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MULTIMARKET TRADING AND THE COST OF DEBT

EVIDENCE FROM GLOBAL BONDS

by Lubomir Petrasek

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In 2010 all ECB publications feature a motif taken from the €500 banknote.

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CONTENTS

Abstract

Global bonds are international securities designed to be traded and settled efficiently in multiple markets. This paper studies global bonds to examine the effects of multimarket trading on corporate bond liquidity, prices, and the cost of debt. Using a sample of primary and secondary market transactions matched by issuer, I find that global bonds command a significant liquidity and price advantage over comparable domestic bonds. On average, global bonds trade at yields 15 to 25 basis points below domestic bonds of the same issuers, with the difference being greater for speculative grade bonds and in times of crisis. Global issues are more liquid, as evidenced by several trade-based liquidity measures, but the liquidity advantage of global bonds does not fully explain the yield differential. The findings imply that international corporate bond markets are not fully integrated, and global bond offerings can reduce the cost of debt.

Keywords: Cost of debt, corporate bonds, liquidity, international financial markets.

JEL classification: G15, G12, G32, F36.

NON-TECHNICAL SUMMARY

Large multinational corporations increasingly raise funds by issuing global bonds. Global bonds resemble U.S. domestic bonds in their design, but their distinctive features allow them to be traded in multiple markets. They are placed simultaneously with U.S. and overseas investors, and can be traded in the U.S. bond market, the Eurobond market, as well as between markets. However, the effects of multimarket trading on corporate bond value are not well understood. This paper studies the effects of multimarket trading on the cost of debt, corporate bond prices, and liquidity. I examine primary and secondary market prices of global bonds, and compare them with bonds issued by the same corporations in the domestic market. I further study corporate bond liquidity in secondary markets, and its relationship to multimarket trading.

The results confirm the finding of Miller and Puthenpurackal (2005) that global bond issues are associated with a lower cost of debt financing than domestic issues. The costs of issuing global bonds, including interest costs and underwriter compensation, are on average 16 basis points lower that the costs of issuing U.S. domestic bonds. Relative to the Eurobond benchmark, the costs of issuing global bonds are almost 40 basis points lower. In addition, I find that global bond offerings reduce the cost of debt because multimarket trading enhances corporate bond value, and new global bond issues are priced at a premium relative to domestic bond issues of the same firms. On average, global bonds are offered at yield spreads 15 basis points below comparable U.S. domestic bonds, and 30 basis points below comparable Eurobonds. These findings explain why global bonds have become in recent years the debt instrument of choice for large corporate issuers.

When I examine trading prices from TRACE from 2003 to 2009, I find that the difference in issuance yields does not reflect temporary factors such as issuance price pressure or new issue underpricing because it carries over into secondary market prices. Rather, the difference shows that investors more highly value bonds that allow for multimarket trading. If two bonds of the same issuer, one global and one domestic, trade on the same day, the yield on the global bond is on average 23.8 basis points lower. The difference is greater for speculative grade bonds (-51.5 basis points) than for investment grade bonds (-11.6 basis points). Since high yield bonds are relatively expensive to trade,

these findings indicate that transaction costs rule out profitable arbitrage between global and domestic bonds. In addition, I find an increase in the yield differential during the credit crisis of 2008 and 2009, suggesting that funding constraints may also limit arbitrage.

I further examine the effects of multimarket trading on corporate bond liquidity. The results show that, compared with domestic bonds of the same issuers, global bonds are more liquid. They exhibit greater trading volumes in both the U.S. bond market and the Eurobond market, trade more frequently, and their prices are less volatile and less affected by trading volume. The liquidity advantage of global bonds persists even after controlling for their greater issue size ($1 bn. vs. $0.3 bn.). However, trade-based liquidity measures explain no more than 2% of the variation in yield spreads, and only a small part of the yield differential between global and domestic bonds.

Overall, the results provide insights into the degree of international bond market integration, and have implications for the cost of debt. The findings imply that international bond markets are not fully integrated, and large issuers can lower their cost of debt by offering global bonds. Global bond offerings are associated with a lower cost of debt financing because investors require lower yields on bonds that can be traded and settled efficiently in multiple markets. Multimarket trading improves the liquidity of corporate bonds and creates value for investors.

INTRODUCTION

Rather than issuing bonds in domestic markets, many of the world's largest corporations have recently started to issue global bonds. Global bonds are offered simultaneously to investors in the two major markets for dollar-denominated debt, namely the U.S. bond market and Eurobond market. Unlike domestic bonds, global bonds are designed for multimarket trading. These bonds include features that facilitate their trading, clearing, and settlement in the U.S. bond market, the Eurobond market, as well as between markets. Although first issued by the World Bank in 1989, global bonds have recently become the debt instrument of choice for large corporate issuers, and corporate global debt issuance exceeded U.S. domestic bond issuance and Eurobond issuance in recent years[2].

Despite the increasing importance of global bonds, the effects of multimarket trading on corporate bond value are not well understood. Miller and Puthenpurackal (2005) examine global bond offerings from the issuer's perspective, and find that firms can lower their cost of debt by issuing global rather than domestic bonds. However, why global bond offers reduce borrowing costs remains unclear. The main objective of this paper is to identify and measure the benefits that global bonds offer to investors. The paper provides new evidence from secondary markets that can clarify why global bond issuers have a lower cost of debt. I examine trading prices and liquidity of global and domestic bonds in secondary markets, and relate the cost advantage of global bonds to the effects of multimarket trading.

Global bonds have key similarities when compared with U.S. domestic bonds. They are registered with the SEC, have similar indentures as U.S. bonds, and pay interest semiannually. The distinctive property of global bonds is their multimarket trading. They are designed to trade simultaneously in the U.S. bond market and the Eurobond market, and have features that minimize cross-market transaction costs. Multimarket trading could make global bonds more valuable to investors, lowering the yield that investors require to hold global bonds. There are two reasons why multimarket trading may

[2] According to the SDC New Issues Database, the proceeds from issuing global bonds exceeded the proceeds from issuing U.S. domestic bonds or Eurobonds in 2006, 2007, and 2008. Compared are all corporate issues of public, senior and unsecured bonds that are denominated in U.S. dollars.

increase bond value. First, by virtue of trading in several markets, global bonds have the potential to reach a wider international investor base and become more liquid. Prior research documents a positive relationship between corporate bond prices and their liquidity (see, e.g., Longstaff, Mithal, and Neis (2005), Chen, Lesmond, and Wei (2007), Bao, Pan, and Wang (2008)). Higher prices on global bonds could therefore reflect a liquidity premium. Second, global bonds have the capacity to span several credit markets. To the degree that international bond markets are not fully integrated (see, e.g., Stulz (1981), Errunza and Losq (1985)), investors may value the ability to trade global bonds in both the U.S. bond market and the Eurobond market.

This paper examines the effects of multimarket trading on corporate bond liquidity, prices, and the cost of debt. To explore these effects, I first confirm the finding of Miller and Puthenpurackal (2005) that global bond offerings are associated with a lower cost of debt. Further, I test whether the cost advantage of global bonds reflects only lower issuance costs, or also higher market valuations of global bonds. The tests are conducted on both primary and secondary transaction prices. Next, I compute several trade-based measures of corporate bond liquidity, and test whether global bonds are more liquid than comparable domestic bonds. Finally, I test whether liquidity and transaction costs can explain the price differential between global and domestic bonds, or if the price differential reflects the ability of global bonds to span segmented markets.

The methods and the data used in this paper represent a substantial improvement over most previous studies of corporate bonds. I exploit the fact that global bonds are typically issued by large corporations that have multiple debt issues outstanding in the domestic market as well as the global market. This allows me to better control for issuer credit risk by comparing prices and liquidity of bonds issued by the same firms in different markets. Matching by issuer can also control for endogenous self-selection of firms into the group of global or domestic issuers. Therefore, I collect a matched sample of primary and secondary transactions in global and domestic bonds issued by the same corporations (global bond issuers). Primary market transactions are obtained from the New Issues Database of Securities Data Company (SDC). Secondary market transactions in the U.S. bond market are from TRACE[3], and additional information on trading activity in the Eurobond market is obtained from TRAX[4].

I begin the analysis by confirming prior findings of Miller and Puthenpurackal (2005) regarding the cost of debt. In accordance with Miller and Puthenpurackal (2005), I find that the costs of issuing global bonds, including interest costs and underwriter compensation, are on average 16 basis points lower than the costs of issuing U.S. domestic bonds. Relative to the Eurobond benchmark, the costs of issuing global bonds are almost 40 basis points lower. In addition, I show that global bond offerings have a lower cost of debt because global bond issues are priced at a premium relative to domestic bond issues of the same firms. On average, global bonds are offered at yield spreads 15 basis points below comparable U.S. domestic bonds, and 30 basis points below comparable Eurobonds. Thus, investors pay premium prices for bonds that can be traded in multiple markets, which lowers the cost of debt for global bond issuers. These findings explain why global bonds have become in recent year the debt instrument of choice for large multinational corporations.

