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Preliminary

Comments welcome

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Abstract

Bonds are traded in OTC markets, where opacity and fragmentation imply large transaction costs for retail investors. Is there something special about bonds, in contrast to stocks, that precludes trading in transparent, limit-order markets? Historical experience suggests this is not the case. Before WWII, there was an active market in corporate and municipal bonds on the NYSE. Activity dropped dramatically, in the late 1920s for municipals and in the mid 1940s for corporate, as trading migrated to the OTC market. This migration occurred simultaneously with an increase in the role of institutional investors, which fare better than retail investors in OTC market. Based on current and historical high frequency data, we find that, for retail investors, trading costs in municipal bonds were half as large in 1926-1927 as they are now. The difference in transactions costs is likely to reflect the difference in market structures.

The Microstructure of the Bond Market in the 20th Century

I. Introduction

Bonds are almost universally traded on over-the-counter (OTC) markets in the U.S., in contrast to stocks, which for the most part are traded on organized exchanges. The OTC markets are decentralized and dealer-intermediated. There is little pre-trade transparency, as dealers do not post widely disseminated firm quotes. Post-trade transparency is also quite limited, although it has recently improved under pressure from Congress, the SEC, buy-side traders, and the NASD. Only dealers can post quotes, and thus investors cannot compete to supply liquidity.

How costly is this lack of transparency and competition for investors? This is a central question for investors, policy makers and researchers alike. Are the differences in the structure of the markets on which different types of securities are traded an efficient response to the needs of the different types of investors holding those securities? Is it inherently problematic to trade bonds on a transparent limit-order book? Or, are differences in market structures the result of externalities in liquidity provision and strategic behavior by financial intermediaries? Will mandated changes in disclosure of price and volume information, or in the mechanisms through which trade is organized, lower costs for investors? Or, will such regulatory interference simply suppress a natural diversity in institutional arrangements that benefits investors?

Answers to these questions are difficult to obtain through cross-sectional comparisons of existing markets because volume, prices, and trading mechanisms are all jointly endogenous variables. Perhaps corporate and municipal bonds have low liquidity and high trading costs because they are traded in opaque, decentralized, broker-dealer markets. Alternatively, perhaps they trade over the counter because the infrequent need

for trade, and sophistication of the traders involved, renders the continuous maintenance of a widely disseminated, centralized limit-order book wasteful and costly.

We believe the historical experience can shed light on these questions, because it has not always been the case that equities and bonds were traded in such different venues. Until 1945, there was an active market in corporate bonds on the NYSE. In the 1930s, the trading volume in bonds was between one fifth and one third of the trading volume in stocks on the Exchange. In earlier periods, there was also an active market for municipal bonds and government bonds. Indeed, the first organized exchange in New York, from which the modern NYSE traces its descent, was established by a group of brokers “under the buttonwood tree” to trade U.S. government bonds. Municipal bond trading largely migrated from the exchange in the late 1920s, and volume in corporate bonds dropped dramatically in the late 1940s.³ Since this collapse, bond trading on the Exchange has been limited.

This historical evidence shows that an active bond market with a centralized and transparent limit order book is perfectly feasible. This, in turn, raises other questions. Why did liquidity of the bond market dry up on the NYSE, and why has it been so difficult for the exchange to regain volume despite its periodic attempts to do so?

To answer these questions we first provide institutional information on the microstructure of the bond market in the twentieth century. Then, we consider possible explanations for the drop in the liquidity of the bond market on the Exchange. First, we ask whether decreases in liquidity could have been associated with changes in the role of bond financing generally. Based on data assembled from different sources (Federal Reserve, NBER and Guthman (1950)) we show that bond financing actually grew during the periods when trading volume collapsed on the Exchange.

Second, we ask whether the drop in liquidity could have resulted from SEC regulations increasing the cost of listing on the Exchange. We show that the decline in liquidity was not correlated with a decline in listings. Furthermore, while Exchange trading disappeared in securities which were exempt from the 1933 and 1934 acts (such

³ The historical evolution of trading volume in municipal bonds and corporate is documented in the present paper. The Treasury and Federal Study of the Government Securities Market, published in July 1959, mentions (Part I, page 95) that trading volume in Treasury securities migrated from the NYSE to the OTC market during the first half of the 1920s.

as municipal bonds), it remained active in securities which were subject to this regulation (most notably stocks).

A third possible explanation focuses on the interaction between different traders, with different preferences. It is widely recognized that there are positive externalities in liquidity (see for example the insightful theoretical analyses of Admati and Pfleiderer (1988) and Pagano (1989)). Traders prefer to route their orders where they expect that they will find liquidity, i.e., where they expect the other investors to have sent their orders. These complementarities give rise to multiple equilibria. While each of these equilibria can be locally stable, it can be upset by an exogenous shock, or a change in the characteristics of the players. Different equilibria will vary in terms of their attractiveness for different categories of market participants. Intermediaries benefit when liquidity concentrates in venues where they earn rents, such as opaque and fragmented dealer markets. Large institutional investors are likely to benefit relative to retail investors in a dealership market. We find evidence that, simultaneously with the switch in liquidity from the exchange to the OTC market, institutional investors and dealers became more important, relative to retail investors. We argue that, as institutions and dealers became more prevalent in bond trading, they tipped the balance in favor of the over-the-counter markets.

To complement this general analysis, we provide detailed analysis of the evolution of trading in municipal bonds. Municipal bonds are a natural security to study in this context. The interest on the bonds is tax-exempt, and retail investors are therefore a significant presence in the market, as they are with equities.⁴ Migration of liquidity from the Exchange to the OTC market is most costly for retail investors.

We observe a striking drop in municipal bond trading on the NYSE in the late 1920s. At that time trading volume was soaring. The Exchange was desperately short of capacity (see Davis, Neal and White, 2005). The NYSE decided to reallocate capacity from relatively inactive bonds towards equity, which were more profitable for the floor traders.

⁴ The other types of securities we observe trading through broker-dealer markets are largely held by institutions, for which transparency is less critical. Corporate and treasury bonds in the U.S. are unattractive to individual investors. Interest is taxed as ordinary income, at high rates in comparison to the returns on stocks. (See Dammon, Spatt, and Zhang (2004).) They are accordingly more naturally held through intermediaries in tax-deferred or tax-free entities.

Simultaneously, retail investors, attracted to equities by the large recent returns, lost their appetite for municipal bonds, leaving investment in this market to institutions. At this point, trading activity in municipal bonds rapidly migrated to the OTC market. This experience illustrates how shocks can lead to shifts in the focal point for trading. The difficulty of reversing such shifts once they have occurred (even if the conditions triggering the shift change) is illustrated by the inability of the Exchange to regain volume in municipal bonds, even when equity trading dropped relative to bonds during the years of the Great Depression.

But did this shift in venues actually affect trading costs? Did the migration of the municipal bonds from the Exchange to the OTC market alter spreads and liquidity? To shed light on these questions we compare the costs of trading municipal bonds in the 1920s on the exchange to the costs of trading them today over the counter. The natural or potential liquidity of these bonds is unlikely to have been higher historically than it is today. The availability of counterparties is likely to have improved and the costs of finding them is likely to have decreased since 1927, given the improvements in communication and data processing. Yet we find that the cost of trading municipals today is more than twice as high as it was when they were traded on the NYSE 80 years ago.

A series of recent papers have shown empirically that the microstructure of the bond market generates large transactions costs, and that the costs of trade are much higher for smaller trades.⁵ As Mende, Menkhoff, and Osler (2004) point out, this runs contrary to models of microstructure based on asymmetric information. In their study of the market for municipal bonds, Harris and Piwowar (2004) write: “Our results show that municipal bond trades are significantly more expensive than equivalent sized equity trades.” That bonds command larger transactions costs than stocks, at least for small and medium sized trades, is surprising. Risk is one of the main components of the cost of supplying liquidity. Bonds are less risky than stocks. They should have lower spreads. Harris and Piwowar (2004) suggest that such large transactions costs reflect the lack of transparency of the bond market. Another empirical study of the municipal bond market, Green,

⁵ This is consistent with Bernhardt et al (2004) who show theoretically that, in dealer markets, imperfect competition will lead to greater transactions costs for retail trades. Bernhardt et al (2004) offer empirical evidence that this was the case on the London Stock Exchange when it was a dealer market.

Hollifield, and Schürhoff (2004), estimates a structural model of bargaining between dealers and customers, and concludes that dealers exercise substantial market power. In their study of the corporate bond market, Edwards, Harris and Piwowar (2004) and Goldstein, Hotchkiss and Sirri (2005) show that the lack of transparency in the corporate bond market led to large transactions costs, while the recent improvement in post-trade transparency associated with the implementation of the TRACE system lowered these costs for the bonds included in the TRACE system.⁶

While these papers all suggest that the relatively large transactions costs facing bondholders are due to the fragmented and opaque microstructure of the bond market, they cannot speak to what the costs would be if the bonds were traded in an alternative venue. The historical experience offers an opportunity to observe such trading.

In the next section we review the organization of the bond market in the 20th century. In Section III we describe the general factors that appear to have led volume to leave the exchange. Section IV considers a particular example, involving several New York City bonds for which trading suddenly evaporated in the late 1920s. In Section V we compare the costs of trading historically on the exchange and currently over the counter. Section VI concludes.

II. The organization of bond trading in the 20th century

Corporate and municipal bonds have historically been available both on organized exchanges and on over-the-counter markets, with the relative importance of these venues changing over time. A few mechanical aspects of the trading process are similar across the different venues. Prices on long-term bonds have traditionally been (and still are) expressed quoted as percentage of par, with trading in eighths, except for Treasuries which trade in finer increments. In other respects the trading process on the exchange differs dramatically from its counterpart over-the-counter. In this section we describe the mechanics of bond trading on the NYSE and in the OTC market in the twentieth century.

⁶ See also Bessembinder, Maxwell, and Venkataraman (2005).

We also summarize the discussion by market participants from the 20s to the 50s of the relative roles and merits of the two market venues.

Our sources for this information are the books and publications to which we had access at the Archives of the NYSE.⁷ We also benefited from useful discussions with brokers who operated in the bond market on the NYSE in the 1950s.

II.1) Bond trading on the NYSE

Bond trading on the NYSE has always been purely “order-driven,” in contrast with the equities market, where specialists play a central role. In the equity market specialists are assigned particular stocks, and assume responsibility for providing liquidity and maintaining continuous prices. In an order-driven market, the exchange simply collects, posts and matches the orders of customers and the brokers acting for them.

The physical separation of bond from stock dealing took place in 1902, when the so called “bond crowd” was formed. Until the late twenties, bond trading took place in the same room as stock trading. Trading in the “bond corner” was organized around three booths in the North East corner of the Exchange (see Meeker, 1922). As trading in bonds increased, it was allocated more and more space. On May, 1928, the “bond room,” located at 20 Broad Street, and connected directly with the NYSE floor, was opened for trading (Source NYSE Fact Book, 1938). This was part of a general program to increase capacity on the exchange in response to the increases in volume in the 1920s (see Davis, Neal, and White, 2005).

Investors trading on the Exchange must pay commissions to the brokers facilitating the trade. Until 1975, commissions were regulated by the Governing Committee of the exchange. The constitution of the NYSE, with amendments to November 25, 1927, states the commission rates in its Article XIX. For bonds, the relevant rules are as follows:

Sec. 2. Commissions shall be as follows:

(a) On business for parties not members of the exchange...
On Bonds: Not less than \$2.00 per \$1,000 value.

⁷ We are very grateful for the kind hospitality and help of the Archives department of the NYSE, especially Steve Wheeler.

- (b) On business for members of the Exchange when a principal is not given up...
On bonds: Not less than 80 cents per \$ 1,000 value.
- (c) On business for members of the Exchange when a principal is given up...
On bonds: Not less than 40 cents per \$ 1,000 value...
- (d) On obligations of the United States, Porto Rico, Philippine Islands and States, Territories and Municipalities therein...Such rates as members or non-members as may be mutually agreed upon.

