singapore confirm the efficiency benefits accruing to the United States from a large, liquid Treasury market. Though neither Hong Kong nor Singapore had any fiscal need to borrow, both deliberately chose to issue government debt securities to increase the efficiency of their financial markets and lower financing costs for firms borrowing in local currencies.

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The benefits of this [well-funded Treasury debt] are various and obvious. First. Trade is extended by it; ... Secondly. Agriculture and manufactures are also promoted by it; ... Thirdly. The interest of money will be lowered by it; ... This circumstance will enable both the public and individuals to borrow on easier and cheaper terms. And from the combination of these effects, additional aids will be furnished to labour, to industry, and to arts of every kind.

Alexander Hamilton, First Secretary of the Treasury
Report on Public Credit [to the U.S. House of Representatives]
January 9, 1790

I. INTRODUCTION

U.S. Treasury debt securities (Treasuries) are the world's most widely held debt security. Beginning with the entry of the United States into World War I, recurring federal budget deficits have ensured a large supply of Treasuries relative to U.S. gross domestic product (GDP) in subsequent years. From the end of fiscal year 1930 through the end of fiscal year 2001, the federal net debt to GDP ratio averaged 45 percent.[1] As of September 30, 2001, federal net debt as a percent of GDP was 33.0 percent, of which Treasuries constituted 87.3 percent of federal net debt or 28.5 percent of GDP.[2]

For decades, financial market practitioners have intuitively recognized that Treasuries provide a unique and irreplaceable source of liquidity that facilitates the efficient operation of global financial markets particularly during recessions or financial crises. Until the last decade, however, most empirical research about federal net debt looked at macroeconomic questions; *i.e.*, does the federal budget balance and the level of federal net debt affect real interest rates, savings, and investment. Microeconomic questions about the liquidity that Treasuries provide to financial markets and how such liquidity affects the broader economy were largely ignored. Recently, however, economists have published a growing body of empirical literature, demonstrating the microeconomic benefits accruing from Treasuries.

Because liquidity constraints may cause firms to terminate otherwise profitable investments, asset liquidity is valuable. As a result, financial market practitioners pay liquidity premia over net present value to obtain liquid financial assets, especially Treasuries.

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[1] Calendar year 1929 is the first year for which the U.S. Department of Commerce has calculated gross domestic product. Fiscal year 1929 is the first year in which gross federal debt is broken into federal net debt and federal debt held in intragovernmental accounts. Gross federal debt (both absolutely and as a percent of gross national product) reached its post World War I trough at the end of fiscal year 1930. Therefore, June 30, 1930, is an appropriate starting point for calculating an average of federal net debt as a percent of GDP.

[2] U.S. Department of the Treasury, *Annual Report of the Secretary of the Treasury on the State of Finances for the Fiscal Year Ending June 30, 1944* (Washington, D.C.: Government Printing Office, 1954): 802-811; Executive Office of the President, Office of Management and Budget, *Budget of the United States Government Fiscal Year 2020: Historical Tables* (Washington, D.C.: Government Printing Office, 2002): 116; U.S. Department of the Treasury, Bureau of Public Debt, *Monthly Statement of the Public Debt of the United States* (September 30, 2001), found at ftp://208.131.225.4/opd/opdm092001.pdf; U.S. Department of Commerce, Bureau of Economic Analysis, *Gross Domestic Product, Third Quarter 2001* (November 30, 2001), found at website http://www.bea.doc.gov/bea/newsrel/gdp301p.htm.

As the world's most liquid debt security, Treasuries lubricate global financial markets. A large supply of Treasuries relative to U.S. GDP allows financial market participants to develop a true credit-risk free yield curve, fund their portfolios efficiently through repos, and hedge interest rate risk effectively.

During an economic expansion, Treasuries enhance the efficiency of financial markets. By facilitating cost-efficient hedging, Treasuries lower the financing costs for firms making investments in the United States.

During a recession or a financial crisis, Treasuries provide financial markets with a unique, exogenous source of liquidity that the privately generated debt securities cannot duplicate. The liquidity provided by Treasuries is qualitatively different than the liquidity provided by privately generated debt securities because Treasuries are ultimately based upon the coercive taxing power of the U.S. government. Thus, a large, liquid Treasury market ameliorates the contraction of U.S. employment, investment, and output that would otherwise occur during a recession or a financial crisis.

The microeconomic liquidity benefits associated with a large supply of Treasuries relative to U.S. GDP provides serendipitous macroeconomic benefits as well. Within limits, increasing the supply of Treasuries alleviates private sector liquidity constraints, increases private investment, and accelerates long-term real GDP growth. This is known as the liquidity constraint model. It is consistent with both empirically observed liquidity premia for Treasuries and the performance of the U.S. economy.

International comparisons with Hong Kong and Singapore confirm the efficiency benefits accruing to the United States from a large, liquid Treasury market. Though neither Hong Kong nor Singapore had any fiscal need to borrow, both deliberately chose to issue government debt securities to increase the efficiency of their financial markets and lower financing costs for firms borrowing in local currencies.