Next, I examine trading prices from TRACE from 2003 to 2009. I find that if two bonds of the same issuer, one global and one domestic, trade on the same day, the yield on the global bond is on average 23.8 basis points lower. Since the yields at which bonds trade in secondary markets reveal similar patterns as offering yields, the difference in offering yields between global and domestic bonds does not reflect temporary factors such as new issue underpricing (Cai et al. (2009)) or issuance price pressure (Newman and Rierson (2004)). Rather, the difference shows that investors more highly value bonds that allow for multimarket trading. In addition, the yield differential is greater for speculative grade bonds (-51.5 basis points) than for investment grade bonds (-11.6 basis points), and it increases during the credit crisis of 2008 and 2009. These findings indicate that transaction costs and funding constraints rule out profitable arbitrage between global and domestic bonds, since speculative grade bonds are relatively expensive to trade (see,

[3] TRACE is the Trade Reporting and Compliance Engine sponsored by the U.S. Financial Industry Regulatory Authority (FINRA).
[4] TRAX is the trade matching and regulatory system for the Eurobond market sponsored by the International Capital Markets Association (ICMA).

e.g. Edwards et al. (2007)), and funding constraints limit arbitrage during financial crises (see, e.g., Brunnermeier and Pedersen (2008), Stein (2009)).

I also study the effects of multimarket trading on corporate bond liquidity. The results show that, compared with domestic bonds of the same issuers, global bonds are more liquid, even after controlling for well-known determinants of corporate bond liquidity such as bond age and issue size. Global bonds exhibit greater trading volumes in both the U.S. bond market and the Eurobond market, trade more frequently, and their prices are less volatile and less affected by trading volume. However, the trade-based liquidity measures explain no more than 2% of the variation in yield spreads, and only a small part of the yield differential between global and domestic bonds. The greater part of the yield differential between global and domestic bonds remains unexplained by common measures of corporate bond liquidity, and provides evidence of bond market segmentation.

The remainder of the paper is organized as follows. Section I develops the hypotheses, and Section II describes the data. Section III shows the empirical results, including the analysis of primary market prices and the cost of debt, secondary market prices, and the liquidity of global and domestic bonds. Section IV provides a discussion of the main results, and Section V concludes.

1. HYPOTHESES

This paper explores several hypotheses about the effects of multimarket trading on the cost of debt and corporate bond prices (i.e. yields to maturity). Issuers are concerned about the cost of debt, including interest costs and underwriter compensation. Corporate bond prices, on the other hand, reflect investors' valuations. The issuer's and the investor's perspective are complementary since higher investors' valuations lower the cost of debt.

1.1. Multimarket Trading and the Cost of Debt

As a starting point for the analysis of corporate bond prices, I confirm the finding of Miller and Puthenpurackal (2005) that global bond offerings lower the cost of debt financing. Firms can reduce their cost of debt either by offering bonds that are highly valued by investors or by minimizing issuance costs. Thus, the relevant measure of borrowing costs from an issuer's perspective is the yield to maturity based on the net proceeds from the offer after deducting total underwriting fees. Using this measure of borrowing costs, I test whether the costs of issuing global bonds differ from the costs of issuing comparable U.S. domestic bonds or Eurobonds.

1.2. Multimarket Trading and Corporate Bond Prices

The most important component of borrowing costs is the yield to maturity that investors require to hold a firm's debt. Firms can therefore lower their cost of debt mainly by issuing bonds that are highly prized by investors. Thus, I next examine whether investors more highly value bonds that allow for multimarket trading. I test the hypothesis by comparing the relative valuations of global and domestic bonds in both primary and secondary markets. First, I test the hypothesis that global bonds are issued at different yields to maturity (i.e. prices) than comparable domestic bonds of the same issuers. If offering yields of domestic bonds exceed offering yields of global bond by a significant margin, it is likely that multimarket trading provides value to investors.

However, differences in offering prices of global and domestic bonds do not necessarily imply that secondary market prices also differ. Issuance prices may also be affected by transitory factors such as underpricing (Cai et al. (2009)) or by issuance price pressure (Newman and Rierson (2004)). Therefore, I further test the hypothesis that secondary market prices of global and domestic bonds differ. The use of secondary market transactions has the additional advantage of relying on a greater number of observations, making it possible to compare same-day prices of global and domestic bonds matched by issuer. The data also allow me to compute several trade-based liquidity measures, and examine whether multimarket trading affects corporate bond value by increasing corporate bond liquidity, or because of market segmentation.

1.2.1. Liquidity

One channel through which multimarket trading can increase corporate bond value is liquidity. Bonds that allow for multimarket trading could be more liquid because they have a greater issue size, or because they have a wider investor base and a greater number of dealers. Several recent papers find a positive relationship between corporate bond prices and their liquidity (e.g., Longstaff, Mithal, and Neis (2005), Chen, Lesmond, and Wei (2007), Bao, Pan, and Wang (2008), Nashikkar, Subrahmanyam, and Mahanti (2009)), suggesting that global bonds may command a liquidity premium relative to domestic bonds.

Global bonds are often placed with investors in multiple markets, allowing them to have a greater issue size. However, prior research on the relationship between bond issue size and its liquidity is inconclusive. On the one hand, Edwards, Harris, and Piwowar (2007), Chen, Lesmond, and Wei (2007), and Mahanti et al. (2008) argue that larger issues are more liquid. On the other hand, Crabbe and Turner (1995) find no difference in yields attributable to size in a sample of bonds and medium-term-notes that have the same corporate issuer. Crabbe and Turner argue that large and small securities issued by the same borrowers are close substitutes. I contribute to this debate by testing whether global bonds have a liquidity advantage due to their greater issue size.

In addition to their greater issue size, global bonds could be more liquid because they have a greater number of dealers and a wider investor base. For one thing, both the dealers in the U.S. market and the dealers in the Eurobond market stand ready to buy and sell global bonds. The microstructure models of Demsetz (1968), Ho and Stoll (1983), Glosten and Harris (1988) and others predict a positive relationship between the number of dealers making the market in a given security and its liquidity. A greater number of dealers leads to more competitive dealer markets (Demsetz (1968)), and facilitates inventory risk management through inter-dealer trading (Ho and Stoll (1983), Reiss and Werner (1998)). Lower inventory risk and more intense competition among market makers, in turn, reduce transaction-costs.

Liquidity may also be greater for bonds with a wider investor base. Since global bonds can be marketed to investors in both the U.S. market and the Eurobond market, their pool of potential investor is greater. Duffie, Garleanu, and Pedersen (2005, 2007) develop a model in which transactions costs and liquidity in over-the-counter markets, such as the corporate bond market, depend on the number of potential investors. Their model predicts that illiquidity discounts are smaller if investors have access to multiple market makers, and the number of qualified investors is larger. Thus, global bonds that have an international investor base and a large network of dealers should be more liquid than domestic issues.

1.2.2. Bond Market Segmentation

The original rationale for creating the global bond instrument in 1989 was bond market segmentation. The World Bank observed yield disparities on its dollar-denominated debt outstanding in the Eurobond market and in the U.S. market, and issued the first global bond to take advantage of the disparities (see, e.g., Karpur et al. (1997), Fabozzi and Mann (2005)). By virtue of trading in both markets as well as between markets, global bonds would overcome international bond market segmentation and command higher prices (see, e.g., Stulz (1981), Errunza and Losq (1985)).

Even today, explicit and implicit barriers to international investments continue to exist and prevent full integration of Eurobond and U.S. domestic bond markets. On the one hand, the U.S. Tax Equity and Fiscal Responsibility Act of 1982 attempts to discourage the holding of anonymous bearer instruments such as Eurobonds by U.S. investors. It does so by imposing tax sanctions on the issuer and U.S. holders of bonds, unless the bonds are in registered form. In practice, Eurobonds are "locked up" for 40 days and offered exclusively to non-U.S. investors to satisfy the regulatory requirements. As a result, Eurobonds are rarely held by U.S. investors (Wood (2008)). On the other hand, overseas investors may face significant costs associated with cross-border clearing and settlement if they invest directly in bonds traded in the U.S. domestic market. Non-U.S. investors may therefore be willing pay a premium for global bonds that can be traded and settled more efficiently.[5]

In addition, several empirical studies suggest the U.S. bond market and the Eurobond market are not fully integrated. Kim and Stulz (1988, 1992) find significant positive abnormal returns associated with Eurobond issuance, and attribute the findings to bond market segmentation. Kim and Stulz (1988, 1992) argue that yield differences between the U.S. bond market and the Eurobond market do occasionally occur, and firms

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[5] U.S. investors settle global bond transactions through DTC as they would settle domestic bond transactions. Overseas investors settle global bond transactions through Clearstream or Euroclear as they would settle Eurobond transactions. Cross-market trades in global bonds are efficiently settled between the depositories.

that have an international reputation can take advantage of the differences by issuing bonds in the Eurobond market. More recently, Miller and Puthenpurackal (2005) find that global bond issuers have a lower cost of debt capital, and suggest that bond market segmentation could explain the difference.