Thus, commissions were already deregulated for Treasuries and municipal bonds in the 1920s. Even for the other bonds, the constraints on commissions on bonds tended to be quite lenient, relative to commissions on stock trades. For example, on stocks priced between \$10 and \$25, for parties not members of the exchange, the minimum commission could not be less than 12.5 cents per share traded. Hence, for the sale of 50 shares, at a unit price of \$20, the commission would have to be above \$6.25, substantially above the \$2 threshold prevailing for bonds.

Meeker (1922) and Shultz (1946), who were economists at the NYSE, offer very detailed descriptions of the bond trading process on the exchange. Meeker (1922) explains that, in the “bond corner,” trading in foreign bonds and Liberty Bonds was conducted in the two smaller booths, while the other bonds were traded in the third, and largest, bond booth. For the more recent period, Shultz (1946) explains that the “bond room” was divided in four separate divisions: the “active crowd”, the “inactive” or “book” or “cabinet” crowd, the foreign crowd, and the Government securities crowd. Frequently traded domestic bond issues were assigned to the active crowd.

Active bonds were traded on the open outcry floor market. Meeker (1922, page 163) reports that:

In the case of market orders in the active bonds, whose prices are reported on the right side of the quotation board, the broker after noting the latest price on the board, goes directly to the bond crowd and effects a sale at the most favorable bid or asked price he can obtain.

Shultz (1946) offers a detailed example of order placement and trading in the “active crowd”:

Broker A’s telephone clerk on the floor receives an order over the direct telephone wire from his office to buy 5 Atchison General 4s of 1995 at 106. He makes out a “buy” order blank and hands it to his broker, who proceeds to bid for

the bonds in the crowd. There are no immediate sellers so Broker A leaves the center of the crowd for the time being. The quotation clerk makes a notation to the effect that Broker A is bidding 106 for the bonds. Broker B's telephone clerk then receives an order from his office to sell 3 Atchison General 4s at $106 \frac{1}{4}$. A "sell" order slip ... is made out and handed to broker B, who offers the bonds in the crowd. The quotation clerk records on his slate that Broker B is offering Atchison General 4s at $106 \frac{1}{4}$. A short time later Broker C's telephone clerk gets a call from his office for a "quote" on Atchison General 4s. The quotation clerk informs him that the market is $106 - \frac{1}{4}$, 106 bid, offered at $106 \frac{1}{4}$. The telephone clerk relays this information back to his office and shortly thereafter receives an order to sell 10 bonds at 106. Broker C takes the "sell" order slip, enters the crowd and learns from the quotation clerk that Broker A is bidding 106 for the bonds... Broker A "takes" 5 at 106 and broker C reduces his offer to 5 Atchison General 4s at 106. The quotation clerk changes his record to show the new offer and erases Broker A's bid.

The majority of the listed domestic bonds, however, were traded in the inactive, or cabinet, crowd. In the inactive crowd, all orders were written on standard slips and filed in the bond "cabinets" or "ledgers." This was, in effect, a limit-order book, collecting firm buy and sell orders and enforcing time and price priority. Apart from the manual technology, the workings of the "bond cabinet" are very similar to those of electronic order books in the 21st century, such as Euronext, Xetra, Sets, or Inet. Meeker (1922, page 161) writes:

Since most bonds are relatively inactive, the bid and asked quotations for them are kept on the bond ledgers... Under the name of a given bond issue, the clerk inscribes the various bid and ask quotations for it, as well as the amounts of bonds to be purchased or sold and the initials of the various brokers and dealers from whom he received the information. When these bid and ask quotations are for any reason withdrawn by the bond men, they are erased from the ledger. A bond man can thus learn the market for any inactive bond which he may desire to purchase or to sell, by asking the ledger clerk.

Shultz (1946) provides a detailed illustration the workings of the cabinet:

For example, Broker A's clerk receives an order to sell 5 Peoples' Gas, Light and Coke 5s of 47 at 116. He makes out a "sell" order slip and takes it to the cabinet to which the particular bond issue is assigned. The order is handed to a "bond clerk," a Stock Exchange employee who files the order... Broker B's clerk then hands the bond clerk an order to sell 30 Peoples' Gas, Light and Coke 5s of 47 at 116. This order is placed behind Broker A's order, notwithstanding the size of Broker B's offer. Broker C's clerk later enters a "buy" order for the same issue calling for 15 bonds at $115 \frac{3}{4}$... The quotation would now be " $115 \frac{3}{4}$ -116, 15 and 35"... Broker D receives an order to buy 25 Peoples' Gas 5s at 116. Inasmuch as Broker A has priority as to time, his order for 5 bonds is completely filled and broker B then sells 20 bonds to broker D.

Once the trades had been completed, they were widely disseminated. Meeker (1922, page 161) explains that:

Reporters obtain the prices of sales as they occur in the bond crowd, make out slips and pass them to the board boys, who at once post the prices on the board – if the bond is one which is recorded there. Simultaneously they inform the telegraph operator, and very shortly afterward the quotations appear on the bond tickers throughout the country.

Thus, the bond market on the NYSE enjoyed a very high level of pre- and post-trade transparency. All brokers could observe the book of available orders and the recent trades, and inform their customers about them. In 1976, the NYSE introduced the electronic system Automated Bond System, an electronic order book with full price and time priority. This system is still in use today, but activity confined to a relatively small number of retail trades. More than 1000 bond issues are still listed on the Exchange, including Treasury bonds, Corporate bonds (e.g., General Motors), Utility bonds (Baby Bells), State bonds (e.g., State of California bonds), and Municipal bonds (e.g., NYC bonds). In all these cases, however, the overwhelming majority of trades are conducted over the counter.

II.2) The over-the-counter market

While many bonds are (and have traditionally been) exchange listed, many more are (and have traditionally been) unlisted. Unlisted bonds trade over the counter, in a market based on bilateral, informal contacts between dealers. These dealers typically maintain inventories in the securities for which they “make markets.” A good description of the over-the-counter market at that time is offered in an investment analysis text published by an NYU professor in 1946:

The market in over-the-counter securities is made by dealers within and between their offices at prices established by individual negotiation, that is, through bid and ask prices... A dealer creates and maintains a market for any issue of bonds or of stock by announcing openly to the other dealer and broker houses that he stands ready both to buy and sell that security at the bid price and the offering price that he quotes to those who inquire... The securities houses

that act as dealers or brokers in the over-the-counter market include investment banking houses, over-the-counter houses, municipal bond dealers, government bond dealers, stock exchange firms which operate over-the-counter trading departments, and dealer banks... A house that makes a market in an issue usually “maintains a position” in the security by trading (buying and selling) against its position in the issue. It buys and sells for its own account and risk as principal... Unlike exchanges, where sales in a particular security are concentrated at one post on the exchange floor and the actual prices at which the security is sold are reported, the over-the-counter market is unable to report all transactions in a security. (Prime, 1946, pages 60 to 63.)

In contrast with the exchange, there are no explicit commissions in the over-the-counter market. In the words of Gellermann (1957, page 104):

“...the price charged by the over-the-counter dealer will be a net price – no mention will be made of a commission, but you can be sure that the equivalent of a commission, or more, will be included in the price.”

We see, then, that a central difference between the two types of trading mechanisms lies in their relative transparency. On an exchange, there is a location where orders and transactions prices are recorded, and these are, to varying degrees, available to the public. In an over-the-counter market, obtaining information about prices involves contacting several dealers to obtain price quotes. The resulting transactions prices are not recorded in any central location, nor are the dealers under any obligation to disclose them.

Transparency, however, is an endogenous outcome. It would be premature to conclude that the institutional setting is the *cause* of the lack of transparency. Both could be a response to a more fundamental lack of liquidity. If investors almost never wish to trade their bonds, it may be economically wasteful to maintain the infrastructure to provide continuous price quotations. On the other hand, investors may rarely trade their bonds because information about prices is not available at low cost, or because they know the lack of transparency will put them at an informational disadvantage in negotiating terms of trade.

II.3) The roles and merits of the two trading venues as viewed by market observers and participants from the 1920s, to the 1950s

II.3.1) Where do bonds trade?

Even listed bonds have traditionally also been traded over the counter. The trading of Treasury bonds, which historically had occurred on the Exchange, migrated to the OTC dealer market in the twenties. Migration of the trading of corporate bonds occurred later, during the 1940s. These developments are evident in Figure 1. Panel A plots total par value traded on the NYSE per year, in 2003 dollars. Bond volume peaked in the 1930s, fell dramatically in the 1940s, and then rose moderately in the 1960s before tailing off to negligible amounts in recent years. (The increase in the 1960s was largely due to the popularity convertible bonds traded on the exchange enjoyed with retail investors during this period.) Panel B illustrates that relative to the volume in equities, the drop in bond volume in the 1940s was even more dramatic. Bond volume rose to over 30% of stock volume during the depression years, fell precipitously in the 1940s, and has continued a steady decline since then.

Contemporary observers were aware of these trends. As early as 1946, an investments textbook mentioned that:

Prominent among the issues that are traded both on an exchange and over-the-counter are United States Treasury bonds and such instrumentalities as Federal Farm Mortgage Corporations and Home Owners Loan Corporation issues. The volume of trading in these issues, especially Treasury bonds, in the over-the-counter market ordinarily exceeds that on the exchanges. (Prime, 1946, page 59.)

A few pages later in the same book, we find, “Stocks are bought and sold primarily through the exchanges; bonds are usually bought and sold over the counter. (Prime, 1946, page 65)”

Along the same lines, P. Shultz concluded his book with a list of open issues, including the following question, “What is to be done about bond trading, only 10 per cent of which is now done on the exchange and the rest over-the-counter?” (Shultz, 1946) A book written in the 1950’s by an investment banker, noted that:

The major, and often the only, market for state, county, city, town, and village bonds—as well as the increasing number of obligations issued by the so-called authorities—is also the over-the-counter market. ... Corporate bonds—industrial, rail, and utility—are frequently traded over-the-counter even though such issues are listed on an exchange. (Gellermann, 1957, pages 102 and 103).

II.3.2) What are the relative advantages and disadvantages of exchange and OTC trading, and for whom?

In the thirties, it seems to have been recognized that exchange listing was associated with greater liquidity—the ability to trade cheaply and quickly without moving the price. An interesting little book, published in 1932, *The Confessions of a Bond Salesman*, concludes its Chapter III (page 19) as follows:

He who is likely to need quickly to turn his capital into cash—and what investor is not—should, by all means, buy listed securities, or securities whose market is based upon the listed market.

Even, Lawrence Chamberlain, who was a senior manager of a Bond House, conducting trading in the OTC market, and a vocal advocate of the latter system, writes that, “It is unquestionably true that the average listed bond can be more readily sold or hypothecated than the average unlisted.” (Chamberlain, 1925, page 63) On the other hand, Chamberlain described the OTC market as a significant competitor of the exchange, already in the 1920s:

The great system of American bond houses ... is really an immense exchange in itself, reaching out with its branch offices and traveling representatives over the more settled parts of the United States and Canada. This system, with the aid of telegraph and telephone, fulfils for most purposes the legitimate functions of an investment exchange. There is of course no similar system for stocks... So satisfactory is this system of bond—interchange that over 90 per cent of transactions in listed bonds (it is estimated) takes place outside of the exchanges. If one wished to buy or sell Peoples’ Gas Light and Coke Company Refunding 5s he would probably do slightly better with a well-known Chicago Bond house than on the New York or Chicago exchange. (Chamberlain, 1925, page 66.)

Market participants and observers were also aware that different trading venues were preferable for different types of investors. In his 1946 investment analysis textbook, NYU professor John Prime wrote:

Some securities have certain features that make them especially adaptable to trading in the over-the-counter market. Among those features [is the] eligibility for purchase by banks and insurance companies... Institutional investors such as banks and insurance companies usually buy and sell securities in large blocks... They desire to avoid a public record of large purchases or sales of bonds because of the adverse effect such a transaction may have on the market price of such issues... Furthermore, since a large buying order on the Exchange at a limited price must give precedence to all orders having priority at that price, the institutional order would experience difficulty in completion at the limited price. The over-the-counter-dealer is in a better position to provide this service than the stock exchange broker. (Prime, 1946, page 66.)

