Liquidity in a Market for Unique Assets: Specified Pool and TBA Trading in the Mortgage Backed Securities Market

Pengjie Gao[a], Paul Schultz[a], and Zhaogang Song[b]

Abstract

Agency mortgage-backed securities trade simultaneously in a market for specified pools (SPs) and in the to-be-announced (TBA) forward market. TBA trading appears to create liquidity in the SP market. Exogenous increases in TBA trading before settlement dates lowers SP trading costs. SPs that are eligible to be traded as TBAs have significantly lower trading costs than other SPs. We present evidence that TBA eligibility, rather than the characteristics of TBA eligible SPs, is behind the lower trading costs. We show that dealers hedge SP inventory with TBA trades, and they are more likely to hedge TBA-eligible than TBA-ineligible SP positions.

October, 2015

[a]Mendoza College of Business, University of Notre Dame. [b]Board of Governors of the Federal Reserve.
We would like to thank seminar participants at SMU, the University of Nebraska and the University of Notre Dame for helpful comments.

The market for agency mortgage-backed securities (MBS) is among the largest, most active, and most liquid of all securities markets. At first glance, the market's liquidity is surprising because each MBS is unique, composed of specific mortgages with their own prepayment characteristics. In this paper, we study the institutional feature of this market that allows it to work so well – its structure of parallel trading in a to-be-announced (TBA) forward market in MBS and a specified pool (SP) market in which specific MBS are traded.

The TBA market takes thin markets for thousands of different MBS with different prepayment characteristics and trades them through a handful of thickly traded cheapest-to-deliver contracts. The TBA market is very liquid. Trades are very large and we find that round-trip trading costs average less than four basis points.

We provide the first evidence that TBA trading makes the SP market more liquid. We identify an exogenous factor that directly affects TBA trading but not trading of SPs: TBA settlement dates. There is one settlement date each month for all TBA trades of MBS with a given maturity and issuer. These dates are set by the financial industry regulatory authority (FINRA) well in advance of the settlement month. Traders who do not wish to take or deliver MBS roll over their positions before the settlement date, resulting in TBA trading volume that is three to four times as large in the days prior to settlement dates as it is during the rest of the month. SP trades can be settled at any time during the month. Nevertheless, trading costs for SPs, like TBA trading costs, are much lower prior to TBA settlement dates when the predictable volume of TBA trading is high.

We also show that TBA-eligible SPs are much cheaper to trade than SPs that are not eligible for TBA trading and that TBA eligibility itself, not characteristics of the eligible SPs, increases liquidity. We run two separate tests to determine whether TBA eligibility is a cause of SP liquidity. In the first, we use LTV levels and a dummy variable for LTVs greater than 1.05 to see whether there is an abrupt change in trading costs at the LTV cutoff for TBA eligibility. We find that trading costs in general decline with LTV ratios, but increase sharply at the 1.05 cutoff. Our second test is a variation on propensity score matching. In the first stage we estimate the probability that a SP is TBA eligible using characteristics that include minimum and maximum loan values, LTV ratios, and average FICO scores. In the second stage, we group SPs by the estimated probability that the SP is TBA eligible and test whether actual eligibility affects trading costs. After adjusting for the probability that a SP is TBA-eligible, we find that TBA eligibility itself significantly decreases trading costs.

There are several plausible explanations for why TBA trading reduces SP trading costs. Our data allows us to explore one of them. We show that dealers typically hedge specified pool inventory changes with offsetting TBA trades. For individual dealers we regress daily changes in TBA inventory on changes in the inventory of TBA eligible specified pools with the same maturity and coupon. Coefficients are negative, implying that the median dealer hedges specified pool inventories with TBA trades. Specified pools that are not TBA eligible because of the loans they contain are less likely to be hedged, all else equal. The specified pools that are not TBA eligible, and are therefore less likely to be hedged with TBA trades, have higher trading costs than the specified pools that are usually hedged.

Higher trading costs, however, are not the only adverse consequence of dealers' inability to hedge. We present evidence that dealers are reluctant to take hard-to-hedge specified pools into inventory. We find that dealers are more likely to act as brokers for these specified pools than for pools that are easily hedged. That is, they prearrange a sale of the specified pool to a second customer before purchasing the specified pool from the first customer. This means that investors have to wait to sell unwanted MBS while a buyer is sought. This is a cost that we cannot measure.