I contribute to this discussion by testing if securities that allow for multimarket trading carry a premium. In fully integrated capital markets, global bonds should be priced no differently than domestic bonds issued by the same firms after controlling for liquidity. On the other hand, systematic differences in prices of global and domestic bonds with similar liquidity characteristics would provide evidence against bond market integration.

2. DATA

The data for this study come from several sources. The SDC database provides information on new issues, including offering prices, underwriting spreads, proceeds in the U.S. market, and proceeds in overseas markets. I obtain information on all corporate bond issues that are offered by public corporations, denominated in U.S. dollars, and publically traded in the U.S. bond market, the Eurobond market, or both markets (global bonds). In addition, I keep only issues of bonds that are straight, senior, non-convertible, non-asset backed, and without credit enhancements. Sample bonds are issued between January 1998 and December 2008, and have a maturity of five years or more at the time of issuance. Short-term notes are excluded because they are not comparable with longer-term bonds. Overall, 4441 new issues from the SDC database pass these filters.

The sample is further restricted to bonds offered by global bond issuers. Issues by firms that never issue a global bond are deleted because my method relies on comparing global and domestic bonds of the same issuers. This restriction also allows me to control for differences in credit quality between firms with access to global bond markets and pure domestic issuers. Overall, 2329 new issues from SDC pass these filters; 1039 are global bond issues, 1179 are U.S. domestic bond issues, and 111 are Eurobond issues. The bonds are issued by 234 corporations, of which 205 are U.S. and 29 are non-U.S. firms. The distribution of the new issues sample over time is shown in Table I.

[Table I]

Summary statistics for the sample of 2329 new issues are provided in Panel A of Table III. Issuance yields average 5.96% for global bonds, 6.26% for domestic bonds, and 6.25% for Eurobonds, but vary greatly across issuers and over time. Therefore, a direct comparison of yields or yield spreads without controlling for issuer and time effects is not meaningful. Gross spread is the total fee paid to underwriters, expressed as a percentage of the offer price. Gross spreads are lower for global bonds (0.56%) than for domestic bonds (0.8%) or Eurobonds (0.98%). This is in accordance with the findings of Miller and Puthenppurackal (2005), who examine issuance costs in greater detail. The total cost of debt is the yield to maturity calculated on issuance proceeds net of underwriting fees. It is the relevant measure of borrowing costs from the issuer's perspective. The total cost of debt is 6.04% for global bonds, 6.37% for domestic bonds, and 6.45% for Eurobonds.

Panel A of Table III next shows the issuance yield spread and the total cost of debt spread over U.S. Treasury securities with comparable maturities. In order to account for interest rate changes, all tests in this paper rely on spreads over Treasuries rather than raw yields. The spreads are calculated by subtracting the corresponding constant maturity Treasury rates from the yields. The daily yield curve for constant maturities of 2, 5, 10, and 30 years is from the U.S. Department of Treasury. Treasury yields for other maturities are obtained by standard methods. Linear interpolation is used for intermediate maturities, and the yield curve is assumed to be flat beyond 30 years. Issuance yield spreads average 1.61% for global bonds, 1.49% for domestic bonds, and 1.39% for Eurobonds. The total cost of debt spreads that take into account issuance costs are 10 to 20 basis points greater than the yield spreads.

The average global bond issue ($1,604 million) is approximately three times larger than the average domestic issue ($536 million) or the average Eurobond issue ($567 million). Foreign placements amount to 27.5% of the total proceeds for the average global bond, and 15.7% for the average domestic bond. Although some domestic bond offerings involve significant private placements with foreign investors, the median domestic offering involves zero foreign placements. In contrast, global bond offerings are typically marketed to investors in both U.S. and Eurobond markets. Table III further suggests that global and U.S. bonds are comparable with respect to their maturity and embedded call options. Eurobonds tend to have shorter terms to maturity, and are less likely to have embedded call options. The majority of sample bonds have an investment grade rating at the time of issuance.

The main source of secondary market prices for global and U.S. bonds is the Trade Reporting and Compliance Engine, commonly referred to as TRACE. Since June 2002, all broker-dealers active in the U.S. market have an obligation to report transactions in publicly registered corporate bonds to TRACE. Because global bonds are, like U.S. domestic public bonds, registered with the SEC, they are subject to TRACE reporting and dissemination. Eurobonds, in contrast, are not subject to TRACE reporting, and are not included in the TRACE sample. The information disseminated by TRACE includes bond CUSIP, transaction price, date, time, and volume. I complement this data with bond descriptive information from the Fixed Income Securities Database (FISD).

The TRACE sample starts in 2003, the first full year of TRACE reporting. It is comprised of a subset actively traded bonds. Specifically, a global (domestic) bond is required to trade on the same day as another domestic (global) bond of the same issuer in order to enter the sample. Further, sample bonds are required to have at least 5 years to maturity at the time of trading. There are 930 such bonds issued by 135 issuers; 480 are global bonds and 450 are U.S. domestic bonds. However, the number of new issues corresponding to these bonds is 957, since several bonds are issued in multiple tranches.

Several filters are applied to the sample trades. First, only trades on volume of \$100,000 or greater are included. Retail-sized trades are discarded because their transaction costs account for a non-negligible percentage of the traded price (see, e.g., Edwards et al. (2007)). Nevertheless, even retail trades are considered when calculating measures of corporate bond liquidity. In addition, the data are purged of trade reports that were subject to corrections, are missing key information, include commission in the price, were entered by multiple dealers, or appear to be outliers. To identify outliers in the transactions data, I employ the algorithm proposed by Brownlees and Gallo (2006):

$$\left(p_i - \bar{p}_i(30)\right) > 3s_i(30) + \ 0.5 = true, observation\ i\ is\ removed,$$

where $\bar{p}_i(30)$ and $s_i(30)$ denote respectively the sample mean and sample standard deviation of a neighborhood of 30 observations around i, trimmed by excluding the minimum and the maximum values. The value of 0.5 is added to avoid zero variances produced by sequences of equal prices. The idea behind the algorithm is to assess the validity of an observation on the basis of its relative distance from a neighborhood of the closest valid observations for a given bond. The algorithm removes 0.6% of trades from the sample. Altogether, there are 558,362 valid trades in the sample. These trades take place between January 2003 and March 2009 (see Table II).

[Table II]

In order to compare prices of bonds that do not mature exactly on the same day, I transform bond prices into spreads over U.S. Treasury yields. Prices are first adjusted for accrued interest and converted into yields to maturity. Then, yield spreads are calculated by subtracting the corresponding constant maturity Treasury rates from the yields, as in the case of issuance spreads.

Panel B of Table III provides summary statistics for the TRACE sample. The summary measures have been obtained by first averaging yields and spreads across all sample trades for each bond and then across bonds. Trading yields are 5.95% for the average global bond, and 6.10% for the average domestic bond. Trading yield spreads average 2.28% for global bonds, and 2.43% for domestic bonds, but change greatly over the sample period. The spreads range from just above 1% in January 2003 to more than 6% in September 2008.

[Table III]

Global bonds trade in both the U.S. market and the Eurobond market. Hence, I complement the data from the U.S. bond market with information on trading activity in the Eurobond market from ICMA's TRAX[6]. Compared to the U.S. bond market, the Eurobond market is much more lightly regulated, and detailed information on individual transactions is not publically disseminated. Nevertheless, I obtain from TRAX information on the average daily trading volume in the Eurobond market. Summary

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[6] The ICMA (the International Capital Markets Association) is the self-regulatory organization and trade association for the international securities market. TRAX is the ICMA trade matching and regulatory reporting system for the Eurobond market.

statistics for the liquidity measures can be found in the liquidity section (3.3) of the paper.

3. EMPIRICAL ANALYSIS

3.1. Cost of Debt and Primary Market Prices

I begin the analysis by testing whether global bond issuance results in a lower cost of debt than domestic issuance, as argued by Miller and Puthenpurackal (2005). For that purpose, I test for the significance of $\hat{\beta}_1$ in the following regression model:

$$\widetilde{Cost\ of\ Debt}_{ij} = \beta_0 + \beta_1 \widetilde{Global}_{ij} + \beta_2 \widetilde{Maturity}_{ij} + \beta_3 (\widetilde{Maturity}_{ij})^2 + \beta_4 \widetilde{Spread\ Market}_t + \beta_5 \widetilde{Call\ Option}_{ij} + \widetilde{rating}_{ij} + \widetilde{year} + \tilde{\varepsilon}_{ij}, \quad (1)$$

where each observation on the *i*-th issue of firm *j* has been transformed by subtracting the panel mean for firm *j* (i.e. the issuer fixed effect). The dependent variable is the cost of debt, calculated as the yield to maturity on net issuance proceeds after subtracting issuance costs. The model includes controls for the maturity structure of credit risk, market-wide credit spread movements as measured by the yield spread of the U.S. aggregate corporate bond index from DATASTREAM over 10-year Treasury rates, and embedded call options. There are also fixed time effects for each sample year, and indicator variables for each rating notch to control for credit spread changes. The specification is similar to that used by Miller and Puthenpurackal (2005), except that I use issuer fixed effects to control for credit quality and unobserved heterogeneity among firms.