While this emphasizes the advantages of the OTC market for large institutions, Gellerman, who was an investment banker, mentions the disadvantages of this market for small investors:

There is no record of transactions in the over-the-counter market, which puts the individual investor at a strong disadvantage. The professional or institutional investor can transact business with an over-the-counter firm on some basis of equality, but the individual is more or less forced to rely on the integrity of the firm with which it is dealing. Almost all over-the-counter firms are members of the National Association of Securities Dealers, which has regulatory authority over its members. NASD has never ruled on what it considers a reasonable profit on a purchase or sale by one of its members, but is known to favor between 3 and 5 per cent. There have been some startling deviations from this policy, however. (Gellermann, 1957, pages 104 and 105.)

III. Why did the bond market move to the OTC?

In this section, we first describe the data we use in our study. Then, we then consider possible explanations for the migration of volume away from exchange trading in light of these data.

III.1) Data

We collected historical data on the bond market from several different sources.

III.1.1 Total amount of bonds outstanding

Hickman (1960) provides data on the total par amount of outstanding corporate bond issues between 1900 and 1944. He also documents which of these issues are listed on the NYSE and which are not. The latter are mostly private issues, traded over-the-counter. This book provides no information on Treasuries or Municipal bonds, however.

The NYSE factbook on line (www.nysedata.com/factbook) provides rich historical data on the total amount of outstanding bond issues listed on the NYSE, often dating back to the first half of the 20th century. It does not, however, categorize the bonds by type of issuer.

The Federal Reserve bank (www.federalreserve.gov/releases/z1/) provides a yearly time-series, dating back to 1944, of the flow of funds statistics. That includes the total amount of outstanding bonds, categorized by type of issuers (Treasury, Municipal, Corporate), as well as information on who holds these bonds. However, it does not document whether these bonds are listed on the NYSE or not.

Guthman (1950) provides information on the total amount of bonds outstanding between 1920 and 1948. He categorizes these bonds by issuer type (Treasuries, Corporate, Munis). He also gives information on who holds these bonds, but does not document whether the bonds are listed on the NYSE.

III.1.2 Trading volume

The NYSE factbook on line (www.nysedata.com/factbook) also provides historical data on the trading volume in bond issues listed on the NYSE, often dating back to the first half of the 20th century. Again, it does not categorize these bonds by type of issuer. Obviously, there is no data available on trading volume in the OTC market. By its very nature, the OTC market is decentralized. Trades conducted over the counter were not compiled in a central source, or reported to the investing public and regulatory authorities.

III.2) Trends in bond financing

We first note that the decline in bond trading on the exchanges has occurred despite broad increases in the supply of bonds outstanding in all sectors. Figure 2 combines data from different sources (Guthman, 1950, Hickman, 1960 and The Flow of Funds compiled by the Federal Reserve Bank) to show increases in par value outstanding from 1920-2002 for treasury, municipal, and corporate bonds. To ensure comparability all the figures are in 2002 dollars, using the Consumer Price Index. There is a steady geometric increase in corporate bonds outstanding (in real terms), reflecting economy-wide growth in economic activity and new investment in the corporate sector.⁸ Both municipal and federal debt show more variable growth rates, reflecting the cycles in government surpluses and deficits. Treasury finance jumped dramatically in the early 1940s to finance the war effort. Both municipal and federal debt decreased in real terms slightly in the 1990s because of government surpluses.

Comparing Figure 2 to Figure 1, it is clear that changes in trading volume on the exchange are not explained by changes in the supply of bonds. There is no evidence of a drop in debt financing in the 1940s, which was the period when the drop in volume is most striking. Bond trading volume on the exchange largely disappeared in the 1980s and 1990s. Yet this was a period when U.S. corporations made net substitutions of debt for equity, as shown, for example, in Rajan and Zingales (1995). Debt outstanding grew by more than net new investment, because firms financed repurchases of shares with debt.

III.3) The regulatory and disclosure costs

A second possibility, which is often advanced by practitioners, is that trading volume dropped on the exchange in the 1940s because bond listings declined, in response to the regulatory requirements associated with New Deal security legislation.⁹ The

⁸ This increase also reflects the financial choices of US corporations in the 2 postwar decades, during which debt increased from 15 to 30% of corporate financing, while the use of equity declined from 5 to 2% of corporate financing (see White, 2000, page 777).

⁹ For a description of this regulatory framework, see Loss and Seligman, 1998, in particular Volume I, pages 225 and 226. See also White, 2000.

Securities Act of 1933, which is concerned with the initial distribution of securities, states that securities offered to the public must be registered with the SEC. The registration statement must contain specific information about the security, the issuer, and the underwriters. The Securities Exchange Act of 1934, which is concerned with secondary trading, states that no security may be listed on an exchange unless its issuer files an application for registration containing much the same information as is required by the 1933 Act. This information must be kept current by the filing of annual and other reports with the exchange and the SEC. Securities that are not listed on an exchange are not subject to these provisions. The regulatory burden associated with public trading and exchange listing may have encouraged their private placement and led to a decrease in trading volume on the exchange.

In light of this hypothesis, consider the time series of the number of bond issues listed on the NYSE between 1925 and 2003 which we obtained from the NYSE factbook on line (www.nysedata.com/factbook). To shed some light on the relation between this variable and trading volume on the exchange, we also plot on the same graph the time series of bond trading volume on the NYSE. The trading volume figures are expressed in 2003 dollars, using the Consumer Price index.

Figure 3 shows no evident association between the bond volume and bond listings on the exchange. Bond trading volume was at its peak in the mid 1930s, when the number of bonds listed was slightly lower than 1600. The number of bonds listed was at its peak in 1986, with 3856 issues listed, and yet bond trading volume on the exchange was very limited at this point in time.

The overall drop in bond trading volume on the exchange was, apparently, not driven primarily by a drop in the number of listings. More direct evidence to this effect comes from considering Treasury and municipal securities. Trading in these bonds migrated away from the NYSE before 1930, and Exchange trading never recovered in these securities. Yet they were exempt from the 1933 and 1934 Acts.

It seems implausible, then, to attribute the drop in bond trading volume on the Exchange to increased listing costs associated with the New Deal securities legislation.

III.4) The balance of trading clienteles

Liquidity attracts liquidity. There are obvious positive externalities in trading. Once a trading venue becomes a focal point for trading, it is difficult to move trading elsewhere because of the coordination problems involved. The first defectors from the status quo will have no one to trade with, unless they can bring large numbers of other participants with them. Similarly, once volume migrates away from a venue, it can be very difficult to get it back.

As discussed earlier, dealers and large institutions are likely to fare well in an over-the-counter setting. Their professionalized management and frequent presence in the market makes transparency less important to them than to less sophisticated small investors who trade infrequently. The repeated interaction dealers and institutions have with each other render them less vulnerable to the opportunities a lack of transparency affords other participants to profit at their expense on a one-time basis. Smaller institutions and individuals for the opposite reasons will tend to fare better in an exchange-based trading regime. Indeed, the theoretical model of Bernhardt et al (2004) shows that, in a dealer market, large institutions will trade more frequently and in larger amounts than retail investors, and incur lower transactions costs.¹⁰

Nevertheless, the theory of market microstructure also makes clear that large traders and small traders need each other. Institutions and dealers are likely to be better informed. Their trades inform prices and this benefits small uninformed investors who can thus trade at “informationally efficient” prices. Institutions and dealers need small investors (the fabled “liquidity traders” of market microstructure models) to absorb large positions they are unwinding in their roles as intermediaries to issuers or arbitrageurs. Thus, there are forces that will lead traders of different types to follow each other to venues that might at first appear disadvantageous to them. This point is formally established in insightful theoretical analysis of Admati and Pfleiderer (1988).

In the case of the bond markets, over-the-counter and exchange-based trading coexisted for decades in the 20th century with viable levels of activity in each setting.

¹⁰ Bernhardt et al (2004) also offer an interesting empirical illustration of these effects in the case of the London Stock Exchange.

What upset this balance? A natural place to look is to changes in the relative importance of types of traders. We argue that several factors combined in the late 1940s to increase the importance of the coalition of dealers and institutions, allowing them to abandon the exchanges and forcing smaller investors to follow them to the OTC market.

III.4.1) Dealers

As mentioned earlier, there was a sharp increase in the total amount of Treasury bonds outstanding from 1940 to 1945 (see Figure 2). While this increase was partly corrected between 1945 and 1950, the amount of public debt remained quite high. Treasury bonds were mostly traded over-the-counter by dealers. The increase in the total amount of public debt is likely to have enhanced their importance in global financial markets.

As mentioned by Meltzer and von der Linde (1960, page 2), 17 dealers operated in the Treasury market in the post-war period. Five were bank dealers,¹¹ and seven were nonbank dealers.¹² Meltzer and von der Linde (1960, page 11) note that:

In five cases, Government securities operations are conducted in a relatively small department of a large bank. For some nonbank dealers other activities – dealing in corporate or municipal bonds, underwriting new issues, or trading on organized exchanges – are regarded as the principal occupation of the firm.

Thus, enhanced activity in the Treasury market might have interacted with the activities of the dealers in the other segments of the bond market. Indeed, market-making in the bond market hinges on supplying immediacy in relatively illiquid securities, and hedging the corresponding position in highly liquid securities. For example, if a dealer purchases large quantity of municipal bonds, in underwriting or providing liquidity to a large investor, it could hedge interest rate exposure by lowering its inventory in liquid Treasuries. Thus, it is likely that increased activity and liquidity in the Treasury market

¹¹ Bankers Trust, Chemical Bank, Continental Illinois, First National Bank of Chicago and Morgan.

¹² Bartow, Leeds & Co, Briggs, Schaedle & Co, C.F. Childs & Co, C.J. Devine & Co, Discount Corp, First Boston, Aubrey, Lanston & Co, New York Hanseatic Corp, Wm. E. Pollock & Co, Cha. E. Quincey & Co, D. W. Rich & Co, Salomon Bros & Hutzler.

facilitated market making in other segments of the bond market, such as the municipal and corporate bond markets.

The above discussion suggests that the importance and effectiveness of dealers in the bond market is likely to have increased in the 1940s, relative to the 1930s.

III.4.2) Institutional investors

To examine further the balance between investor clienteles, we study the evolution of the structure of the ownership of bonds. Excellent data on bond ownership structure is available from the Fed for the period starting in 1944. In the previous period, data is more difficult to obtain. However, Guthman (1950) does offer data on institutional ownership from 1920 to 1948. Combining these two data sources, we present a (somewhat incomplete) picture of the evolution of bond ownership between 1920 and 2004.¹³

As can be seen in Figure 4, Panel A, there was a dramatic increase in institutional ownership in corporate bonds between 1940 and 1960. In the 1940s the weight and importance of institutional investors in the bond market grew tremendously. Given the ownership structure, it is very likely that these investors came to amount for the majority of the trading activity in the bond market. Naturally, they chose to direct their trades to the dealer market, where they could effectively exploit their bargaining power, without being hindered by reporting and price priority constraints. Thus, the liquidity of the corporate bond market migrated to the dealer market.