Regulators have recently expressed concern about the liquidity of over-the-counter markets for corporate and municipal bonds and have suggested that more transparency is needed. Our findings suggest another way to increase liquidity. Forward market trading of MBS in the TBA market appears to lower trading costs both for those MBS traded in the TBA market and for the MBS traded in the parallel SP market. Some legal obstacles would need to be overcome, but it may make sense to have a forward market in municipal and corporate bonds. There may be a sufficient number of, for example, relatively homogenous, 4% 20-year, AA-rated California municipal bonds to create a liquid cheapest-to-deliver forward market.

The rest of the paper is organized as follows. Section I discusses how the secondary market for MBS operates. Section II describes the data used here. Section III compares prices for similar TBA and specified pool MBS. Section IV provides estimates of trading costs in the TBA and specified pool markets. In Section V we examine the impact of TBA trading on SP liquidity. Section VI presents evidence that eligibility for TBA trading lowers SP trading costs. In Section VII, we show that dealers use the TBA market to hedge specified pool positions. Section VIII concludes.

I. How the Market for MBS Works

Tens of thousands of unique agency mortgage backed securities have been issued by Fannie Mae, Freddie Mac or Ginnie Mae in recent years. All are default-free, but each is unique in its prepayment characteristics. From the standpoint of investors, a MBS has desirable prepayment characteristics if the mortgages in the MBS are unlikely to be paid off early if interest rates fall.

Specific MBS do not change hands in TBA trades. Instead, buyer and seller agree to six parameters for the trade: coupon, maturity, issuer, settlement date, the face value of the MBS, and the price. Sellers will attempt to deliver the cheapest MBS that meets the trade requirements, and buyers assume that is what they will receive. All trades of MBS with a specific maturity and issuer settle on the same date each month. Most TBA trading settles in the next month, but TBA trades with settlement dates two or three months in the future are also common.

Forty-eight hours before the settlement date, the seller tells the buyer which specific MBS will be delivered. In most cases though, TBA buyers do not take delivery and TBA sellers do not deliver MBS. Traders instead take offsetting positions. The ability to easily close out positions makes TBA trading a useful way to hedge risk from mortgage rate changes. One of the major sources of TBA trading is mortgage originators who use the TBA market to sell mortgages forward.

TBA market investors can observe real-time indicative TBA quotes through Tradeweb, the electronic trading platform. For each TBA contract, Tradeweb provides one bid and one ask price after uses a proprietary algorithm to filter out meaningless dealer quotes. Indicative quotes are updated continuously as dealers update their quotes. Vickery and Wright (2013) observe that internal Federal Reserve analysis shows that quotes generally track prices of completed transactions closely.

TBA trading works because the MBS exchanged in that market are relatively homogeneous. MBS with more desirable prepayment characteristics are instead traded in the specified pool market where sellers can realize the full value of their MBS rather than getting the cheapest to deliver price. Buyers in the SP market know the MBS they are getting and can be expected to closely examine the prepayment characteristics of the MBS. Trades in the SP market can be settled at any time rather than on one day during a month. In contrast to TBA trades, SP market transactions generally result in delivery of the MBS.

TBA trading succeeds in converting a market with thousands of MBS into a thick market with a few contracts traded. In June, 2011, the first full month of data in our sample, there were 24,528 different specified pools traded. During the last month of our sample, May, 2013, 27,433 specified pools traded. In contrast, across all combinations of maturity, coupon, issuer, and settlement date, only 510 different TBA contracts traded during June, 2011, and only 475 traded during May, 2013. This, however, understates the degree to which TBA trading is concentrated in a few contracts. TBA trading takes place in MBS with maturities of 5, 7, 10, 15, 20, 30 and 40 years and with coupon yields ending in even percents, in half percents (e.g. 3.50%) and in quarter and three-quarter percents (e.g. 3.25% or 3.75%). Over our sample period, 12 maturity-coupon combinations that account for 96% of the trades: 15-years with 2.5%, 3%, 3.5%, and 4%, and 30-years with 2.5%, 3%, 3.5%, 4%, 4.5%, 5%, 5.5%, and 6%. With so much trading volume channeled into so few TBA contracts, it is easy for dealers to find counterparties and to lay off inventory. It is more difficult for dealers to eliminate inventory risk by laying off positions in one of the many thousands of specified pools. As we will show, dealers instead hedge their specified pool inventory with TBA trades.