Equation (1) is estimated with issuer fixed effects to control for unobserved differences in credit quality between issuers of global and domestic bonds. Relative to firms that issue only domestic bonds, global bond issuers are likely to have unobserved characteristics that may increase their credit quality. For instance, global bond issuers are typically well-known corporations with multinational operations and global reputation (see Appendix A). The fixed effects model effectively compares global and domestic bonds issued by the same firms, and it is robust to omitted firm-specific regressors.

I estimate the model on three samples of global and U.S. domestic bonds: The sample of 957 issues of TRACE bonds, the full sample of 2175 bonds, and a smaller sample of bonds offered by firms that had previously issued a global bond. These regressions compare the cost of debt of global bonds against the benchmark of bonds issued by the same firms in the U.S. domestic market. In addition, the model is estimated with Eurobonds as an alternative benchmark.

[Table IV]

The coefficient estimates are presented in Table IV. All standard errors are clustered by issuer. The coefficient on the indicator for global issuance is negative and statistically significant. The first column indicates that global bond offerings have a cost of debt that is on average 16.1 basis points below comparable domestic bond offerings. This result is consistent with the study by Miller and Puthenpurackal (2005), who find that global borrowing costs are lower by 20.7 basis points. The slight difference between the estimated effects of global issuance on the cost of debt reflects the fact that Miller and Puthenpurackal (2005) cover an earlier period. If I restrict the sample period to 1996 to 2003, the coefficient estimate increases in absolute value to 21.1 basis points.

The maturity structure of credit spreads and market-wide credit spread changes are significant and have the expected signs. The call option feature is insignificant. The second and third columns of Table IV include additional controls for issue size and the percentage of the total principal raised outside the U.S. The effect of global issuance is still statistically significant and does not diminish in magnitude. Further, in the whole sample of 2175 issues, there is no evidence that issue size affects the cost of debt. However, there is some evidence in the sample of 957 TRACE bond offerings that larger issues have a higher cost of debt, and the cost of debt can be reduced by placing a greater percentage of the issue with foreign investors. This is consistent with the finding of Newman and Rierson (2004) that large corporate bond issues create price pressure because it is difficult to place them with domestic investors.

The limiting assumption of the fixed effects model is that the credit risk of each issuer remains constant as long as its credit rating does not change. Nevertheless, it is possible that small changes in issuer credit quality do not result in credit rating up- or down-grades, and are correlated with global bond issuance. The summary statistics for bond issuance in Table I show that most global bonds are issued later in the sample period, suggesting that issuer reputation may have improved. To account for this possibility, I estimate the model for the subsample of 1083 bonds that were issued after the first global bond offering by a given issuer. The results are shown in the fifth column of Table IV. The coefficient on the indicator for global issuance decreases to minus 15.6 basis points, but remains statistically significant at the 5 percent level.

Next, I examine whether borrowing costs for global bond issues differ from borrowing costs for Eurobond issues. Since global bonds are a "hybrid" of U.S. domestic bonds and Eurobonds, it is interesting to compare their borrowing costs not only against the U.S. bond benchmark but also against the Eurobond benchmark. However, in contrast to U.S. and global bonds, Eurobonds pay annual coupon, are not registered with the SEC, and tend to have lighter covenants. For all these reasons, the borrowing costs for Eurobonds can be expected to be higher. Indeed, the last column of Table IV shows that when global offerings are compared against the Eurobond benchmark, the borrowing costs for global bonds are 39.6 basis points lower. The test is performed on a sample of 565 offerings by 58 firms that issue both global bonds and Eurobonds.

Thus, I reject the hypothesis that borrowing costs with global bonds are the same as borrowing costs with U.S. domestic bonds or Eurobonds, and find that borrowing costs with global bonds are lower. I further examine whether the difference in borrowing costs is primarily due to lower underwriting spreads, or if it reflects higher prices (i.e. lower yield spreads) on global bonds. In Table V, I estimate the same regression as in Table IV with issuance yield spreads as the dependent variable. Yield spreads measure the relative prices of global bonds from the investor's perspective. The estimates in Table V are only slightly lower in absolute value than the estimates in Table IV, showing that the borrowing costs with global bonds are lower mainly because investors require lower yields to hold global bonds. Issuance costs are of second order importance. The estimates indicate that global bonds are offered on average at yield spreads about 15 basis points below comparable domestic bonds of the same issuers. The effect of global issuance on yield spreads remains negative and significant across all subsamples.

3.2. Secondary Market Prices

The differences in offering prices of global and domestic bonds do not necessarily imply that secondary market prices also differ. The prices of new corporate bond issues may also be affected by transitory factors such as underpricing (Cai et al. (2009)) or issuance price pressure (Newman and Rierson (2004)). Underpricing could be less prevalent among new global issues if there is better information dissemination surrounding global offerings or more competition among underwriters for global issues. Issuance price pressure may be smaller for global issues if the supply shocks associated with large bond offerings are in part absorbed by foreign investors.

This section examines secondary market prices of global and domestic bonds to distinguish between temporary factors surrounding bond offerings and permanent price differentials. As a first step in the analysis of trading yield spreads, I form a sample of trades in global and domestic bonds of one issuer that occur on the same day. In order to enter the sample, a global (domestic) bond is required to trade on the same day as another domestic (global) bond of the same issuer. However, the bonds may have different maturities and embedded call options. I use two methods to control for these characteristics. First, I create a paired sample of bonds that have no call options and mature within two years from each other. I conduct paired t-tests to examine if the bonds trade at different yields. The second method uses panel regressions to relate yield differentials to differences in bond characteristics.

[Table VI]

Table VI presents the results of paired t-tests. I construct a sample of 137 option-free bond pairs matched by issuer and time to maturity, and calculate the average difference in trading yield spreads for each pair of bonds. Presented are the mean and the median of the differences, t-test for the significance of the difference, and results of the non-parametric Wilcoxon signed rank test. The mean difference for the whole matched sample is negative and statistically significant. Global bonds trade on average at yield spreads 22 basis points below those on comparable domestic bonds of the same issuers. However, the mean difference is much greater for below-investment grade bonds (-61 basis points) than for investment grade bonds (-22 basis points). The difference is negative and significant in all sample years, but it is larger during the earlier period and during the turbulent years of 2008 and 2009.

The paired t-tests offer a simple method of testing for differences in yields, but restrict the sample to a small number of non-callable bonds with similar maturities. In addition, they do not allow me to relate yield differentials to bond liquidity. Next, I estimate panel regressions that address these concerns. The regression model is as follows:

$$\widetilde{\widetilde{Yield\ Spread}}_{ijdt} = \beta_0 + \beta_1 \widetilde{\widetilde{Global}}_{ijdt} + \beta_2 \widetilde{\widetilde{Maturity}}_{ijdt} + \beta_3 (\widetilde{\widetilde{Maturity}}_{ijdt})^2 + \beta_4 \widetilde{\widetilde{Call\ Option}}_{ij} + \tilde{\tilde{\varepsilon}}_{ijdt}, \qquad (2)$$

where each observation on the *i*-th issue of firm *j* has been transformed by subtracting the panel mean for all bonds of firm *j* traded on day *d* (i.e. the issuer/day fixed effect). The transformation within each panel removes the firm-specific effect that may be correlated with the error terms. It is akin to computing the mean of the differences in spreads between global and domestic bonds of one issuer traded on the same day, and testing if the mean difference is statistically different from zero. However, the fixed effects transformation allows for the difference in spreads between bonds to be explained by a vector of independent variables. The vector includes controls for the maturity structure of credit spreads and embedded call options.

[Table VII]

Table VII presents the parameter estimates. Reported are also robust t-statistics adjusted for clustering by bond (i.e. both within and between panels). The coefficient on global is -23.8 basis points, significant at the 1 percent level, showing that global bonds trade at lower yield spreads (i.e. higher prices) than comparable domestic bonds issued by the same firms. If the sample is divided into 888 investment grade bonds and 116 speculative grade bonds, global bonds in both subsamples earn significantly lower yield spreads. However, the effect of global trading is much smaller in absolute value for investment grade bonds (-11.6 basis points) than for non-investment grade bonds[7] (-51.5 basis points). This finding is in accordance with either the liquidity hypothesis or the market segmentation hypothesis. Most studies of corporate bond liquidity find that illiquidity has a stronger impact on speculative grade bond prices than on investment grade bond prices (e.g., Longstaff, Mithal, and Neis (2005), Chen, Lesmond, and Wei (2007), Nashikkar, Subrahmanyam, and Mahanti (2009)). Also, the market segmentation hypothesis implies that bonds traded across markets command higher prices because credit risk is priced differently in each market. Thus, the premium on global bonds should be greater for bonds with higher credit risk.