As can be seen in Figure 4, Panel B, the ownership structure is quite different in the municipal market. There, households hold a very large fraction of the bonds, typically between 30% and 40%. This percentage does not tend to decrease throughout the century, quite the contrary. This is due to the tax-exempt status of Municipal bonds, which made them relatively attractive for individual investors, especially at a time where

¹³ The fraction of the bonds owned by different categories of investors is depicted on the vertical axis. For the period before 1945, we only have the total amount and the amount owned by insurance companies, banks and savings institutions. For the period following 1945, we have data on all categories of owners. The percentages on the figure don't add up to one because we have not depicted certain categories of investors. For example, foreign corporate bond ownership, which has become important in the recent years, is not depicted in the figure.

personal income taxation was rising. For example, an NBER study conducted in the 1950s finds:

...personal income tax rates starting at 4% at the first bracket and reaching 79% at the top in 1940 compared with the 1944 (and 1945) rate schedule which spanned a range from 23% to 94%. (Holland, 1958, page 9)

While individuals have always had an important presence in the municipal market, the figure shows the composition of institutional holders changed dramatically in the 1980s. The share of municipals held by banks dropped dramatically, while that of mutual funds rose to offset this drop. This reflects changes in the tax law that limited the ability of commercial banks to deduct interest liabilities used to finance holdings of municipals. (See Feldstein, Fabozzi, and Fabozzi (1995), p. 178.) The ability to engage in this quasi-tax-arbitrage obviously made municipal bonds especially attractive to banks. Mutual funds, in contrast, simply pass the tax-exempt treatment of the bonds through to the mutual-fund shareholder.

Yet, in spite of significant individual ownership, the municipal market also migrated to the OTC market (see for example the above quotation from Gellerman, 1957). In the next section, we offer a detailed investigation of this migration. Before we turn to municipal bonds, we discuss the case of convertible bonds and stocks, which offer interesting benchmarks.

III.4.3) Convertible bonds

A relatively recent example of migration from the Exchange to the OTC market is offered by the convertible bond market. As can be seen in Figure 1, Panel A and in Figure 3, there was some revival of the NYSE bond market in the late 1960s. This was due to the rise of the convertible market, and the interest retail investors took in this

market.¹⁴ An early indication of this evolution is given in NYSE fact book from 1967, on page 14:

Bond volume on the exchange in 1966 was the highest since 1943... the 50 bonds with the largest volume accounted for 65% of the of the activity... Among the 50 most active bonds, 42 were either convertible bonds or bonds maturing within a year or so... Convertible bonds are exempt from the FRB margin requirements at banks and, when selling above the conversion price, rise and fall with the stock into which they are convertible. Thus, these bonds have more appeal to individual traders and investors than do straight corporate bonds.

1967 was a further record breaking year for bond trading volume, and, as mentioned on page 15 in the NYSE fact book for that year, convertible bonds amounted to 63% of all the trading volume that year. The next years continued to see high bond trading volume on the Exchange, and significant retail activity. For example, the 1972 fact book notes, on page 17: "Individual investors continued to be attracted to the bond market in 1971." And a few sentences later: "Of the 50 leading bonds, 32 were convertible issues, the same number as in 1970." Then, as can be seen in Figures 1 and 3, bond trading on the Exchange declined again. As was explained to us by a bond broker who operated in that market at the time, as the market for convertibles matured, it became dominated by large institutions. The latter chose to direct their orders to the OTC market, and liquidity migrated away from the Exchange. Correspondingly, in 1973, the NYSE fact book, noted, on page 17, that: "individual investor's participation in the bond market diminished." This anecdotal evidence is consistent with our argument that when the weight of institutions reaches a critical point, small traders are forced to follow large traders to the OTC venue.

III.4.3) Stocks

One may wonder why exchange trading remained predominant in the stock market, in such a stark contrast with the bond market.

¹⁴ Unlike the other segments of the bond market, trading in convertible bonds remained floor-based even after 1976.

As mentioned above, one difference between bond and stock trading on the Exchange is that, while the bond market has always been purely order driven, specialists have traditionally supplied liquidity supply in the stock market. It is possible that the presence of the specialist anchored the liquidity on the exchange. Because it was common knowledge that the specialist would be there to supply liquidity, small and medium sized trades could continue to be directed to the exchange. Because liquidity attracts liquidity, the larger traders also found it attractive to trade there, in line with the logic of Admati and Pfleiderer (1988).

Our arguments in the previous subsections also suggest that Exchange trading should be expected as long as small investors played an important role in the market. Consistent with this prediction, the rise of institutional investors was weaker and more delayed in the stock market than in the bond market. In the latter it took place in the thirties and the forties, while in the former it only started in the second half of the fifties. Quite remarkably, this is when the Exchange introduced Rule 394 (later Rule 390), which prohibited NYSE members from trading NYSE listed securities away from the Exchange. As noted by White (2000, page 784): “The NYSE specialists lobbied their exchange to adopt Rule 394 in 1955 to prevent commission houses from abandoning the floor of the exchange for telephones.”

IV. The disappearance of municipal bonds trading on the exchange

Through the 1920s the NYSE made a market in sixteen long-term New York City municipal bonds. All the bonds had initially been issued with a maturity of 50 years. In this section and the following one, we study a representative sub-sample of 6 municipal bonds.

IV.1) Data

Thanks to the help and hospitality of the Archives Department of the NYSE, we have manually collected data on Exchange trades and quotes for the representative sub-

sample of 6 municipal bonds, during 292 trading days, from July 1, 1926 to March 31, 1930.

The Exchange supplied data on all trades and daily quotes to a data vendor, Francis Emory Fitch, which reported it in a daily publication. Quotes were also reported, on a weekly basis, in the *Commercial and Financial Chronicle*. The *Chronicle* also reported the highest and lowest transaction price during the week, as well as the total quantity traded that week. On weeks without trades, the *Chronicle* reported the price and month of the last trade. Both the Francis Emory Fitch and the *Commercial and Financial Chronicle* data are available at the NYSE archives.

For the largest part of this period, our data stems from the Francis Emory Fitch reports, which contain more information than the *Commercial and Financial Chronicle*. The Francis Emory Fitch data was unfortunately not available at the Archives for the first 6 months of 1928. For that period, we relied only on the *Commercial and Financial Chronicle*. For the periods for which both data sources are available, we checked that the information reported by the *Commercial and Financial Chronicle* were consistent with that reported by Francis Emory Fitch.

For the period for which we have the Francis Emory Fitch data (July 1, 1926 to December 31, 1927, and July 1, 1928 to March 31, 1930) we have data on each and every trade conducted on the Exchange in these 6 bonds. We know which day the trade took place, as well as the transaction price and the quantity traded. We also have an indication of when during the day the trade took place. To be specific, we know if the trade took place between 10:00 a.m and 12:00 noon, or between 12:00 noon and 2:00 p.m, or between 2:00 p.m and 4:00 p.m. We also observe for days and bonds with a transaction, the bid and ask quotes reported at 11:00 a.m. For the first year of the sample (July 1, 1926 to June 30, 1927), we have also collected the bid and ask quotes on days without transactions. The time series of bid and ask quotes and transactions prices for the six New York City municipal bonds from July 1, 1926 to June 30, 1927 is depicted in Figure 5.

For the first 6 month of 1928, we rely on the *Commercial and Financial Chronicle*, and thus we observe bid and ask quotes only at the weekly frequency. Also, for each week, we observe only the highest and lowest price and total traded quantity. For

the large majority of the weeks, this is not a limitation, however, as there is no more than one trade per week.

IV.2) Results

IV.2.1) Trading in municipals on the NYSE collapsed at the beginning of 1929

Figure 6, Panel A, displays monthly trading volume on the NYSE for the six NYC municipal bonds, measured in number of lots traded. Figure 6, Panel B, plots the average price impact of trades within each month, where the price impact is the absolute difference between the transaction price and the mid-quote for that day. Figure 6 shows that the market was quite active, and price impact rather low in 1926 and 1927. Towards the end of the period, however, liquidity, whether measured by the cost of trading or the amount of trading, collapsed in a remarkably short period of time. As can be seen in Panel A, volume collapsed in February 1929. Panel B shows that price impact had been rising since August 1928. While it had remained below .5% until July, it approached 1% in August. After February, it ranged between 1.5% and 2.5%. Through March of 1930, Francis Emory Fitch continued to report some quotes for Municipal bonds, and a few rare trades. After April of 1930, liquidity had permanently vanished. Francis Emory Fitch had no longer any quote or trade data to report for municipal bonds. We checked that this continued through the end of the decade. In January 1933, October 1936, and October 1939, for example, there were no trades and no quotes whatsoever.

The disappearance of municipal trading on the exchange does not appear to be associated with similar happenings in the corporate bond market. In general, during the 1930s, bond trading on the NYSE was very active, as illustrated in Figure 1. There was no transient decrease in bond trading overall on the exchange in early 1929. For example, the *Wall Street Journal* reported bond sales on the exchange for the year of \$3.045 billion, up slightly over the \$2.962 for 1928. (WSJ, “Yearly Bond Sales,” January 3, 1930, p. 20)

So, why did liquidity suddenly disappear in municipal trading on the Exchange? Municipal bond volume migrated off the exchange because of a convergence of factors, which now we examine in turn.

IV.2.2) The surge in stock trading in the late 1920s raised the profits of members but created capacity constraint problems

Bond volume on the exchange was flat in the 1920s, in contrast to stock volume. Figure 7 uses data published January 3, 1929 in the *Wall Street Journal*, and shows bond volume (par value), stock volume (shares traded) and exchange seat prices (midpoint between the high and low dollar values). Each series is normalized by its value in 1890, to emphasize the relative growth rates. Prior to 1920, bond volume and stock volume trended upward together, along with seat prices. For example, in the post-war recovery, from 1918 to 1919, all three roughly doubled. Bond volume peaked in 1922, but stock volume shot up dramatically in the boom of the late 1920s. This surge was in large measure due to increased access and interest on the part of retail investors.

The increase in stock trading activity raised the profits of the members of the Exchange. Figure 7 shows that seat prices (which reflect the expectation of the capitalized profits of the members) tend to follow stock volume, when growth in stock volume and bond volume depart. The marginal seat price was, apparently, driven by activity in stocks, not bonds. A regression of the percentage change in the normalized seat price against percentage changes in normalized bond and stock volumes yields an adjusted R^2 of 43%. The coefficient of stock volume is significantly positive with a t-statistic of 5.28, while that of bond volume is not significantly different from 0. Given the strong public demand for investing in stocks, and the commission rates described in Section II, stock trading was more profitable than bond trading.

While the increase in stock trading activity raised the profits of members, it also strained capacity. An article in the *Wall Street Journal* on January 3, 1929 (p. 31) states:

Since the speculative phase in stocks set in April, last, the physical and mechanical facilities of the Exchange have been taxed to capacity and, notwithstanding many improvements made for faster service, the ticker service during many sessions

proved to be unable to keep abreast of the actual sales made on the floor, especially during the 2,000,000 and 3,000,000 share days.

Davis, Neal and White (2005) chronicle the exchange's attempts to increase capacity in response to the dramatic increases in volume. On several days during 1928, the exchange was forced to close on the day following a day of unprecedented trading volume. The exchange eventually declared a quarter-seat dividend to all existing members, in order to increase the number of seats available and thus the number of people allowed to trade on the floor.

IV.2.3) One response to these capacity problems was to allocate trading capacity away from bonds, towards equities

The reallocation of resources to stocks is reflected in the minutes of the Committee on Arrangements of the NYSE through the early part of 1929. In the minutes of January 3, for example, the committee approved "allowing Arthur E. French & Co. to have a telephone space in sections WA and WB in the bond crowd, for stock business." The committee approved a similar proposal for another member firm on January 8, and also referred to two individual members the "matter of removing the Inactive Stock Crowd to the bond room." In the January 15 meeting, one of those individuals, M. Mills, "reported progress with reference to the location of post 30 in the bond room." There then follows, in February and March, a series of approvals of changes of location, moving responsibility for 16 individual preferred stocks and two common stocks to Post 30 from other posts. Examples of these entries are: March 26, "Request of Arthur A. Zucker to move Filene's sons company 6½% cumulative preferred to post 30, effective April 1, 1929, was approved." April 2, "The committee approved the request ... that the Common Stock of the Nickel's Holding Corporation be moved from post 14 to post 30." These changes involved costly adjustments to infrastructure, and so were not trivial decisions. On March 12, for example, the minutes report: "The committee directed that Post 30 be removed to the Southerly Bond Crowd Room as soon as a separate tube station relay can be provided...As soon as post 30 is moved, telephone booths are to be placed in the space now occupied by that post."