II. WHAT IS ASSET LIQUIDITY?

Asset liquidity reflects the perceived speed, ease, and certainty at which an asset can be converted into cash for a price close to its expected value. Liquid assets may be converted quickly into cash with small transaction costs and little or no loss of expected value. Other than cash, Treasuries are the most liquid assets. Treasuries have the lowest transaction cost and bear no credit risk. Other financial assets such as federal agency debt securities or NYSE- or NASDAQ-listed stocks are also considered liquid. They may be sold quickly at relatively low transaction costs. Since they bear some credit or market risk, they experience greater price volatility than Treasuries. In contrast, illiquid assets cannot be converted quickly into cash. In general, real assets are considered illiquid. Real assets are less homogeneous, divisible, and transportable than financial assets. Few real assets trade in organized secondary markets. In most cases, owners selling real assets incur high transaction costs and face significant price uncertainty.

III. HOW DOES LIQUIDITY AFFECT THE PRICE OF FINANCIAL ASSETS?

In 1965, Eugene F. Fama formulated the efficient market theory.[3] Among other things, this theory holds that financial markets incorporate all available information into the price of financial assets.

[3] Eugene F. Fama is the Robert R. McCormick Distinguished Service Professor of Finance at the University of Chicago Graduate School of Business. Building on William Sharpe's capital asset pricing model, Fama developed a comprehensive theory why stock market price fluctuates randomly. In January 1965, the *Journal of Business*

Because financial markets are efficient with regard to information, the market value of any financial asset should be equal to its net present value, which is the sum of all expected future cash flows generated by the asset discounted by an interest rate reflecting the risks associated with such cash flows.[4]

While net present value is an extremely valuable concept in explaining asset prices, net present value cannot explain certain anomalies in the market prices of financial assets. In particular, Treasuries have consistently had higher market prices (lower yields) than net present value alone justifies. To explain these anomalies, Yakov Amihud and Haim Mendelson (1986) proposed a liquidity premium theory; *i.e.*, the market price of an asset is the sum of an asset's net present value and its liquidity premium.

Amihud and Mendelson observed the spread between an asset's bid price and its ask price as a natural measure of an asset's liquidity – the greater the liquidity of an asset, the lower its bid-ask spread. Hypothesizing that investors must be compensated with higher expected returns for owning less liquid financial assets, Amihud and Mendelson examined the expected returns and bid-ask spreads of NYSE stocks between 1961-1980. After controlling for risk, Amihud and Mendelson found (1) the average return increases with its bid-ask spread and (2) the slope of the return-spread relationship decreases with the spread. Their findings confirm the liquidity premium theory.[5]

Expanding on their previous study, Amihud and Mendelson (1991) examined the yields on short-term Treasury bills and notes with the same maturities of six months of less. For these maturities, both Treasury bills and notes are short-term single payment (discount) securities generating the same cash flow and facing the same risk factors. If liquidity premia do not exist, yields on these Treasury bills and notes should be the same. Any difference in the yields confirms the liquidity premium theory. Examining 489 matched Treasury bills and notes from April to November 1987, Amihud and Mendelson found:

1) *The relative bid-ask spread on notes is greater than that on bills by a factor of about 4. This indicates the lower liquidity of notes compared to bills.*

2) *The yield to maturity on notes is higher than the yield on bills with the same maturity. On average, ΔY [annual yield to maturity in percent] = .428% per annum with a standard error of 0.021 and is significantly different than zero.*[6]

Other economists have subsequently advanced the liquidity premium theory. Examining Treasury bond issues in 1987-1990, David O. Beim (1992) found the liquidity of Treasury bonds as

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published Fama's entire 70-page Ph.D. thesis, "The Behavior of Stock Market Prices." Nine months later the *Financial Analysts Journal* summarized Fama's thesis under the title, "Random Walks in Stock Market Prices." Known as the "efficient market" theory, Fama explains the workings of free and efficient financial markets. First, information about stocks is widely and cheaply available to all investors. Second, all known and available information is already reflected in current stock prices. Third, the price of a stock agreed on by a buyer and a seller is the best estimate, good or bad, of the investment value of that stock. Finally, stock prices will almost instantaneously change as new unpredictable information about them appears in the market. All of these factors make it difficult, if not impossible, to capture returns in excess of market returns, without taking greater than market levels of risk. His pioneering work revolutionized the study of finance and management of investment portfolios.

[4] Net present value may be expressed as:

$$NPV = \sum_{t=1}^{\infty} c_t/(1+i)^t$$

where t = time, c_t = cash flow in time t, and i = risk-adjusted interest rate.

[5] Yakov Amihud and Haim Mendelson, "Asset Pricing and the Bid-Ask Spread," *Journal of Financial Economics* 17 (1986): 223-249.