In line with Merton's (1974) model of the maturity structure of credit risk, time to maturity has a significant positive effect on yield spreads of investment grade bonds. Yield spreads of speculative bonds also increase with time to maturity, which agrees with the findings of e.g. Helwege (2002), and Chen et al. (2007). The contribution of the call option feature to yield spreads is positive, and it is larger for speculative grade bonds (29 basis points) than for investment grade bonds (6 basis points). These estimates are in agreement with the findings of King (2002) regarding call option values implicit in U.S. corporate bonds. Overall, the regression model explains 18% of the differences in yield spreads between different bonds of the same issuers, and the contribution of the global dummy to the R-squared is around 2%.

[Table VIII]

In order to understand what factors explain the yield differential between global and domestic bonds, I estimate Equation (2) year-by-year and conditional on the occurrence of a crisis. A crisis is said to occur on the five percent of days (82 days) with the largest market-wide credit spreads, where market spread is measured as the difference between yield to maturity for the U.S. aggregate corporate bond index from DATASTREAM and 10-year Treasury rates. All the crisis days occur during the second half of 2008 and in 2009. As the estimates in Table VIII show, the yield differential remains negative over the entire sample period 2003 to 2009, ranging from 20 to 45 basis

[7] Most speculative bonds are issued as investment grade bonds but enter the speculative sample due to downgrades.

points. However, some of the greatest differentials are observed during the crisis period of 2008 and 2009. During the crisis period, global bonds trade at yields 44 basis points below domestic bonds, which is greater than the average difference of 24 basis points. These findings suggest that the price difference between global and domestic bonds increases in times of market distress. The implications of the financial crisis for the spread between global and domestic bond yields are further discussed in Section IV.

3.3. Liquidity of Global Bonds

One argument in favor of global bond issuance is greater liquidity. Global bonds could be more liquid because they are larger issues, or because they have a greater number of market makers and a wider investor base. This section examines whether global bonds are more liquid than bonds issued in the U.S. domestic market by the same corporations. I also test if liquidity can explain the yield differential between global and domestic bonds.

Liquidity is the ability to buy or sell an asset in large quantity quickly and without affecting the market price. I compute several proxies for corporate bond liquidity that have been proposed in the literature: bond age, principal, trading volume, trading frequency, price volatility, and the price impact of trades. Bond age and principal are widely used liquidity proxies that do not require transaction data. Alexander et al. (2000) and Edwards et al. (2007) show that trading volume of corporate bonds declines as they become older and settle into institutional portfolios. I measure bond age at the time of trading in years, and total principal issued in all markets in millions of dollars.

The transaction-based measures of corporate bond liquidity use data from TRACE for the U.S. bond market complemented with information from TRAX for the Eurobond market. I compute the monthly trading volume in the U.S. bond market as the sum of trading volume from all TRACE transactions over a period of 20 trading days preceding each observation. For confidentiality reasons, TRACE does not disseminate the exact trading volume for transactions larger than the cap value of $5 million ($1 million for high yield bonds). I assume that that the actual transaction volume is equal to the cap value. The monthly trading volume for the Eurobond market is obtained by multiplying the average daily volume for the previous month provided by TRAX by 20. In contrast to reporting to TRACE, which is mandatory for all broker-dealers registered in the U.S., only ICMA members have an obligation to report their trades to TRAX[8]. Thus, the TRAX volume may be an imperfect proxy for trading activity in the Eurobond market. The total trading volume is estimated for each bond as the sum the TRACE and TRAX volumes.

Next, I compute three measures of trading frequency: The monthly number of trades from TRACE, the monthly number of large trades from TRACE, and the monthly number of zero-volume days by counting days on which no large trades occur. Large trades are defined as transactions on volume of $100,000 or greater. Smaller, retail-sized trades may not be indicative of greater liquidity (see, e.g., Edwards et al. (2007)). The number of zero volume days is counted over the last 20 trading days preceding each trade.

Price volatility is related to liquidity through dealer inventory risk (see, e.g., Stoll (1978)). I compute two measures of price volatility: the monthly price range as a percentage of the average price, and the coefficient of variation of the transaction price. The coefficient of variation is the monthly standard deviation scaled by the average price. Both measures are computed over the period of 20 trading days preceding an observation, and only large trades are used in their calculation. The measures are winsorized at the 99.5^{th} percentile.

In addition, I compute a measure of the price impact of trading related to that proposed by Amihud (2002). The adjusted Amihud measure is defined as the ratio of the monthly percentage price range to the total monthly trading volume (in millions of dollars). The ratio is similar to the price impact measure of Amihud (2002) in that it relates price volatility to trading volume. However, like Goyenko et al (2009), I use monthly rather than daily price changes to account for the infrequent trading of corporate bonds. Furthermore, I use only large trades in the numerator, and winsorize the measure at the 99.5^{th} percentile to eliminate outliers. The formula is:

[8] The ICMA currently has 400 members in 50 countries, and its TRAX system covers the greater part of the over-the-counter market for international securities. Its members are mostly in European countries, and there is little overlap between ICMA and FINRA membership.

$$Amihud_{20} = \frac{(\max_{20}(p) - \min_{20}(p))/\bar{p}_{20}}{Volume_{20}\ (\$\ M)}. \quad (3)$$

[Table IX]

The liquidity measures for bonds in the TRACE sample are summarized in Table IX. The median global issue in this sample is more than twice as large as the median domestic issue ($1.2 bn. vs. 0.46 bn.). Whereas 39.44% of the total principal for the median global bond is placed with non-U.S. investors, the median domestic bond involves no foreign placements. Trading volume in both the U.S. market (TRACE) and the Eurobond market (TRAX) is several times greater for global bonds. The average monthly trading volume for the typical global bond is $74.2 million in the U.S. market, and $11.78 million in the Eurobond market. The typical domestic bond has an average monthly trading volume of $14.48 million in the U.S. market, and only $0.63 million in the Eurobond market. The typical global bond trades 104 times per month, of which 40 trades are large (on volume of at least $100,000). In contrast, the typical domestic bond trades only 30 times per month, of which merely 10 trades are large. No large trades are executed on 15 out of 20 trading days for the median domestic bond, and 7.6 out of 20 trading days for the median global bond. Global bond prices also have a smaller price range and are less volatile than domestic bond prices. Finally, the adjusted Amihud measure shows that global bond prices are less impacted by large trades than domestic bond prices. The estimated price impact of trading $1 million is 12 basis points for the median global bond, and 75 basis points for the median domestic bond. These estimates are in the same range as those found by Edwards et al. (2007).

In Table X, I test whether global bonds are more liquid than domestic bonds after controlling for bond characteristics such as age, issue size, maturity, and embedded call options. As for the analysis of yield spreads, I use issuer/day fixed effects to hold constant the credit risk and other firm-specific determinants of liquidity. Liquidity measures are the dependent variables in these regressions. All measures of bond liquidity, except bond age and the number of zero volume days, are transformed by taking natural logarithms. The first column of Table X shows that global bonds trade more actively than domestic bonds, even after taking into account their greater issue size and differences in age at the time of trading. Column 2 reveals that the trading volume in the Eurobond market (from TRAX) depends even more strongly on global bond issuance than the total volume.

The total number of trades from TRACE is not significantly related to either global issuance or bond age. It is greater for larger issues and bonds with embedded call options. However, the total number of trades is not likely to be a good proxy for bond liquidity since the majority of trades are retail-sized. The total number of trades may reflect retail investors' speculation call option values, as indicated by the significant coefficient on the significant coefficient on the call option feature, rather than the capacity to execute large trades without affecting the price. In contrast, the number of large trades is significantly related to both global issuance and bond age, even after controlling for issue size and other bond characteristics. The number of zero volume days that considers only large transactions is also significantly smaller for global bonds.

Both measures of price volatility are lower for global bonds, and the differences are statistically significant. The price range decreases as bonds season, which may reflect lower duration rather than improved liquidity. However, price variability as measured by the coefficient of variation increases with age, suggesting that more seasoned issues are less liquid. As expected, price volatility depends negatively on issue size and positively on time to maturity. The adjusted Amihud illiquidity, which is a proxy for the price impact of trading, is significantly lower for global bonds. This measure also shows that bonds become increasingly illiquid as they season, and larger issues are more liquid than smaller ones.

Thus, there is evidence that global bonds have a liquidity advantage over domestic bonds, even after controlling for their greater issue size and other characteristics. Can the liquidity advantage of global bonds explain why investors require lower yields on global bonds? This question is examined by re-estimating the yield spread regressions (Equation (2)) with additional controls for corporate bond liquidity.

[Table XI]

Table XI shows the coefficient estimates for the indicator of global issuance and each of the liquidity measures. Among the liquidity measures (column 2), age has a significant positive effect on yield spreads. Each additional year of age increases the required yield spread by 4.4 basis points. These estimates agree with the findings of e.g. Alexander et al. (2000) and Edwards et al. (2007). The effect of issue size on yield spreads is negative but insignificant. This is consistent with the finding of Crabbe (1995) that issue size is not an important determinant of yield spreads once issuer credit risk is held constant. Also, trading volume is not significantly related to yield spreads at the issuer level. The total number of trades in the preceding month and the number of large trades are significantly related to yield spreads, but the effect is unexpectedly positive. As discussed before, trading frequency may be a poor proxy for liquidity. Similarly, I find no significant relationship between the number of zero volume days and yield spreads. As expected, the price range and coefficient of variation have a positive significant effect on yield spreads. These measures of price variability also have the highest explanatory power for yield spreads in terms of R-squared. Finally, in accordance with the theory, bonds with greater Amihud illiquidity earn significantly larger yield spreads.