IV.2.4) In the late 1920s, institutions became relatively more important than retail investors in municipal bonds

As retail investors were attracted by the dramatic appreciation in equities, they lost interest in less exciting securities, which they had held traditionally, such as municipal bonds. The *New York Times* states in late January, 1929:

Since municipalities in various parts of the country have found, to their chagrin, that they cannot borrow at nearly as advantageous rates this year as last, the charge is made in many quarters that the stock market is directly responsible. In other words, an investor will not take a municipal bond at 4 per cent if he sees an opportunity to double his money in the stock market. (*NYT*, Jan. 31, 1929, "Topics in Wall Street," p. 29.)

This left institutions as the major player in the municipal market. For example, near the end of January 1929 the *New York Times* reported, "There were probably fewer municipal bonds sold at retail this week than in any week since December. Insurance companies and institutions did what little buying was noted." (*NYT*, Jan. 26, 1929, "\$21,488,121 Sought by Municipalities.") In early February the *Times* stated:

The municipal bond market this week has been extremely quiet, though most of the new offerings have been fairly well received. Institutions continue to furnish most of the buying power, and, in addition to the new offerings, have been called upon to absorb various blocks of old issues which have been brought out of retirement. (*NYT*, Feb. 2, 1929, "58 Loans Sought by Municipalities," p. 27.)

As discussed above, while retail investors tend to be hurt by OTC trading, institutions can benefit from it. Hence, the investors active in municipal bonds in the late 1920s were naturally attracted by the OTC market.

IV.2.5) Putting the pieces together

These several factors—booming demand for high margin stock trading services, flat demand for lower margin bond trading services, waning interest in municipal bonds in particular from the retail clientele the Exchange serves best, and reduction by the

Exchange of the resources available for bond trading, to better serve stock traders—combine to provide a circumstantial case that Exchange trading in municipal bonds stopped in early 1929 because floor traders had more profitable activities to pursue and institutions, which had become the main players in this market, naturally gravitated to OTC trading.

As it turned out, of course, the boom in equity volume was short-lived. Yet municipal bond volume never returned to the Exchange. This irreversibility is not surprising, due to the positive externalities associated with liquidity, and the coordination problems in moving volume from one venue to another. Concerned with the competition of the OTC market, in the mid 1930s the Exchange introduced the “nine bond rule”:

The Committee has recently ruled that members must seek a market on the Exchange in certain bonds before executing orders for less than 10 bonds elsewhere. This rule is likewise intended to give the public the full benefit of the existing market and it is hoped that eventually it will result in bringing to the Exchange a larger portion of the business in listed bonds which is now done over the counter. (New York Stock Exchange Committee on Bonds: Report to the Governing Committee. May 12, 1936).

While this rule may have had some effect in corporate bonds, it did not result in a revival of municipals trading on the Exchange.

V. Historical evidence on the consequences of the migration of the bond market to the OTC

Volume, trading costs, and the trading venue are all jointly endogenous outcomes. Of these outcomes the structure of the trading venue is the one that falls within the control of regulatory authorities. The natural policy questions in market micro-structure, therefore, involve how the structure of the trading venue affects the ease, frequency, and cost of trading. Market makers, exchange authorities, and providers of trading services also have a natural interest in this question, as they attempt to compete for trading volume.

A centralized exchange, like the NYSE, and the decentralized, dealer-intermediated market through which bonds are traded in the U.S., represent polar

extremes in market design. The exchange offers transparency ex-ante, through publicly posted bid-ask spreads, and ex-post, through public reporting of transaction prices. This transparency is missing in the bond market. Comparing the costs of trading stocks, which are listed on exchanges, and bonds, which trade through a dealer market, confounds the effects of trading different types of securities with the consequences of the trading in different venues.

In this section we compare the costs of trading municipal bonds at a time when they traded actively on the NYSE with the costs of trading the bonds recently, when they traded in dealer markets. Examining the historical experience does not eliminate the problems with the joint endogeneity of the variables of interest, but it does inform the questions at hand in a unique manner. The natural concern is that the use of broker-dealer intermediated markets, infrequent trade, and the high costs of trading are all attributable to the lack of a need for frequent trade by bondholders—the natural or potential liquidity in the market. It is difficult (at least for the authors) to imagine how this could have been higher in the 1870s or the 1920s than it is today, when virtually all other measures of liquidity in financial markets—such as volume and turnover—in all other sectors have increased so dramatically in the intervening years. Similarly, the underlying exogenous costs of trading have surely decreased through time. These costs are largely the costs of gathering and disseminating information, and matching buyers and sellers who are physically separated in time and space. Technology has lowered these costs tremendously, due to the speed of electronic communication and data processing.

Accordingly, if we find that it is more expensive to trade a municipal bond through the dealership market in 2002 than it was on the exchange in 1926, one might more confidently attribute much of the cost differential to the transparency of the trading venue.

All the bonds in the historical sample are New York City municipals. These were, and are today, among the most liquid bonds in the municipal market. All six of these bonds were “seasoned” during the sample period. They had all been issued more than ten years previously. They were all very long maturity, having been issued with a

maturity of 50 years. Table 1 reports descriptive information and summary statistics for the bonds.

Table 2 reports similar statistics for modern New York municipal bonds. New York bonds are among the most liquid bonds in the modern market for several reasons. Because New York has high state income taxes, and only New York issues qualify as tax-exempt for New York state income tax, New York residents understandably favor New York bonds. The state also has many high-income residents, with high marginal tax rates, who are attracted to municipals. It is also a state with a large population. Thus, the bonds in Table 2 trade relatively frequently when compared to the population of municipal bonds. The modern environment does not offer a set of municipal bonds with maturities as long as the bonds from the 1920s. Municipal bonds today are typically issued “in series.” A single underwriting includes a range of maturities up to 20-30 years. Most long-term municipals are also callable. Therefore, by the time most of the bonds have five to ten years of seasoning, they are often close to their call date. All the bonds we have selected have more than five years of seasoning. Nevertheless, it is obvious from inspection of the table that the modern bonds typically trade with greater frequency and in larger volumes than did the New York City bonds during 1926-1927.

The sample of 39 modern bonds was gathered from the web site “Investinbonds.com.” This web site reports historical transactions in municipal bonds gathered by the Municipal Securities Rule Making Board (MSRB), and combines these transactions data with information on the bonds, such as credit ratings, obtained from other data vendors. The MSRB began requiring all registered broker dealers to report transactions in municipal bonds to them beginning in May of 2000. The data was initially made available to the public with a 30-day lag, unless the bond traded more than four times in a day, in which case it was reported with a one-day lag. Through a series of steps, the MSRB has moved to more timely reporting, until currently transactions are reported 15 minutes after they are executed. The MSRB data identify trades as customer purchases, customer sales, or interdealer trades.

The time series of bid and ask quotes and transactions prices from the 1920s for the six New York City municipal bonds in our sample is shown in Figure 5. Most trades occur at the best quotes or between them. The latter case corresponds to the situation

where the brokers of the buyer and the seller meet on the floor and agree on a transaction price within the quotes. Thus, the average “price impact” (defined as the absolute value of the difference between the transaction price and the mid-quote, divided by the latter) is slightly lower than half the spread. There are also some trades outside of the quotes. These may arise because the transaction occurred at a different point in time than the quotation, because of the large size of the trade, or because of a data error. Nevertheless, it appears that the quoted spread provides a reasonably generous measure of the cost of trading for the bonds, when augmented with the commission.

For the modern sample, we do not have quoted spreads. Trading is quite infrequent, however, and most trades can be matched with offsetting transactions that clear dealer inventories. Trades in seasoned bonds are usually initiated with a sale by a customer to a dealer. We select all customer sales followed by customer purchases that add up in par value to the initial sale, with no intervening transactions. Our measure of trading cost is the realized “dealer markup,” the percentage return earned by the dealer on the round-trip transaction. Green, Hollifield, and Schürhoff (2004) apply other trade matching methods, such as a first-in-first-out rule, and find that they yield similar measure of trading costs. Harris and Pirowar (2004) use time-series methods to estimate effective spreads for the bonds that experienced more than four trades during their sample period, and also find measures of trading cost that average between 1.5% and 2.0%.

While there is cross-sectional variation in the measures of trading cost for both sets of bonds, and the costs of trading appear correlated with trading frequency and volume, the trading costs are still uniformly lower in the historical sample. The average dealer markup across the bonds in the modern sample is 2.45%. For the municipals trading on the NYSE in 1926-1927, the average percentage bid-ask spread was 0.59%. The average price impact was 0.246%. As discussed earlier, traders had to pay commissions on the exchange. A generous estimate of the magnitude for a commission would be \$2 for a \$1000 trade. Even after adding the corresponding round-trip commission of 0.4% to the average bid-ask spread, our findings suggest that transactions costs for retail investors in the municipal bond market in the 1920s were less than half what they are now. Our sample of modern municipals are very seasoned, and hence may have higher costs associated with them than other bonds. Harris and Piwower (2004)

find that effective spreads in the municipal bond market average 2 percent for retail size trades.

It is also striking that on dimensions other than cost, the modern sample appears more “liquid.” The vast majority of the bonds trade with greater frequency, and with much higher par volumes.

To gain a better sense of whether variation in trade frequency and volume mitigates or reinforces the conclusions suggested by the averages, we ran the following cross-sectional regression using the averages for the modern sample reported in Table 2:

$$(\text{Mean markup})_i = b_0 + b_1(\text{Mean days with trade})_i + b_2(\text{Mean yearly volume})_i + e_i$$

where $i=1, \dots, 39$ indicates the bond. Using the fitted values of $b_0=2.615$ ($t=13.822$), $b_1=-0.0122$ ($t=-2.040$) and $b_3=0.0007$ ($t=2.274$), we predict the mean markup on a modern bond with the same annual trading frequency and volume as the bonds trading in 1926-1927. The volume is adjusted to the 2003 price level. Table 3 displays the resulting fitted values for the trading markup for each bond, along with the difference between it and the average bid-ask spread plus round trip commission on the NYSE. The average difference is -1.37%. The average fitted value based on the modern data is 2.4 times higher than the average trading costs in 1926-1927.

In summary, in the modern period the bonds trade more often, at higher volumes, and yet the cost of retail trades is one and a half to two times higher.

VI. Conclusions

When several trading venues are available there will typically be multiple equilibria in the allocation of trades. This multiplicity reflects the positive externalities associated with liquidity. When the investors expect that one market venue will attract all the orders, then they direct their own orders to that market, thus confirming the initial expectation. Because of such strategic complementarities, liquidity may not gravitate to the most efficient trading venue, and market forces may fail to correct this inefficiency,

even in the long term. The history of the bond market in the US in the twentieth century offers an interesting illustration of these tensions.

The bond market was quite active on the NYSE until the 1940s. Then liquidity collapsed on the Exchange as trading migrated to the OTC market. This change was not due to a decline in the role of bond financing in the economy at large. Neither does it seem to have been driven by a drop in the number of listings. The migration of liquidity happened simultaneously with sudden changes in the balance of ownership of the securities. Liquidity gravitated to the OTC market at a time when dealers and large institutions became more important in the bond market.

The shift in trading venue arguably increased the rents earned by financial intermediaries and large institutional traders, at the expense of small and medium-sized investors, for whom this evolution translated into higher transactions costs. The decline in transparency is costly to many parties besides small investors. Accurate price information is a public good that is critical in coordinating economic decisions. Firms rely on financial market prices in making investments and capital structural decisions. Final investors rely on these prices to evaluate the performance of intermediaries and managers of firms to whom they delegate decision-making power.