[6] Yakov Amihud and Haim Mendelson, "Liquidity, Maturity, and the Yields on U.S. Treasuries," *Journal of Finance* 46 (September 1991): 1411-1425.

measured by bid-ask spreads decays by as much as 1/3 in first two years after issuance, the decay in liquidity slows after the second year, but then the decay in liquidity accelerates in later years. Liquidity is also related to the quantity of an issue outstanding though not proportionately. Beim concluded:

> *Term structure estimates, which assume that the prices of bonds are strictly equal to the present value of their cash flows, are biased, because liquidity is positively priced.*[7]

Expanding on Amihud and Mendelson (1991), Avraham Kamara (1994) incorporated immediacy risk – the risk that realized prices at which an order is executed differ from current quoted prices – into liquidity premia analysis.[8] Examining Treasury bills and notes with approximately 14 weeks to maturity from January 1977 to July 1984, Kamara found the note-bill yield differentials are positive and include immediacy risk premia. The differential increases with interest rate volatility times the expected time to transact in the note market relative to the bill market as estimated by the bill-note turnover ratio.[9]

Francis A. Longstaff (1995) examined how marketability can affect the prices of financial assets. Longstaff found that marketability restrictions reduce stock prices substantially in what amounts to a penalty for illiquidity.[10] This finding is consistent with the liquidity premium theory.

Longstaff (2001) also compared the prices and yields of Treasury zero-coupon bonds and Resolution Funding Corporation (Refcorp) zero-coupon bonds reveals the size of the liquidity premia that Treasuries enjoy. In response to widespread financial insolvencies among saving and loan institutions, Congress enacted the *Financial Institutions Reform, Recovery, and Enforcement Act* (FIRREA) in 1989. FIRREA established Refcorp as a funding mechanism to resolve these insolvencies. Treasury bonds collateralize the principal of Refcorp bonds while the U.S. government guarantees Refcorp interest payments. Because Refcorp bonds have exactly the same risk profile and tax treatment as Treasury bonds, any price or yield differentials between comparable Refcorp and Treasury bonds reveal liquidity premia. Comparing the yields of Treasury and Refcorp zero coupon bonds with maturities ranging from 3 months to 30 years from April 1991 to March 2001, one study found the average yield differentials ranged from 9.35 to 16.28 basis points (a 100 basis points equals 1 percent), all of which were statistically significant. These yield differentials imply average price differentials between the two zero coupon bonds (as measured as a percent of the Treasury zero-coupon bond price) from 0.035 percent for the 3-month maturity to 5.05 percent for the 30-year maturity.[11]

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[7] David O. Biem, "Estimating Bond Liquidity," *Columbia First Boston Series in Money, Economics, and Finance* FB-92-08 (April 1992).

[8] Although traders in the Treasury market observe quoted prices, actual transaction prices may differ than quoted prices. This is because a quote is for a small quantity. Traders with large quantities cannot determine in advance the actual price for the entire quantity they wish to trade. They must search for opposite parties and face the risk of an adverse intervening price movement prior to completing the trade. Such immediacy risk is costly for Treasury dealers because their positions are highly leveraged.

[9] Avraham Kamara, "Liquidity, Taxes, and Short-Term Treasury Yields," *Journal of Financial and Quantitative Analysis* 29 (September 1994): 403-417.

[10] Francis A. Longstaff, "How Much Can Marketability Affect Security Values?" *Journal of Finance* 50 (December 1995): 1767-1774.

[11] Francis A. Longstaff, "The Flight-To-Liquidity Premium in U.S. Treasury Bond Prices," *University of California Los Angeles Working Paper* (May 2001).

IV. ECONOMIC USES OF TREASURIES IN FINANCIAL MARKETS

While Treasuries provide the U.S. government with an extremely efficient means of funding accumulated federal budget deficits in past fiscal years, Treasuries serve many other important economic functions, including:

- **Benchmark pricing**. To be useful as a tool for benchmark pricing, a yield curve must be "true;" *i.e.*, (1) Observed prices (or yields) of a benchmark should remain close to the market consensus of what prices (or yields) should be; and (2) Changes in prices (or yields) should reflect revisions in the market consensus, not idiosyncratic movements in the prices (or yields) of the benchmark or random noise. Treasuries have all of the necessary characteristics to create a "true" credit risk-free yield: (1) market participants regard Treasuries as free from any credit risk; (2) Treasuries are regularly issued in predictable quantities along the most of the yield curve with maturities ranging from 4 weeks to 10 years; (3) the supply of Treasuries is large; and (4) the Treasury market is extremely liquid and well integrated, making large idiosyncratic price movements of Treasuries at any maturity extremely unlikely. Because of these characteristics, market participants use the observed yields on Treasuries to create a credit risk-free yield curve. The credit risk-free yield curve is then used as a guide for evaluating the price (or yield) of other dollar-denominated fixed-rate debt securities that bear credit risk. When other dollar-denominated, fixed-rate debt securities are sold, they are typically quoted in relation to Treasuries with a similar maturity.[12]