Of particular interest are the coefficients on the indicator variable for global issuance, which are shown in the first column of Table XI. Regardless of the included liquidity measure, the coefficient on global is negative and significant. The magnitude of the coefficient changes very little after controlling for liquidity. The effect of global issuance on yield spreads remains between -22.3 and -25.4 basis points, and the increase in R-squared is on the order of 1% to 2%. The effect of controlling for liquidity on the yield differential may appear to be small because the transaction-based liquidity proxies are noisy compared to the indicator variable for global issuance. However, the results agree with the recent findings by Rossi (2009) and Wang (2009) that liquidity proxies explain only an incremental 1% of the cross-sectional variation in yield spreads once credit risk is correctly controlled for. Thus, the findings suggest that liquidity alone cannot fully account for the premium prices that investors pay for global bonds.

4. DISCUSSION

In fully integrated capital markets, global and domestic bonds of the same issuers should command the same prices after controlling for differences in liquidity. However, the coefficient estimates in Table XI show that investors demand lower yield spreads (i.e. pay higher prices) for global bonds that can be traded in both the U.S. bond market and the Eurobond market, as well as across markets. The greater liquidity of global bonds does not appear to explain the yield spread differential. Thus, the evidence suggests that international bond markets are not fully integrated, and investors value the ability of global bonds to span the U.S. and the Eurobond markets.

The results can be interpreted in terms of Stulz's (1981) model of international asset pricing. Stulz (1981) shows that in the presence of barriers to international investment that make it costly to hold foreign assets, investors require lower returns on international assets that are not subject to such costs. Global bonds earn lower yield spreads according to this model because foreign investors face higher transaction costs if they want to invest directly in U.S. domestic bonds. However, the question remains why U.S. investors who can readily access both domestic and global bonds hold global bonds and do not arbitrage away the yield differentials.

In practice, arbitrage between global and domestic bonds is limited by the costs of transacting in corporate bond markets. Edwards et al. (2007) estimate that average round-trip transaction costs for a representative institutional order size of $200,000 amount to 48 basis points. Even for large institutional orders of $1 Million, Edwards et al. (2007) estimate round-trip transaction costs of 22 basis points. The estimated transaction costs are still higher for high-yield bonds and distressed securities. For example, Edward et al. (2007) calculate that the round-trip institutional transaction costs increase by a further 20.8 basis points for BB and B-rated bonds. Higher transaction costs may explain why I find the greatest yield differentials between global and domestic bonds of below-investment grade issuers. Round-trip transaction costs of 40 basis points or higher would make it nearly impossible to profitably exploit the yield difference of 50 basis points on speculative grade bonds.

Furthermore, the results in Tables IV and VIII show that the yield difference between global and domestic bonds widens during the credit crisis of 2008 and 2009. Conditional on the crisis, the yield differential almost doubles, reaching 44.2 basis points. This result is in accordance with prior findings that non-arbitrage bands become wider in a crisis (see e.g. De Long et al. (1990), Brunnermeier and Pedersen (2008)). One reason is that bid-ask spreads and indirect transaction costs increase during crisis periods (see, e.g. Chordia, Roll, and Subrahmanyam (2000)), and the costs of transacting may exceed arbitrage profits. In addition, as shown by Brunnermeier and Pedersen (2008) and Stein (2009), arbitrageurs typically face binding funding constraints in a credit crisis, and may be unable to take on new positions or even maintain their existing positions. For both reasons, arbitrage between global and domestic bonds becomes less effective in a credit crisis, increasing the price premium on global bonds.

5. CONCLUSIONS

Large multinational corporations increasingly raise funds by issuing global bonds. Global bonds resemble U.S. domestic bonds, but their distinctive features allow global bonds to be traded in multiple markets. They are placed simultaneously with U.S. and overseas investors, and can be traded in the U.S. bond market and the Eurobond market, as well as between markets. However, the effects of multimarket trading on corporate bond value are not well understood. This paper studies the effects of multimarket trading on the cost of debt, corporate bond prices, and liquidity. I examine primary and secondary market prices of global bonds and compare them with bonds issued by the same corporations in the domestic market. I further examine corporate bond liquidity in secondary markets, and its relationship to multimarket trading.

The results confirm the finding of Miller and Puthenpurackal (2005) that global bond issues are associated with a lower cost of debt financing than domestic issues. In addition, I find that new global bond issues are priced at a premium relative to domestic bond issues of the same firms. On average, global bonds are offered at yield spreads 15 basis points below comparable U.S. domestic bonds, and 30 basis points below comparable Eurobonds. The difference in issuance yields does not reflect temporary factors such as issuance price pressure or underwriter competition because it carries over into secondary market prices. When I examine trading prices from TRACE from 2003 to 2009, I find that if two bonds of the same issuer, one global and one domestic, trade on the same day, the yield on the global bond is on average 23.8 basis points lower. The difference is greater for speculative grade bonds (-51.5 basis points) than for investment grade bonds (-11.6 basis points). Since high yield bonds are relatively expensive to trade, transaction costs rule out profitable arbitrage between global and domestic bonds. In addition, the increase in the yield differential during the credit crisis of 2008 and 2009 suggests that funding constraints may also limit arbitrage.

I further examine the effects of multimarket trading on corporate bond liquidity. The results show that, compared with domestic bonds of the same issuers, global bonds are more liquid. They exhibit greater trading volumes in both the U.S. bond market and the Eurobond market, trade more frequently, and their prices are less volatile and less affected by trading volume. The liquidity advantage of global bonds persists even after controlling for their greater issue size ($1 bn. vs. $ 0.3 bn.). However, the trade-based liquidity measures explain no more than 2% of the variation in yield spreads, and only a small part of the yield differential between global and domestic bonds.

Overall, the results provide insights into the degree of international bond market integration and have implications for the cost of debt. The findings imply that international bond markets are not fully integrated, and large issuers can lower their cost of debt by offering global bonds. Global bond offerings are associated with a lower cost of debt financing because investors require lower yields on bonds that can be traded and settled efficiently in multiple markets. Multimarket trading improves the liquidity of corporate bonds and creates value for investors.

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Table I
Sample of New Issues

The table shows the distribution over time of the number of new issues of sample bonds. The sample of new issues is made up of global bonds and other bonds offered by global bond issuers in the U.S. domestic or the Eurobond market. The bonds are issued between 1998 and 2008, publicly traded, U.S. dollar-denominated, fixed coupon straight bonds with at least 5 years to maturity, senior and unsecured.

Issuance Year	Bond Type Global	U.S.	Eurobond	Total
1998	22	169	25	216
1999	46	125	27	198
2000	45	89	7	141
2001	92	142	5	239
2002	68	110	14	192
2003	72	144	7	223
2004	38	66	3	107
2005	48	129	2	179
2006	145	99	9	253
2007	230	67	9	306
2008	233	39	3	275
Total	1039	1179	111	2329

Table II
Sample of Secondary Market Transactions (TRACE Sample)

The table shows the distribution over time of the sample of secondary market transactions from TRACE. This sample is made up of transactions in U.S. and global bonds matched by issuer and trading day that occur between January 2003 and March 2009. The bonds are U.S. dollar-denominated, fixed coupon straight bonds with at least 5 years to maturity at the time of trading, senior and unsecured. All sample trades are on volume of $100,000 or greater.

Trading Year	Bond Type Global	U.S.	Total
2003	31584	23076	54660
2004	37193	24115	61308
2005	75014	43674	118688
2006	61347	34550	95897
2007	61356	33948	95304
2008	70939	36965	107904
2009	15726	8875	24601
Total	353159	205203	558362

Table III
Summary Statistics

The table summarizes information from both primary (Panel A) and secondary (Panel B) corporate bond markets. The sample of new issues is made up of global bonds and other bonds offered by global bond issuers in the U.S. domestic or the Eurobond market. Information on new issues is from the SDC database. Issuance yield is the yield to maturity at issuance from SDC. Gross spread includes total managers' fees, expressed as a percentage of the offer price. Total cost of debt is the yield to maturity calculated on issuance proceeds net of underwriting fees. Yield spreads are obtained by subtracting the corresponding constant maturity Treasury yield from the issuance yield and the cost of debt. Total principal is the principal amount placed in all markets. Foreign principal as % of total principal shows the percentage of the total principal issued that is initially placed with non-U.S. investors. The secondary markets sample (Panel B) contains transactions from TRACE, matched by issuer and trading day. Secondary market data are available only for a subset of actively traded bonds (TRACE bonds). Trading yields and yield spreads are first averaged across the sample trades for each bond and then across bonds.