Our historical investigation emphasizes the interaction between different building blocks of the financial system. The supply of trading mechanisms, with different microstructures, by competing market centers, such as the NYSE and the OTC market, contributes to the allocation of liquidity, but it does not do so alone. Rather, it interacts with other elements, such as the distribution of the ownership of securities. This ownership structure, itself, reflects the distribution of income, the tax system, and the development of financial institutions. Designing an efficient financial market, with such desirable features as transparency, priority rules and openness, does not guarantee that it will emerge as the primary trading venue.

Our finding that transaction costs in municipal bond market were lower in 1927 than at the beginning of the twenty first century is not unlike the finding, by Rajan and Zingales (2003), that equity markets were more developed in 1913 than in the major part of the post-World War II period. Both suggest that the interaction between economic

agents does not always naturally lead to a trend of gradual improvement in financial architectures.

What are the implications of our analysis for market organizers? The microstructure of the bond market on the NYSE exhibits several desirable features. It is an electronic limit-order book, with full transparency. More than one thousand issues are listed on this market, including some very large and liquid bonds, issued by corporations, municipalities, agencies or the Treasury. Yet, trading on this system is negligible. Our analysis suggests that investing money and energy in attracting new listings may not be an effective course of action. There is very little correlation between the number of issues listed on the Exchange and the trading volume on this market.

Dealers and large institutions benefit from the OTC market, but this market is costly for retail and medium-sized investors. The Exchange could possibly improve the liquidity of its bond market by attracting retail and medium size orders. To achieve this goal it could be useful to increase the accessibility of the bond market, e.g., by providing rich data on internet and relying on retail brokers. It could also be useful to institute dedicated liquidity suppliers, who would intermediate the immediacy needs of retail investors in the bond market.

The municipal bond market may be an appropriate target in this respect, as it is a large market, in which retail investors play a major role. These investors would likely benefit from a transparent, easily accessible, limit-order book. So would municipal issuers, for whom a decline in secondary market transactions costs would translate into a decline in the cost of funds.

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Table 1: Historical sample

Issuance	Coupon	Days with trade per year	Volume per year (1926 \$)	Volume per year (2003 \$)	Mean Spread	Mean Price Impact
1904	3.5	18.00	87.00	906.06	0.73 %	0.20 %
1907	4.5	42.00	147.00	1530.93	0.64 %	0.19 %
1908	4	14.00	66.00	687.36	0.60 %	0.38 %
1909	4	30.00	90.00	937.31	0.48 %	0.25 %
1911	4.25	35.00	159.00	1655.91	0.48 %	0.16 %
1914	4.25	21.00	152.00	1583.01	0.61 %	0.29 %
Average	4.08	26.67	116.83	1216.76	0.59 %	0.25 %

Table 2: Modern sample

Rating	Call Dates	Call Price	Issuance	Maturity	Days with trade	Volume per year	Mean Markup
AAA_S	4/28/2005	100.000,	1-Jul-84	1-Jun-23	0.84	88.42	2.86%
Insured	11/13/2002,,100		15-Jan-87	15-Jun-17	18.57	1224.15	2.37%
Insured	6/15/2002	100.000	1-Jun-87	15-Jun-17	3.58	105.26	2.31%
Insured	6/15/2002	100.000	1-Jun-87	15-Jun-17	1.68	48.42	2.48%
Insured	11/13/2002	100.000	15-Jan-87	15-Jun-17	51.58	7307.37	1.81%
AAA_S	5/31/2005	100.000	01-Oct-93	01-Jun-23	50.95	3605.26	2.20%
Insured	04/28/2005	100.000	15-Nov-93	01-Nov-17	42.32	1613.68	2.60%
Insured		100.000	05-Oct-89	01-Oct-16	18.11	598.95	3.72%
Insured	10/01/2005	100.000	01-Jun-90	15-Aug-15	22.74	1600.00	3.52%
Insured	08/15/2004	100.000	05-Oct-89	01-Oct-17	24.21	1503.16	2.80%
Insured	10/01/2004	100.000	05-Oct-89	01-Oct-18	27.58	1638.95	3.44%
Insured	08/01/2004	100.000	23-Feb-90	01-Aug-18	11.79	1650.53	2.18%
Insured	09/15/2004		26-Sep-90	15-Mar-18	13.26	5703.16	4.05%
Insured	08/15/2004		01-Jun-90	15-Aug-17	22.32	1925.26	3.51%
Insured	10/01/2004		05-Oct-89	01-Oct-19	24.00	1966.32	2.89%
Insured	08/01/2004	100.000	23-Feb-90	01-Aug-19	13.47	612.63	3.13%
Insured	09/15/2004		27-Sep-90	15-Mar-19	35.79	5560.00	2.90%
Insured			14-Oct-93	01-Oct-19	14.11	569.47	2.04%
Insured			27-May-93	15-May-16	10.74	310.53	1.60%
Insured		100.000	15-May-93	15-Feb-22	46.32	5321.05	2.12%
Insured	08/07/2002		13-Aug-92	15-Jun-20	89.40	4824.06	2.37%
Insured			17-Nov-93	15-Jun-19	56.42	9620.00	2.04%
Insured			17-Nov-93	15-Jun-19	82.53	8806.32	2.07%
Insured			17-Nov-93	15-Jun-19	72.00	10675.79	2.05%
Insured	11/13/2002		15-Jan-87	15-Jun-17	103.42	14651.75	1.81%
Insured			07-Mar-91	15-Jun-16	16.42	3200.00	1.00%
Insured			17-Nov-93	15-Jun-19	15.37	4217.89	1.83%
Insured			15-Jun-92	15-Jun-21	33.05	4763.16	1.30%
Insured		100.000	13-Aug-92	15-Jun-18	28.84	1155.79	2.29%
Insured		100.000	13-Aug-92	15-Jun-18	34.74	2920.00	2.17%
Insured		100.000	13-Aug-92	15-Jun-17	14.11	398.95	2.17%
Insured		,	13-Aug-92	15-Jun-17	17.89	2711.58	1.96%
Insured			13-Aug-92	15-Jun-17	19.58	1134.74	2.23%
Insured		100.000,					
Insured	08/07/2002	102.000	13-Aug-92	15-Jun-20	49.93	1676.18	2.37%
Insured	08/07/2002	4	13-Aug-92	15-Jun-20	49.45	2182.60	2.17%
Insured	08/07/2002	5	13-Aug-92	15-Jun-20	57.06	13456.97	2.33%
Insured	,	44	01-Jul-93	01-Jan-18	50.53	6982.11	2.78%
Insured		17	01-Jul-93	01-Jan-20	64.42	4020.00	1.78%
Insured	08/04/2009, 08/04/2007	8	19-Sep-90	01-Jul-20	85.47	31765.47	4.22%
Average					34.45	3693.43	2.40%

Table 3:
Average and Predicted Trading Costs for Historical Municipal Bonds Sample

Bond Maturity	Days with trades	Trading volume in 2003 dollars	Average (%) bid-ask spread	Plus Commission	Fitted Value	Difference
1954	18.00	906.06	0.73	1.13	2.451	-1.320
1957	42.00	1530.93	0.64	1.04	2.196	-1.158
1958	14.00	687.36	0.60	1.00	2.486	-1.488
1959	30.00	937.31	0.48	0.88	2.306	-1.428
1960	35.00	1655.91	0.48	0.88	2.289	-1.406
1964	21.00	1583.00	0.61	1.01	2.455	-1.444
Average				0.990	2.364	-1.374

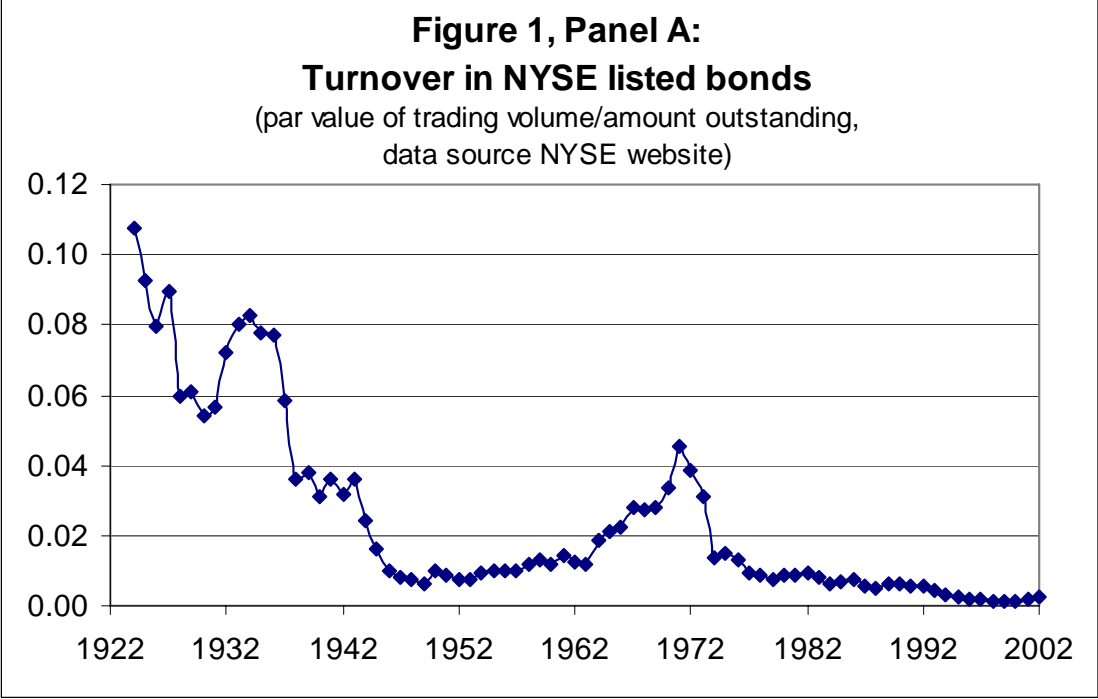


Figure 1, Panel B:
Bond trading on the NYSE as a % of stock trading
 (\$ value of trading volume, data source NYSE website)

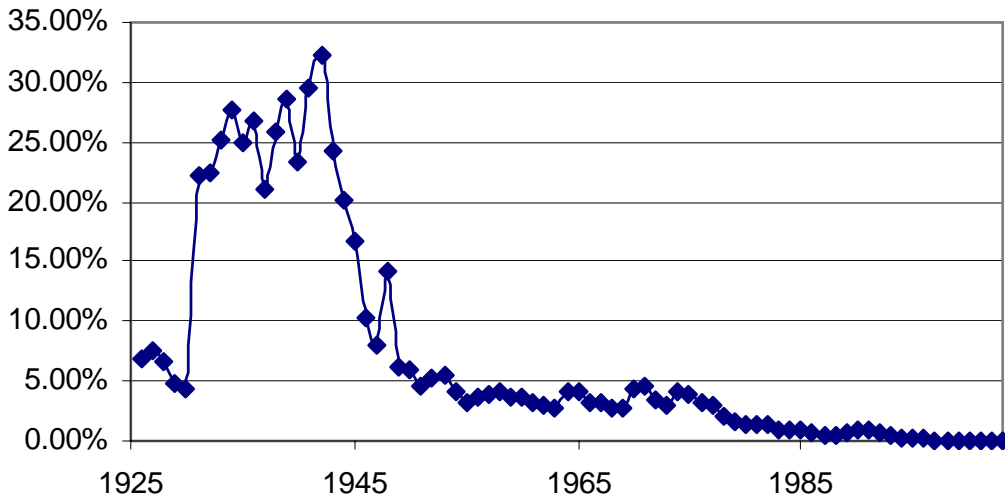


Figure 2: Par value of all outstanding bond issues, 1920-2002. Millions 2002 dollars.