- **Funding.** Repurchase agreements (repos) are, in effect, short-term loans secured by safe liquid collateral.[13] Portfolio managers that have made long-term investments in Treasuries may fund their positions by reserving out Treasuries in the repo market. The repo market is huge and is largely dependent on Treasuries as the underlying debt security.[14] Primary dealers reported to Federal Reserve Bank of New York that their average daily volume of total outstanding repos was $2.95 trillion during first half of 2001. The Government Securities Clearing Corporation (GSCC), a registered clearing corporation, tracks repo trades cleared through GSCC by product type. GSCC processed in excess of $98.1 trillion in repo trades during the first half of 2001 with an average daily volume of $784.5 billion. Among repo trades processed through GSCC, Treasuries accounted for $78.0 trillion or 81.5 percent of all repo trades.[15]

- **Hedging and speculation**. Most interest rate hedging and speculation strategies employ Treasuries, Treasury futures, or options on Treasury futures.[16]

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[12] Michael J. Fleming, "Financial Market Implications of the Federal Debt Paydown," *Brookings Papers on Economic Activity*, 2 (Fall 2000): 221-251.

[13] In a repo transaction, a borrower simultaneously agrees to sell a particular debt security to a lender and to buy the same security back from the lender at a specified price on a future date, often the next day. A borrower "repos out" the security, temporarily exchanging it for money from the lender. The repo rate is based upon the difference between the current price and the agreed-upon price in the repo. Because repos are fully collateralized, repo rates are lower than rates for unsecured federal funds lending among banks. A reserve repo is the other side of a repo transaction. A lender "reverses in" a security, agreeing to sell it back to the borrower on a future date at an agreed upon price.

[14] Dominique Dupont and Brian Sack, "The Treasury Securities Market: Overview and Recent Developments," *Federal Reserve Bulletin* (December 1999): 797-798.

[15] Bond Market Association, *Research Quarterly* (New York: Bond Market Association, August 2001): 8.

[16] Market participants use Treasuries to hedge their interest rate risk positions in other fixed-income securities. To minimize their interest rate risk exposure, market participants take "short positions" in Treasuries by selling Treasuries in the cash market that participants do not own but instead borrowing such Treasuries in the repo market with the intention of purchasing them later in the cash market. Alternatively, market participants with long positions

V. TREASURIES LOWER FINANCING COSTS FOR MAKING INVESTMENTS

To understand how Treasuries enhance the liquidity of other financial assets and thereby lower financing costs, let us examine the following hypothetical example. Suppose:

- Exelon Corporation decides to build new electricity generation facilities in the northeastern United States.
- Such facilities will cost $2.5 billion to build, plus a $500 million cash reserve for startup and unanticipated expenses. Therefore, Exelon decides to issue $1.5 billion in 10-year corporate notes to fund construction.
- Salomon Smith Barney agrees to underwrite Exelon notes at 100 basis points over comparable on-the-run Treasury yields that were 4.05 percent on November 30, 2001, when the deal was done. Salomon Smith Barney expects an underwriting period of 90 days before the Exelon notes are issued.

During the underwriting period, an underwriter faces both credit and duration risks. Credit risk represents the potential loss of value in Exelon notes due to change in the financial condition of the joint venture. Duration risk (also known as interest rate risk) represents the potential loss in value of these bonds due to an increase in the overall level of interest rates before they are issued. Because underwriting periods are short, duration risk is a far greater threat to underwriters than default risk, and underwriters hedge to protect against duration risk. In this case, Salomon Smith Barney decides to sell $1.5 billion of 10-year Treasuries that it does not own in the cash market while Salomon Smith Barney simultaneously borrows the same Treasuries in the repo market. When Exelon notes are issued, Salomon Smith Barney will then unwind its hedged position.

Treasuries and Treasury derivatives are the cheapest means through which underwriters can hedge duration risk. In this hypothetical example, the bid-ask spreads for on-the-run 10-year Treasury notes are 1/32 while the bid-ask spreads for on-the-run 10-year Fannie Mae benchmark notes and on-the-

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in other bonds can use Treasury derivatives to hedge their interest rate-risk. One way would be to sell Treasury futures at the Chicago Board of Trade, taking a short position in the futures market. Other ways to hedge interest rate-risk would be to buy put options or sell call options on Treasury futures at the Chicago Board of Trade.