	Sample mean			Sample median		
	Global bonds	Domestic bonds	Eurobonds	Global bonds	Domestic bonds	Eurobonds
Panel A: New Issues Sample						
Issuance yield (%)	5.96	6.26	6.25	5.89	6.19	5.90
Gross underwriting spread (%)	0.56	0.80	0.98	0.45	0.65	0.75
Total cost of debt (%)	6.04	6.37	6.45	5.97	6.29	6.15
Issuance yield spread (%)	1.61	1.49	1.39	1.40	1.32	0.90
Total cost of debt spread (%)	1.69	1.60	1.59	1.48	1.41	1.04
Total principal issued ($ M)	1604.41	535.78	567.18	1000.00	300.00	400.00
Foreign principal as % of total principal	27.49	15.65	12.03	16.67	0.00	0.00
Maturity at issuance (yrs)	11.91	13.99	8.68	10.14	10.15	6.09
% of callable bonds	0.67	0.57	0.14	1.00	1.00	0.00
% of investment grade bonds (at issuance)	0.98	0.96	0.95	1.00	1.00	1.00
No. of bond issues (2329)	1039	1039	1039	1039	1039	1039
No. of issuers (219)	219	219	58	219	219	58
Panel B: TRACE Sample						
Trading yield (%)	5.95	6.10	-	5.79	5.93	-
Trading yield spread (%)	2.28	2.43	-	1.87	2.05	-
Time to maturity when traded (yrs)	10.51	10.58	-	7.82	7.05	-
No. of sample trades per TRACE bond	736	456	-	296	99	-
No. of bonds (930) [9]	480	450	-	480	450	-
No. of issuers (135)	135	135	-	135	135	-

[9] The corresponding number of issues is 957, since several bonds are issued in multiple tranches.

Table IV

Cost of Debt: Panel Regressions with Issuer Fixed Effects

The table presents estimates from regressions of the cost of debt on the indicator for global bond issuance, and on controls for issue size (principal), the percentage of principal placed with foreign investors, maturity structure of credit spreads, market-wide credit spreads, and embedded call options. The regressions are estimated on panel data transformed by subtracting issuer fixed effects. Also included are indicator variables for each rating notch and fixed time effects for each sample year (not reported). Robust t-statistics adjusted for clustering by issuer are in parentheses. Coefficients marked with ** (*) are significant at the 5% (10%) levels.

		TRACE Bonds		All Bonds	Bonds Issued after Global	Eurobond Benchmark
Global bond	-0.161**	-0.166**	-0.165**	-0.164**	-0.156**	-0.396**
	(-3.150)	(-3.100)	(-3.080)	(-3.330)	(-2.090)	(-2.320)
Principal (log)		0.017	0.064*	-0.002	-0.003	0.017
		(0.520)	(1.650)	(-0.060)	(-0.050)	(0.480)
Foreign principal %			-0.002**	-0.001	-0.001	
			(-2.530)	(-0.870)	(-0.620)	
Maturity (yrs)	0.082**	0.083**	0.082**	0.034**	0.052**	0.081**
	(9.150)	(8.860)	(8.350)	(4.260)	(6.840)	(3.920)
Maturity squared	-0.002**	-0.002**	-0.002**	-0.001**	-0.001**	-0.002**
	(-8.120)	(-7.820)	(-7.360)	(-2.980)	(-6.080)	(-3.170)
Market spread	0.712**	0.716**	0.702**	1.089**	1.138**	0.948**
	(6.580)	(6.590)	(6.590)	(13.890)	(8.560)	(5.680)
Callable bond	-0.012	-0.016	-0.034	-0.038	-0.001	-0.045
	(-0.220)	(-0.320)	(-0.660)	(-1.260)	(-0.020)	(-0.590)
R-squared	0.66	0.66	0.66	0.66	0.64	0.76
No. of issuers (clusters)	135	135	135	219	92	58
No. of issues	957	957	957	2175	1083	565

Table V

Offering Yield Spreads: Panel Regressions with Issuer Fixed Effects

The table presents estimates from regressions of offering yield spreads the on the indicator for global bond issuance, and on controls for issue size (principal), the percentage of principal placed with foreign investors, maturity structure of credit spreads, market-wide credit spreads, and embedded call options. The regressions are estimated on panel data transformed by subtracting issuer fixed effects. Also included are indicator variables for each rating notch and fixed time effects for each sample year (not reported). Robust t-statistics adjusted for clustering by issuer are in parentheses. Coefficients marked with ** (*) are significant at the 5% (10%) levels.

		TRACE Bonds		All Bonds	Bonds Issued after Global	Eurobond Benchmark
Global bond	-0.153**	-0.158**	-0.158**	-0.151**	-0.142*	-0.306*
	(-3.020)	(-2.990)	(-2.980)	(-3.160)	(-1.940)	(-1.870)
Principal (log)		0.020	0.066*	0.006	0.007	0.030
		(0.590)	(1.750)	(0.160)	(0.120)	(0.910)
Foreign principal %			-0.002**	-0.001	-0.001	
			(-2.570)	(-1.000)	(-0.700)	
Maturity (yrs)	0.089**	0.090**	0.088**	0.042**	0.059**	0.091**
	(10.100)	(9.770)	(9.200)	(5.330)	(7.820)	(4.220)
Maturity squared	-0.002**	-0.002**	-0.002**	-0.001**	-0.001**	-0.002**
	(-8.910)	(-8.570)	(-8.070)	(-4.070)	(-7.200)	(-3.490)
Market spread	0.717**	0.722**	0.708**	1.086**	1.132**	0.969**
	(6.700)	(6.720)	(6.720)	(14.030)	(8.590)	(5.860)
Callable bond	-0.012	-0.017	-0.035	-0.032	0.001	-0.054
	(-0.220)	(-0.330)	(-0.680)	(-1.040)	(0.020)	(-0.730)
R-squared	0.66	0.66	0.67	0.67	0.64	0.75
No. of issuers (panels & clusters)	135	135	135	219	92	58
No. of issues	957	957	957	2175	1083	565

Table VI
Analysis of Trading Yield Spreads: Paired T-tests

The table shows mean and median differences of yield spreads for a paired sample of 137 global and domestic bonds. The bonds making up the pairs are non-callable and mature within two years from each other. Also shown are paired t-tests for the difference in yield spreads between global and domestic bonds, and the Wilcoxon signed rank test. Mean (median) marked with ** (*) are significant at the 5% (10%) levels according to the t-test (Wilcoxon signed rank test).

	No of Matched Pairs	Mean Difference (%)	T-statistic	Median Difference (%)
		All Bonds		
All bonds	137	-0.22**	-5.31	-0.09**
		By Rating		
Investment grade	132	-0.22**	-5.19	-0.09**
Speculative grade[10]	25	-0.61*	-1.82	-0.24*
		By Year of Trading		
2003	26	-0.41**	-2.60	-0.12**
2004	25	-0.13**	-2.34	-0.10**
2005	36	-0.07*	-1.93	-0.05*
2006	61	-0.07**	-3.01	-0.05**
2007	76	-0.05*	-1.81	-0.04**
2008	71	-0.26**	-3.82	-0.14**
2009 (Q1)	32	-0.50*	-1.81	-0.31**

[10] Due to downgrades, the same bond can appear in both the investment grade and the speculative grade sample.

Table VII
Analysis of Trading Yield Spreads:
Panel Regressions with Issuer/Day Fixed Effects

The table presents estimates from regressions of trading yield spreads on a dummy variable that takes a value of one for global bonds, and on controls for the maturity structure of credit spreads and embedded call options. The regressions are estimated on panel data transformed by subtracting the issuer/day fixed effects from all transactions in bonds of an issuer that occur on the same day. Robust t-statistics adjusted for clustering by bond are in parentheses. Coefficients marked with ** (*) are significant at the 5% (10%) levels.

	All Bonds	Investment Grade	Speculative Grade
Global bond	-0.238**	-0.116**	-0.515**
	(-4.760)	(-4.520)	(-2.970)
Maturity (yrs)	0.103**	0.086**	0.092**
	(5.420)	(9.470)	(2.090)
Maturity squared	-0.002**	-0.002**	-0.002
	(-4.560)	(-8.070)	(-1.510)
Callable bond	0.205**	0.063*	0.287
	(2.150)	(1.910)	(1.410)
R-squared	0.177	0.182	0.209
No. of trades	558362	412045	146317
No. of bonds (clusters)[11]	930	888	116
No. of issuers	135	127	18

[11] Due to downgrades, the same bond can appear in both the investment grade and the speculative grade sample.

Table VIII
Yield Differentials by Year and during Crisis

The table presents year-by-year coefficient estimates of the difference between global and domestic yield spreads from the model in Table VII. Crisis period refers to the five percent of days (82 days in 2008 and 2009) with the largest market-wide credit spreads. Robust t-statistics adjusted for clustering by bond are in parentheses. Coefficients marked with ** (*) are significant at the 5% (10%) levels.