Sources: NBER, FED & Guthman (1950)

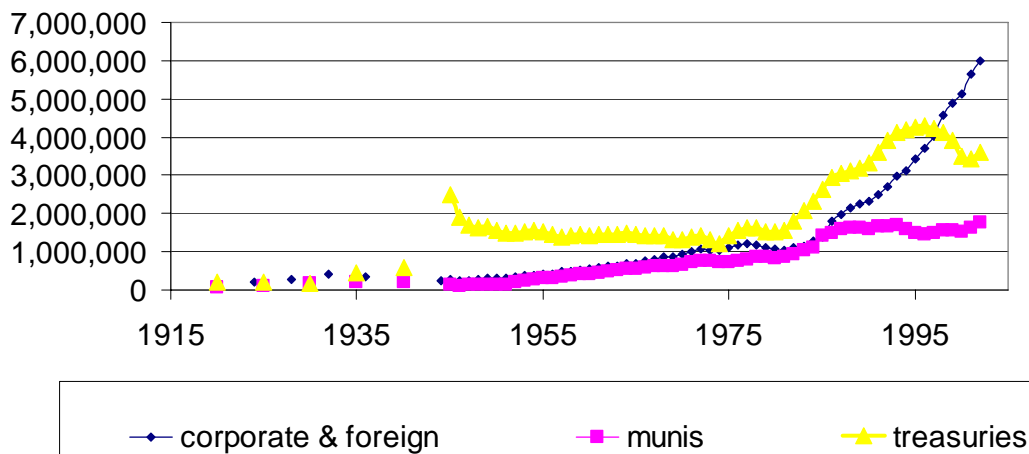
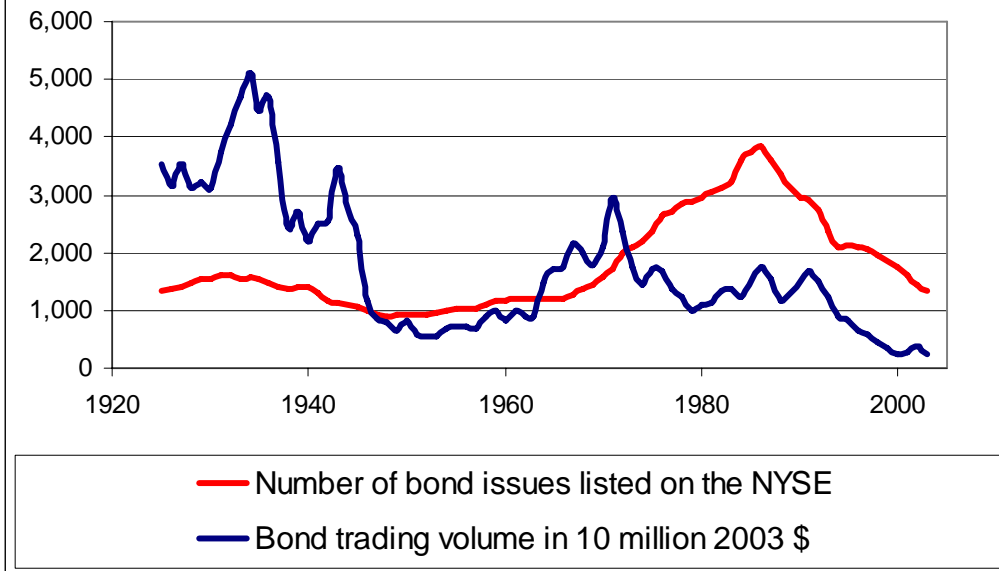


Figure 3:
Bond listing and trading on the NYSE, 1925-2003
(data source NYSE website)



**Figure 4, Panel A: Corporate Bond Ownership
(data sources: Guthman, 1950 and FED)**

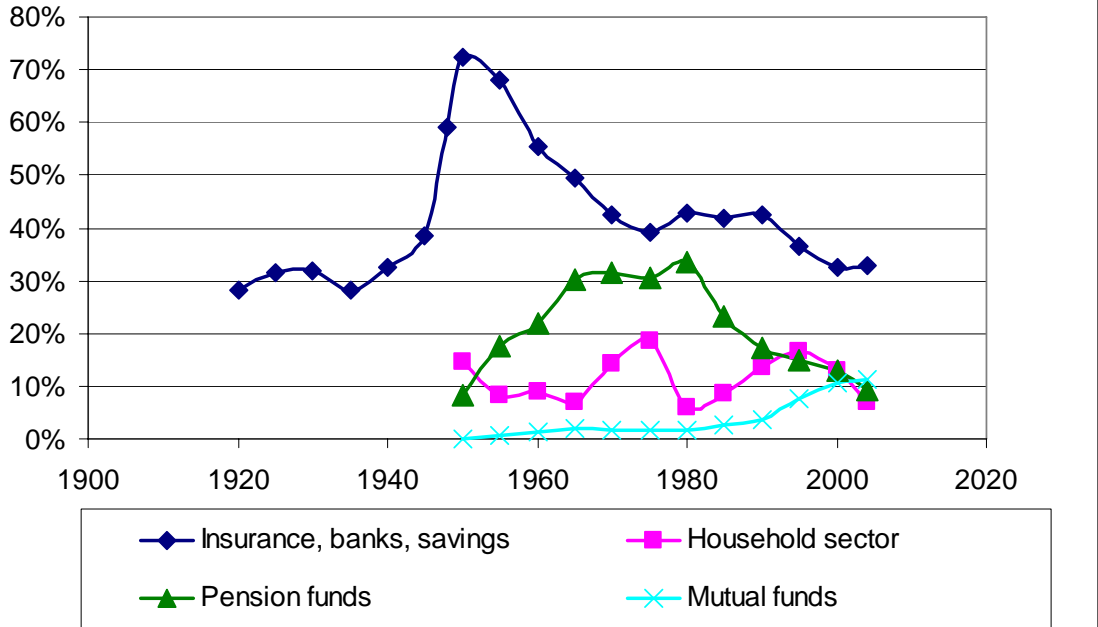
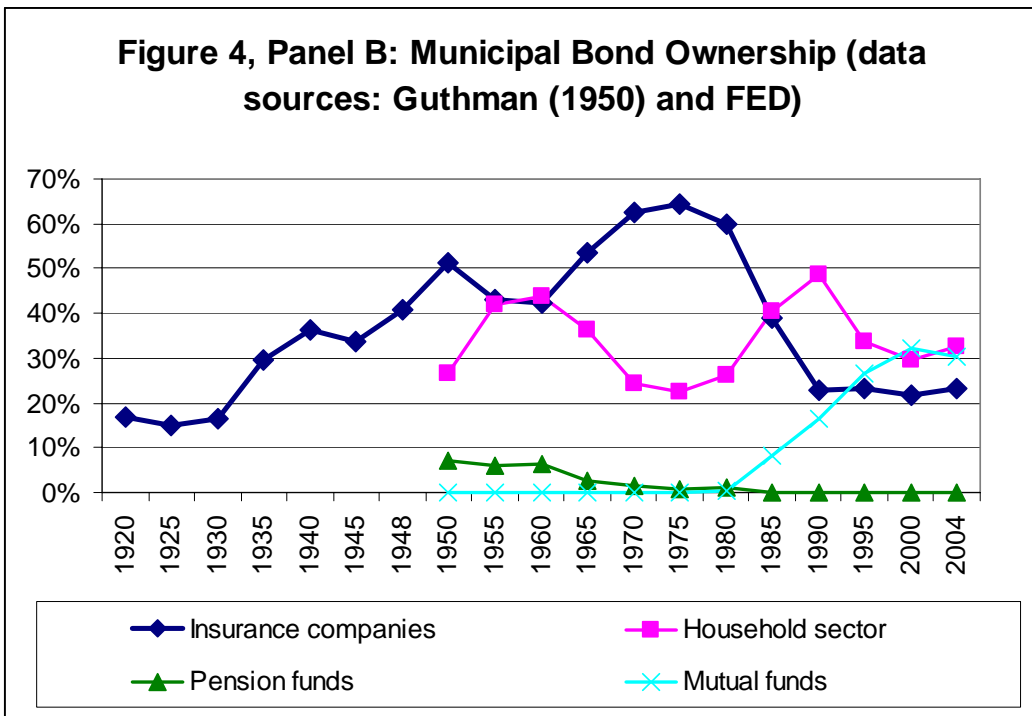
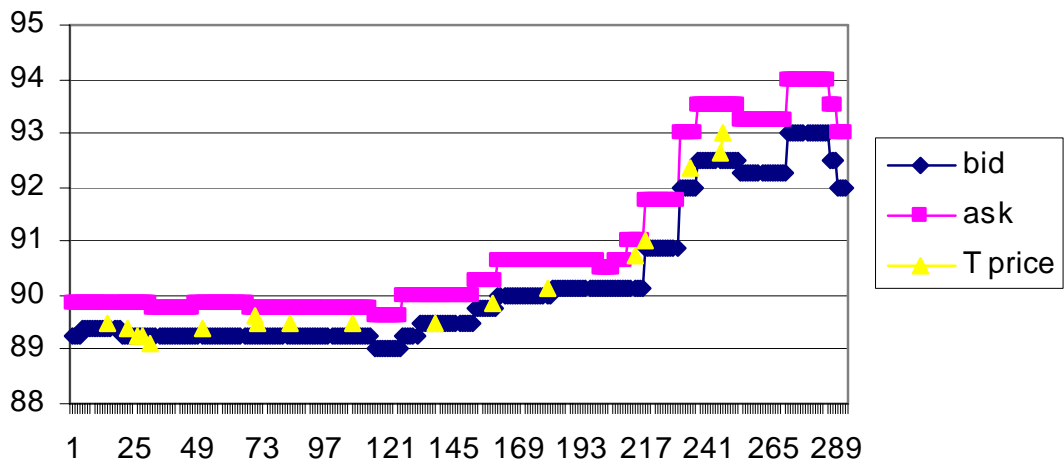


Figure 4, Panel B: Municipal Bond Ownership (data sources: Guthman (1950) and FED)



**Figure 5, Panel A: Quotes and trades in NYC
Muni maturing 1954, cpn 3.5.
July 1, 1926 - June 30, 1927**



**Figure 5, Panel B: Quotes and trades in NYC Muni,
maturing 1957, cpn 4.5, July 1, 1926-june 30, 1927**

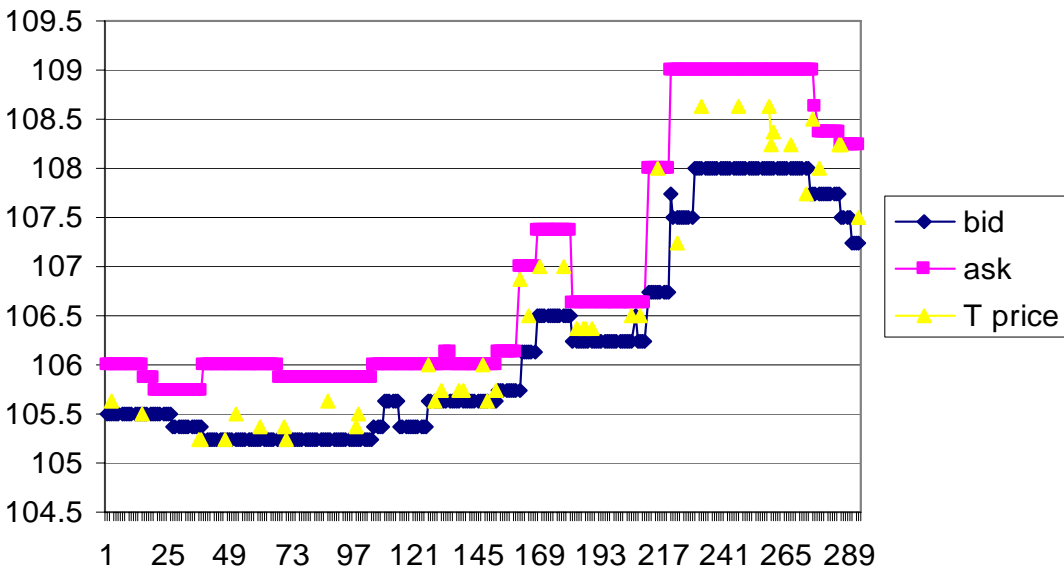


Figure 5, Panel C: Quotes and trades in NYC Muni, maturing 1958, cpn 4%, July 1, 1926, June 30, 1927