Treasuries and their derivatives also provide a convenient means to speculate on the future direction of interest rates. If speculators believe that long-term interest rates are likely to decline, they may buy $10 million of 10-year Treasury notes in the cash market, paying only $1 million down out of their accounts and repoing out $9 million of notes to cover the remainder of their purchases. By borrowing $9 million through the repo market, speculators may leverage their potential returns on their investment by a factor of 10 or more. Treasury derivatives allow speculators to achieve the same outcome. For example, speculators can buy Treasury futures on the Chicago Board of Trade, hoping the price of Treasuries in the cash market at the time for delivery will rise above the futures price that they paid. Speculators may buy call options on 10-year Treasury notes, hoping that the note price increases by more than the option strike price during the term of the option. Speculators may also sell put options on 10-year Treasury notes, hoping to pocket the premium. Conversely, if speculators believe long-term interest rates are likely to rise, they may short sell $10 million of 10-year Treasury notes in the cash market, covering their position temporarily by reversing-in the notes in the repo market until they are ready or must buy the notes sold short in the cash market. The speculators profit if note prices fall between when the notes are sold short and when they are delivered. Treasury derivatives can also be used to bet that interest rates will rise in the future. Speculators can sell Treasury futures at the Chicago Board of Trade, hoping the price of Treasuries in the cash market at the time for delivery has fallen below the futures price received by sellers. Alternatively at the Chicago Board of Trade, speculators may buy put options on Treasury futures, hoping that the futures price falls below the strike price during the term of the option. Speculators may also sell call options on Treasury futures, hoping to pocket the premium.

run 10-year Freddie Mae reference notes are 4/32.[17] Small bid-offer spreads and the ready availability of Treasuries reduce the transaction cost for hedging and unwinding the hedge. In this hypothetical example, the hedging cost using Treasuries is $1,500,000,000 * (.03125 / 100) * 0.5 = $234,375. The hedging cost using federal agency debt securities would have been $1,500,000,000 * (.125 / 100) * 0.5 = $937,500. Thus, the ready availability of Treasuries saved the underwriter $703,125. Given the highly competitive nature of the U.S. financial services industry, lower hedging costs benefit issuing firms through lower underwriting fees.[18]

A wide variety of individuals and institutions may buy Exelon notes when they are issued. A significant portion of these buyers may choose to hedge their interest rate risk through Treasuries or Treasury derivatives. After a typical distribution, approximately three-fifths of such notes are likely to be hedged. If Treasuries were sufficiently scarce that note buyers were forced to use more costly hedging strategies, note buyers would hedge marginally less and face greater interest rate risk exposure. To compensate note buyers for a marginally larger interest rate risk exposure, expected bond yields must increase. Thus, the ability of note buyers to hedge interest rate risk cost-efficiently through Treasuries and Treasury derivatives lowers the interest rates that firms issuing notes must pay. Thus, liquidity of Treasuries market reduces financing costs for major investments in two ways: lower underwriting fees and lower fixed interest rates on notes.

VI. TREASURIES PROVIDE LIQUIDITY DURING A RECESSION OR A FINANCIAL CRISIS

To explain how Treasuries provide financial markets with a unique, exogenous source of liquidity during a recession or financial crisis, Bengt Holmström and Jean Tirole (1998) fashioned an entrepreneurial model of the U.S. economy based upon a large number of firms making long-term investments in real assets to produce profits in an uncertain environment.[19] In the Holmström-Tirole model, each firm issues bonds or stock to finance its investment during period zero. Because every entrepreneur must retain at least a small share of his or her firm's expected net present value for motivational purposes, each firm's overall expected net present value must be greater than the expected net prevent value of its external debt and equity claims. This is known as the entrepreneurial wedge. In period one, the funds that a firm needs to complete its investment may increase or decrease. This is a liquidity shock. At the same time, the expected net present value of its investment may increase or decrease as well. In period one, each firm must decide to continue or terminate its investment. If a firm

[17] On-the-run refers to the most recently issued debt security with a given maturity. Off-the-run refers to older debt securities with a given maturity.

[18] In the absence of Treasuries, financial market practitioners would, of course, use other instruments for hedging. For many reasons, federal agency debt securities would be the most likely alternative. As federal agency debt securities are substituted for Treasuries, the liquidity of federal agency debt markets would likely improve and would possibly narrow the bid-ask spreads for federal agency debt securities. Because federal agency debt securities bear at least some credit risk, the cost of hedging with federal agency debt securities is inherently higher than the cost of hedging with Treasuries. While the bid-ask spreads of federal agency debt securities may decline, such spreads are unlikely to become as narrow as the current bid-ask spreads for Treasuries. In the absence of Treasuries, the cost of hedging with federal agency debt securities may be less than in this hypothetical example, but such cost is still likely to be more than the current cost of hedging with Treasuries.

[19] Bengt Holmström is a professor with the Massachusetts Institute of Technology. Jean Tirole is a professor with both Institut d'Economie Industrielle, Centre d'Enseignement et de Recherche en Analyse Socioéconomique and the Massachusetts Institute of Technology. Bengt Holmström and Jean Tirole, "Public and Private Supply of Liquidity," *Journal of Political Economy* 106 (February 1998): 1-40.

terminates, it loses all of its investment. If a firm continues, it receives a return from its investment in period two that may be higher or lower than its expectations.