Time Period	Global Bond	No. of Trades	No. of Bonds	R-squared
2003	-0.368**	54660	190	0.344
	(-3.340)			
2004	-0.174**	61308	210	0.686
	(-3.670)			
2005	-0.200*	118688	241	0.329
	(-2.040)			
2006	-0.451**	95897	365	0.398
	(-3.260)			
2007	-0.082	95304	609	0.189
	(-1.580)			
2008	-0.321**	107904	674	0.091
	(-4.990)			
2009 (Q1)	-0.255**	24601	485	0.117
	(-4.790)			
01/2003 - 03/2009	-0.238**	558362	930	0.177
	(-4.760)			
Crisis Period 2008/2009	-0.442**	23662	507	0.115
	(-5.730)			

Table IX
Summary of Liquidity Measures
(TRACE Sample)

The table presents summary statistics for measures of corporate bond liquidity. All transaction-based measures including volume, number of trades, number of zero volume days, price range, coefficient of variation, and Amihud illiquidity are computed for the last 20 trading days preceding each transaction. Price range is scaled by the average price. Coefficient of variation is the standard deviation of price scaled by the average price. Amihud illiquidity is defined as the price range divided by the total volume in millions of dollars. Large trades are trades on volume of $100,000 or greater. Only large trades are used to compute the number of zero volume days, price range, coefficient of variation, and Amihud illiquidity.

	Sample mean		Sample median	
	Global bonds	Domestic bonds	Global bonds	Domestic bonds
Age (yrs at time of trading)	1.37	3.23	0.86	2.66
Total principal issued ($ M)	1652.42	712.08	1197.25	462.05
Foreign principal/total principal (%)	32.37	20.67	39.44	0.00
Monthly volume (TRACE, $M)	124.30	46.20	74.20	14.48
Monthly volume (TRAX, $M)	29.45	13.28	11.78	0.63
TRAX volume/total volume (%)	17.37	8.50	15.62	3.91
Monthly no of trades (TRACE)	186.23	79.93	104.36	29.76
Monthly no of large trades (TRACE)	59.07	21.92	40.23	10.05
Monthly zero volume days (TRACE)	8.11	13.63	7.57	15.00
Price range (TRACE, %)	6.59	9.64	4.93	6.02
Coefficient of variation (TRACE, %)	1.80	2.88	1.34	1.92
Amihud illiquidity (TRACE, %)	0.34	1.62	0.12	0.75
No. of bonds (930)	480	450	480	450

Table X

Liquidity of Global Bonds: Panel Regressions with Issuer/Day Fixed Effects

The table presents estimates from regressions of several measures of corporate bond liquidity on a dummy variable that equals one if the bond is global, and on controls for bond age, issue size (principal), bond maturity, and embedded call options. The regressions are estimated on panel data transformed by subtracting the issuer/day fixed effects from all transactions in bonds of an issuer that occur on the same day. All dependent variables except the number of zero volume days are transformed by taking natural logarithms. Robust t-statistics adjusted for clustering by bond are in parentheses. Coefficients marked with ** (*) are significant at the 5% (10%) levels.

	Dependent Variable							
	Total Trading Volume	TRAX Trading Volume	No. of Trades	No. of Large Trades	Zero Volume Days	Price Range	Coef. of Variation	Amihud Illiquidity
Global bond	0.264**	0.659**	0.017	0.120*	-1.189**	-0.003**	-0.016**	-0.052**
	(2.550)	(2.710)	(0.240)	(1.700)	(-5.990)	(-2.400)	(-2.760)	(-6.880)
Age	-0.171**	-0.357**	0.017	-0.078**	0.193**	-0.037**	0.012**	0.018**
	(-10.070)	(-7.210)	(0.930)	(-5.370)	(3.260)	(-7.870)	(3.280)	(7.910)
Principal (log)	0.653**	1.468**	0.454**	0.486**	-1.978**	-0.002*	-0.037**	-0.071**
	(9.710)	(7.970)	(8.590)	(9.330)	(-9.720)	(-1.750)	(-7.870)	(-9.720)
Maturity	0.009	-0.027	-0.025	-0.013	0.137**	0.005**	0.055**	0.010**
	(0.210)	(-0.290)	(-1.370)	(-0.580)	(2.560)	(13.240)	(22.290)	(5.540)
Maturity squared	0.000	0.001	0.001	0.001	-0.003*	0.001**	-0.001**	0.001**
	(0.380)	(0.290)	(1.140)	(0.980)	(-1.900)	(-10.570)	(-16.060)	(-4.950)
Callable bond	0.037	0.140	0.257**	0.161*	-0.430	0.005**	0.030	-0.014
	(0.360)	(0.510)	(2.960)	(1.970)	(-1.590)	(2.960)	(1.440)	(-1.310)
R-squared	0.38	0.20	0.16	0.31	0.19	0.18	0.31	0.14
No. of trades	558362	558362	558362	558362	558362	558362	558362	558362
No. of bonds (clusters)	930	930	930	930	930	930	930	930
No. of issures	135	135	135	135	135	135	135	135

Table XI
Trading Yield Spreads and Liquidity:
Panel Regressions with Issuer/Day Fixed Effects

The table presents estimates from regressions of trading yield spreads on a dummy variable that takes a value of one for global bonds, and on various measures of corporate bond liquidity. There are also controls for the maturity structure of credit spreads and embedded call options (not reported). The model is the same as in Table VII. All liquidity measures except bond age and the number of zero volume days are transformed by taking natural logarithms. Robust t-statistics adjusted for clustering by bond are in parentheses. Coefficients marked with ** (*) are significant at the 5% (10%) levels.

	Regressors		
Measure of Bond Liquidity	Global Bond	Liquidity	R-squared
Age	-0.242**	0.044**	0.189
	(-4.920)	(2.970)	
Principal	-0.232**	-0.049	0.179
	(-4.410)	(-0.890)	
Trading volume	-0.237**	-0.002	0.177
	(-4.770)	(-0.110)	
No. of trades	-0.243**	0.073**	0.184
	(-4.960)	(3.210)	
No. of large trades	-0.245**	0.043*	0.179
	(-4.900)	(1.890)	
Zero volume days	-0.237**	-0.003	0.178
	(-4.700)	(-1.200)	
Price range	-0.229**	2.924**	0.197
	(-4.710)	(5.120)	
Coefficient of variation	-0.229**	0.461**	0.201
	(-4.680)	(4.870)	
Amihud illiquidity	-0.231**	0.111**	0.178
	(-4.570)	(2.330)	
No. of trades	558362	558362	558362
No. of bonds (clusters)	930	930	930
No. of issures	135	135	135

Appendix A
45 Largest Issuers of Sample Bonds

Parent CUSIP	Parent	Sample Trades	Sample Bonds	Credit Rating
617446	Morgan Stanley Dean Witter	4055	25	Inv
25746U	Dominion Resources Inc	3891	23	Inv
842587	Southern Co	1095	21	Inv
025537	American Electric Power Inc	602	19	Inv
060505	Bank of America Corp	32974	19	Inv
524908	Lehman Brothers Holdings Inc	14585	19	Inv/Spec
209115	Consolidated Edison Inc	2087	17	Inv
345370	Ford Motor Co	61734	17	Inv/Spec
149123	Caterpillar Inc	6894	16	Inv
264399	Duke Energy Corp	3544	16	Inv
590188	Merrill Lynch & Co Inc	24042	16	Inv
87612E	Target Corp	15516	16	Inv
026874	AIG	9148	15	Inv
00206R	AT&T Inc	2127	15	Inv
370442	General Motors Corp	127326	15	Inv/Spec
46625H	JPMorgan Chase & Co	12529	14	Inv
580135	McDonald's Corp	4002	14	Inv
78442P	SLM Corp	12767	13	Inv
035229	Anheuser-Busch Cos Inc	2040	12	Inv
125581	CIT Group Inc	10871	12	Inv/Spec
225401	Credit Suisse Group	13273	12	Inv
892331	Toyota Motor Corp	2237	12	Inv
92343V	Verizon Communications Inc	11215	12	Inv
949746	Wells Fargo,San Francisco,CA	3923	12	Inv
126408	CSX Corp	1712	11	Inv
438516	Honeywell International Inc	2108	11	Inv
98385X	XTO Energy Inc	3280	11	Inv
02209S	Altria Group Inc	17015	10	Inv
404280	HSBC	8013	10	Inv
494550	Kinder Morgan Energy Partners	2477	10	Inv
12189T	Burlington Northern Santa Fe	1923	9	Inv
244199	Deere & Co	3643	9	Inv
319963	First Data Corp	4653	9	Inv
441815	Household International Inc	646	9	Inv
45031U	iStar Financial Inc	1615	9	Inv/Spec
49811T	AIG Life Holdings (US) Inc	3941	8	Inv
079860	BellSouth Corp	11483	8	Inv
136375	Canadian National Railway Co	331	8	Inv
172967	Citigroup Inc	538	8	Inv
40414L	HCP Inc	647	8	Inv/Spec
929903	Wachovia Corp,Charlotte,NC	3034	8	Inv
002824	Abbott Laboratories	8217	7	Inv
136385	Canadian Natural Resources Ltd	658	7	Inv
263534	DuPont	8393	7	Inv