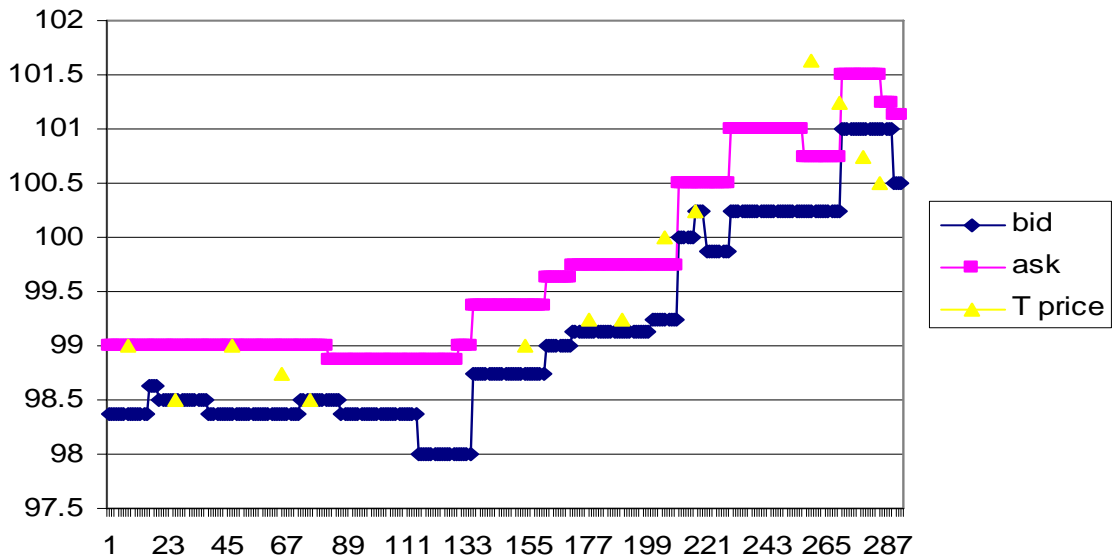


Figure 5, Panel D: Quotes and trades in NYC Muni maturing 1959, cpn 4%, July 1, 1926-june 30, 1927

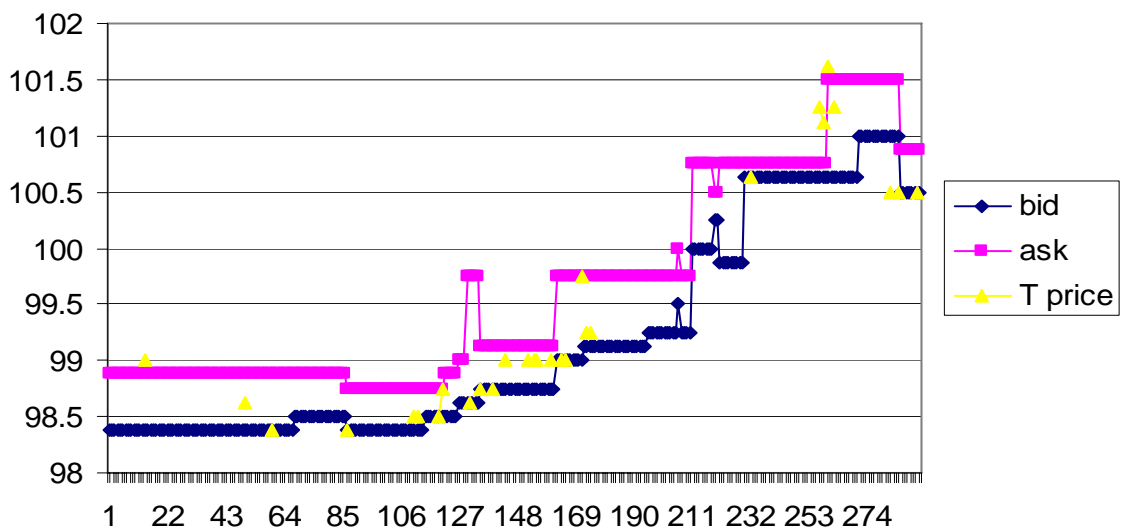


Figure 5, Panel E: Quotes and trades in NYC muni maturing 1960, cpn 4.25%, July 1, 1926-june 30, 1927

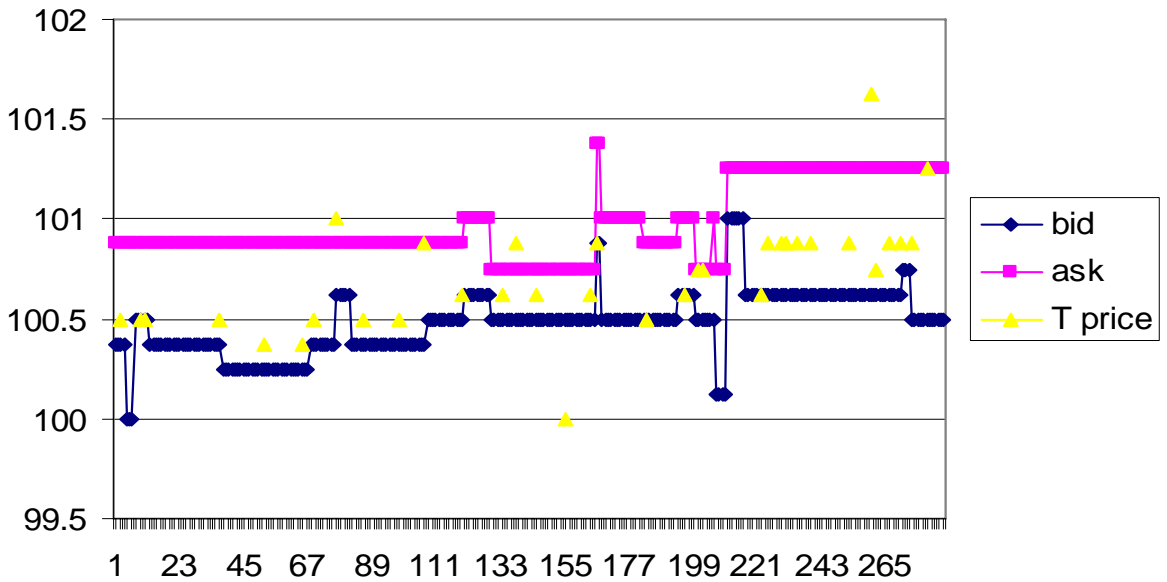


Figure 5, Panel F: Quotes and trades in NYC muni maturing 1964, cpn 4.25. July 1, 1926 - June 30, 1927.

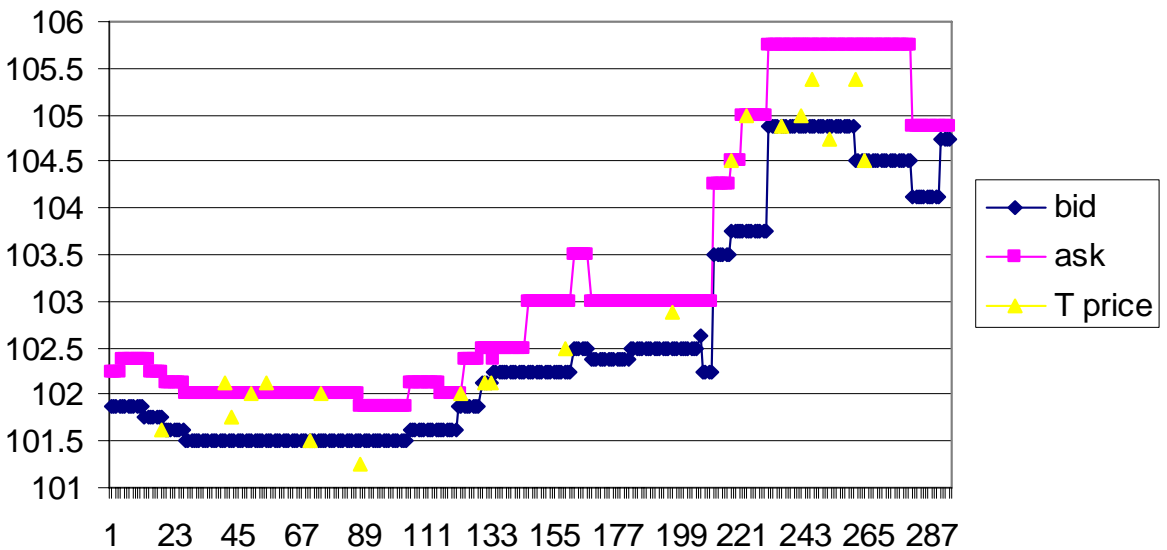


Figure 6, Panel A: Monthly trading volume on the NYSE for our sample of 6 munis, July 1926 to March 1930

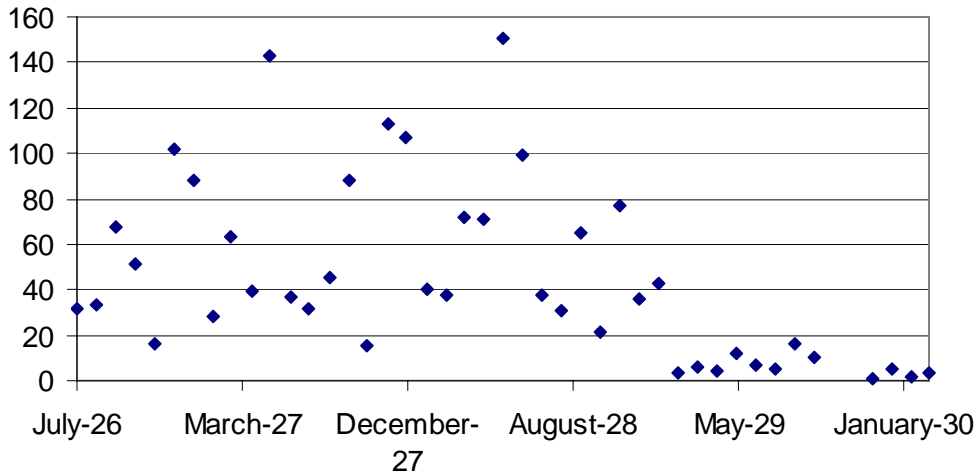


Figure 6, Panel B: Average price impact of trades on the NYSE for our sample of 6 munis, July 26-March 30

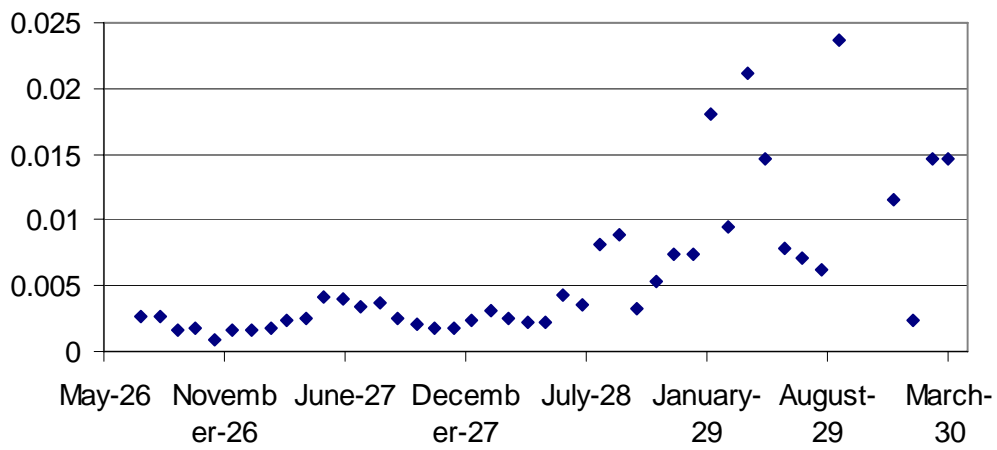


Figure 7: Seat prices, stock volume and bond volume on the NYSE between 1890 and 1928