First, Holmström and Tirole examined random firm-specific liquidity shocks characteristic of an economic expansion. To maximize economic welfare, each firm should continue its investment in period one so long as its expected net present value remains positive. However, the entrepreneurial wedge between a firm's overall and external net present value constrains the ability of firms to issue new bonds or stock to investors. Therefore, liquidity shocks may compel some firms to terminate investments with a positive expected net present value, lowering overall economic welfare.

If firms experiencing positive liquidity shocks during period one can lend surplus funds to firms experiencing negative liquidity shocks, fewer investments with an expected positive net present value will be terminated, increasing overall economic welfare. However, search and transaction costs make direct lending from surplus firms to deficit firms impractical. Therefore, specialized financial intermediaries such as commercial banks arise to collect funds from surplus firms and lend them to deficit firms. Pooling funds through financial intermediaries yields two advantages. First, diversification through a large pool of loans reduces credit risk. Second, financial intermediaries enjoy economies of scale and specialization in assessing the credit risk.

In addition to lending, a firm experiencing negative liquidity shocks may liquidate its portfolio of financial assets by withdrawing bank deposits or selling bonds and stock of other firms acquired in period zero to meet its funding needs in period one. However, acquiring financial assets requires a larger initial investment than is necessary to acquire real assets and consequently reduces a firm's expected rate of return. Therefore, profitability concerns limit the size of the portfolio of financial assets acquired in period zero and the amount of liquidity available to firms from their portfolios of financial assets in period one.

Next, Holmström and Tirole examined liquidity shocks that are not random, but instead are highly correlated (*e.g.*, an unexpected tax increase increases the cost for all firms to continue their investments in period one). Such highly correlated liquidity shocks are characteristic of a recession or a financial crisis. So far, all of the sources of liquidity available to firms – issuing new bonds or stock, borrowing from a financial intermediary, or liquidating financial assets – are endogenous; *i.e.*, private firms generate all of the liquidity within the model. Because all liquidity is endogenous, the overall demand for liquidity cannot be satisfied. If some firms withdraw deposits to satisfy their liquidity needs, financial intermediaries will be unable to satisfy loan demands from other firms. If some firms sell stocks and bonds, their prices will decline. Lower bond and stock prices will inhibit other firms from raising funds through new debt or equity issues. Because firms cannot supply all of the liquidity demanded, the crisis will force some liquidity-constrained firms to terminate investments that still have a positive expected net present value. Such cancellations reduce overall economic welfare.

Finally, Holmström and Tirole introduced Treasuries into their model. Unlike the liquidity provided by privately generated debt securities, the liquidity provided by Treasuries is exogenous. While the liquidity of any private financial asset depends on both firm-specific and general economic conditions that affect firm profitability, the liquidity of Treasuries is not. Instead, the liquidity of Treasuries is ultimately based upon something that no private firm can ever possess – the coercive taxing power of the U.S. government. In an earlier article, Holmström and Tirole (1996) noted:

> *Because of its right to levy nonfinancial penalties and collect taxes, the government can create assets that the private sector simply cannot duplicate. Importantly, the government can issue liabilities on behalf of individual income-earners, who on their*

> *own would have difficulties borrowing against their future income, and it can commit funds of future generations. A government bond is the simplest such instrument.*[20]

Holmström and Tirole do not allow discretionary monetary policy to serve as an alternative source of liquidity in their model. While discretionary monetary policy can supply liquidity to financial markets, Treasuries have important differences with discretionary monetary policy. Individuals and business firms may access the stored liquidity of Treasuries through their own initiative. As Holmström and Tirole noted, "[G]overnment bonds provide an instrument for self-insurance" against highly correlated liquidity shocks.[21] In contrast, liquidity provided through discretionary monetary policy depends upon the decisions and actions of the Federal Reserve. Thus, discretionary monetary policy cannot fully substitute for the liquidity provided by Treasuries. Instead, the liquidity provided by discretionary monetary policy complements the liquidity provided by Treasuries.

Thus, Holmström and Tirole demonstrated the economic benefits that Treasuries provide to the U.S. economy during a recession or a financial crisis. A large, active Treasury market reduces the size of the contraction in employment, investment, and production that would have otherwise occurred during a recession or a financial crisis if there were no Treasuries or if the supply of Treasuries was small relative to U.S. GDP.

VII. TREASURIES INCREASE PRIVATE INVESTMENT, REAL GDP GROWTH

Contending that neither the conventional model nor the Ricardian equivalence model fully explains the macroeconomic effects of federal net debt,[22] Princeton University economist Michael Woodford (1991) proposed a liquidity constraint model. Both the conventional model and the Ricardian equivalence model assume perfect financial intermediation; *i.e*., individuals and firms can easily borrow against their future income at a competitive interest rate. The existence of liquidity premia demonstrates that financial intermediation is imperfect. Because of imperfect financial intermediation, some individuals and firms are liquidity constrained; *i.e*., they cannot borrow against their future income. Liquidity constraints force some individuals and firms to forego otherwise productive investments when their cash flow fluctuates. Thus, liquidity constraints reduce private investment below its optimal level.

Woodford contends running federal budget deficits allow liquidity-constrained individuals and firms to exchange highly liquid assets (Treasuries) for highly illiquid claims on their future income (future taxes). Whether or not increasing federal net debt (the supply of Treasuries) may raise real interest rates, increasing federal net debt helps liquidity-constrained individuals and firms to smooth their investments over time. Contrary to the conventional model, increasing federal net debt neither "crowds out" private investment nor reduces long-term real GDP growth.

Contrary to the Ricardian equivalence model, increasing federal net debt is not economically neutral. Instead, increasing federal net debt provides additional liquidity to the private sector, reduces the amount of profitable investment foregone because of liquidity constraints, and accelerates long-term real GDP growth. Woodford comments that the liquidity constraint model is consistent with U.S. economic performance during the 1980s.

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[20] Bengt Holmström and Jean Tirole, "Modeling Aggregate Liquidity," *American Economic Review* 86 (May 1996): 190.

[21] *Ibid*.

[22] For an extensive discussion of the conventional model and the Ricardian equivalence model, see Robert O'Quinn, *Fiscal Policy Choices: Examining the Empirical Evidence*, Joint Economic Committee, 107th Congress, 1st Session, November 2001: 2-4.

The liquidity benefits from additional federal net debt appear as a reduction in the liquidity premia of Treasuries. In other words, as an increase in the supply of Treasuries alleviates private sector liquidity constraints, the yield spreads on Treasuries and private sector debt securities with similar maturities should narrow.

After the federal budget went into surplus in fiscal year 1998 and the supply of Treasuries subsequently shrank, the differences between comparable Treasuries and corporate notes and bonds and between on-the-run and off-the-run Treasuries have been widening.[23] Thus, decreasing federal net debt is widening the liquidity premia for Treasuries in conformity with the liquidity constraint model.

Increasing the supply of Treasuries to the point at which private sector liquidity constraints are not binding is not optimal because (1) the U.S. government must levy sufficient taxes to pay the interest on Treasuries and (2) the federal tax system is highly distortionary and imposes large deadweight losses on the economy. Any optimization would require a balancing of the macroeconomic benefits of issuing Treasuries to alleviate private sector liquidity constraints and the macroeconomic costs of levying distortionary federal taxes to pay additional interest outlays. To maximize economic welfare, Woodford concludes:

> *It remains likely … that some positive permanent level of public debt per capita will be optimal. This is in contrast to it being desirable to reduce the debt as much as possible*.[24]

VIII. INTERNATIONAL COMPARISON: HONG KONG AND SINGAPORE

Since the modern American financial system began in 1914, the United States has always had a large federal net debt relative to its GDP.[25] Thus, economists cannot develop a statistically valid model using U.S. economic data to forecast how financial markets would behave without a large supply of Treasuries. Likewise, most developed economies have had a large supply of government debt outstanding relative to their GDP.[26] Only Hong Kong and Singapore offer the potential for statistically valid international comparisons about the microeconomic effects of government debt on financial markets.

First as a British colony and later as Special Administrative Region of the People's Republic of China, the Hong Kong government has consistently had budget surpluses. Consequently, Hong Kong did not have a fiscal need to issue government debt securities. Nevertheless, the Hong Kong government decided to create a Hong Kong government debt securities market and authorized the Hong Kong Monetary Authority (HKMA) to issue Exchange Fund bills and notes.[27] By year-end 2000, Exchange

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[23] For an extensive discussion, see Robert O'Quinn, *Federal Debt: Market Structure and Economic Uses for U.S. Treasury Debt Securities*, Joint Economic Committee, 107th Congress, 1st Session, August 2001: 35-40.

[24] Michael Woodford, "Public Debt as Private Liquidity," *American Economic Review* 80 (May 1990): 387

[25] In 1914, the Federal Reserve System began operations. For the first time, the United States had a modern central bank charged with conducting monetary policy. In 1914, World War I began. As a result of this war, the U.S. dollar replaced the British pound as the world's principal reserve currency; New York replace London as the hub of the financial world; and the federal government accumulated a large federal net debt. From the end of World War I to the present, federal net debt would never be less than 16 percent of GNP. Thus, 1914 is useful as a demarcation for the beginning of modern financial markets.

[26] Due to the repudiation of wartime debts, Japan and the Federal Republic of Germany had low government debt to GDP ratios in the years immediately after World War II. However, the unique economic circumstances of the immediate post-World War II years in these countries make any comparison with United States today invalid.

[27] The HKMA begin issuing 91-day, 182-day, and 364-day Exchange Fund bills in 1990, 2-year and 3-year Exchange Fund notes in 1993, 5-year Exchange Fund notes in 1994, 7-year Exchange Fund notes in 1995, and 10-

Fund debt securities outstanding had risen to HK$109 billion or 8.6 percent of Hong Kong's GDP.[28] According to the HKMA:

> *The Exchange Fund Bills and Notes Issuance Programme ensures the supply of a significant amount of high quality Hong Kong dollar debt paper, which can be employed as trading, investing, and hedging instruments. Authorized Institutions that maintain Hong Kong dollar clearing accounts with the HKMA can use their holdings of Exchange Fund paper to borrow overnight Hong Kong dollar[s] from the Discount Window. An active primary and secondary market for the trading of Exchange Fund Bills and Notes, and the establishment of a reliable benchmark yield curve for up to 10 years has facilitated the development of a sophisticated Hong Kong dollar debt market*.[29]

Like Hong Kong, the Singapore government has consistently run budget surpluses and had no fiscal need to issue government debt securities. Nevertheless, the Singapore government authorized the Monetary Authority of Singapore (MAS) to issue Singapore Government Securities (SGS) beginning in 1998.[30] By year-end 2000, SGS outstanding had risen to S$43.2 billion or 27.2 percent of Singapore's GDP.[31] According to the MAS, the objectives for developing a SGS market are to:

1. *Provide a liquid investment alternative with little or no risk of default for individual and institutional investors;*

2. *Establish a liquid government bond market which serves as a benchmark for the corporate debt securities market; and*

3. *Encourage the development of skills relating to fixed income securities and broaden the spectrum of financial services available in Singapor*e.[32]

Unfortunately, economists have not yet published empirical research quantifying efficiency gains from issuing government securities in either Hong Kong or Singapore. However, a consensus of government officials, economists, and financial market practitioners in both Hong Kong and Singapore regard the establishment of active government debt securities markets as a necessary precondition for the development of efficient financial markets.[33] The decision of both Hong Kong and Singapore to establish active government securities markets even though neither needed to fund accumulated budget deficits provides support for the microeconomic efficiency gains that the United States accrues from having a large Treasury market.

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year Exchange Fund notes in 1996. Exchange Fund (discount) bills and (interest-bearing) notes are unsecured debt securities of the Hong Kong SAR government.

[28] Hong Kong Monetary Authority, "Debt Market Development," found at website http://www.info.gov.hk/hkma/eng/debt/index.htm; and International Monetary Fund, International Financial Statistics (Washington, D.C.: International Monetary Fund, August 2001): 238. Author calculated Exchange Fund bills and notes as a percent of Hong Kong's GDP.

[29] HKMA website.

[30] The MAS issues 3-month and 1-year (discount) SGS bills and 2-year, 5-year, 7-year, 10-year, and 15-year (interest bearing) SGS notes.

[31] Monetary Authority of Singapore, "Singapore Government Securities Market," found at website http://www.mas.gov.sg/; and Statistics Singapore, "Latest Annual Indicators," found at http://www.singstat.gov.sg/FACT/KEYIND/keyind.html. Author calculated SGS as a percent of Singapore's GDP.

[32] MAS website.

[33] Author's conversations with officials of the International Monetary Fund, the Hong Kong Monetary Authority, and the Monetary Authority of Singapore.

IX. CONCLUSION

Economists have only recent begun to conduct extensive empirical research into the microeconomic benefits of a large supply of Treasuries relative to U.S. GDP. Their research is yielding important results.

Because liquidity constraints may cause firms to terminate otherwise profitable investments, asset liquidity is valuable. As a result, market participants pay liquidity premia over net present value to obtain liquid financial assets, especially Treasuries.

As the world's most liquid debt security, Treasuries lubricate U.S. financial markets. A large supply of Treasuries relative to U.S. GDP allows financial market practitioners to develop a true credit-risk free yield curve, fund their portfolios efficiently through repos, and hedge interest rate risk effectively.

During an economic expansion, Treasuries enhance the efficiency of U.S. financial markets. By facilitating cost-efficient hedging, Treasuries lower the financing costs for making investments. During a recession or a financial crisis, Treasuries provide financial markets with a unique, exogenous source of liquidity that the private sector cannot duplicate. A large, liquid Treasury market ameliorates the contraction of U.S. employment, investment, and output that would otherwise occur during a recession or a financial crisis.

The microeconomic liquidity benefits associated with a large supply of Treasuries relative to U.S. GDP provides serendipitous macroeconomic benefits as well. Within limits, increasing the supply of Treasuries alleviates private sector liquidity constraints, increases private investment, and accelerates long-term real GDP growth.

International comparisons with Hong Kong and Singapore confirm the efficiency benefits accruing to the United States from a large, liquid Treasury market. Though neither Hong Kong nor Singapore had any fiscal need to borrow, both deliberately chose to issue government debt securities to increase the efficiency of their financial markets and lower financing costs for firms borrowing in local currencies.

In summary, analyzing the economic effects of a large supply of Treasuries relative to U.S. GDP requires economists to examine the microeconomic consequences on financial markets as well as the macroeconomic consequences of fiscal balance and federal net debt on real interest rates, saving, and investment. U.S. policymakers should weigh carefully any action that may diminish the efficiency and liquidity benefits that Treasuries provide to financial markets.

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