The market for agency mortgage backed securities is almost entirely an institutional market. As of 2011, 25% of agency MBS were held by U.S. banks, 9% by insurance companies and pension funds, 11% by mutual funds, and 14% by foreign investors.[1] As a result of its asset purchase programs, the Federal Reserve held 20% of agency MBS. Other investors in agency MBS include Fannie Mae, Freddie Mac, the U.S. Treasury, savings institutions and REITs. These institutions tend to buy and hold MBS for long periods of time. When they trade, they tend trade large quantities of MBS.

II. Data

FINRA began requiring members to report all trades of mortgage backed securities through their TRACE system in May, 2011. In this paper, we examine MBS trading using all trades by all dealers who were FINRA members over May 16, 2011 through April, 2013. This includes virtually all, if not all MBS trades for this period. Data for each trade includes the maturity, coupon, and issuer of the MBS, the price, par value, trade date, trade time, and settlement date for the trade, and identifying numbers for dealers in the trade. Data includes both interdealer trades and trades between dealers and customers, and both TBA and specified pool trades.

Table I provides some summary statistics for MBS trading. Panel A reports the number of trades of various types, and the volume from these trades. As is also noted by Vickery and Wright (2013), the great majority of mortgage backed security volume is in the TBA market. During our sample period dealers sell $32.3 trillion worth of MBS to customers and purchase $32.1 trillion from them through TBA trades. The volume of interdealer trades is $58.5 trillion. Total specified pool sales to customers are worth "only" $2.9 trillion, while purchases are $4.3 trillion. The total dollar volume of interdealer specified pool trades is $1.8 trillion. It is interesting that that interdealer trades account for almost half the volume in the TBA market, but a much smaller proportion of specified pool volume. Interdealer trading is more common in the TBA market because dealers lay off TBA inventory by trading with other dealers, and, as we will show, also hedge specified pool inventory with interdealer TBA trades.

Because the volume of trading in specified pools is so much less than TBA volume, it is tempting to conclude that the specified pool market is unimportant. That is not true. Even though the volume is lower in the specified pool market than in the TBA market, it is still in the trillions of dollars during our sample period. In addition, it is difficult to compare the dollar volumes directly. Dealers and investors

[1] Written statement of Richard Dorfman before the House Committee on Financial Services, Subcommittee on International Monetary Policy and Trade, October 13, 2011.

often roll over positions in the TBA market or enter offsetting trades so that they do not actually take delivery or deliver MBS traded in the TBA market. Finally, without specified pool trading, MBS traded in the TBA market would be less homogeneous, and it is likely that the TBA market would therefore be less liquid.

Panel A of Table I also provides information on the volume and numbers of different types of TBA trades. Over the May, 2011 through April, 2013, there are more than 3.3 million TBA trades. Outright trades make up the majority of TBA trades. Dollar rolls are the second most common type of trade. Dollar rolls are spread trades that are often compared to repos. The seller of a dollar roll sells the front month TBA contract and simultaneously buys a future month contract with the same characteristics. Dollar rolls differ from repos in that the securities that are purchased for delivery in the later month are "substantially similar" to the one sold in the front month rather than the same securities. In addition, in a dollar roll, the buyer of the front month contract receives coupon and principal payments over the month. Dollar rolls tend to be very large trades, and account for most of the buy, sell, and interdealer volume.[2]

Stipulated trades are TBA trades in which the buyer requires the seller to deliver pools with additional stipulated characteristics. The buyer could, for example, specify that no more than a certain percentage of mortgages in a pool are on California homes. Stipulated dollar rolls are dollar rolls that stipulate additional characteristics of pools to be delivered. They are less common, and account for less than 30,000 trades.

These statistics on dollar rolls and stipulated trades are included to provide a complete picture of the MBS market. For most the rest of the paper, we focus our attention on outright TBA trades. These are most similar to SP trades and provide a clear trading alternative.

There are about 1.66 million trades of specified pools. TBA eligible SPs make up the great majority of these trades. These SPs could be sold in the TBA market if the seller so desired. The other pools have characteristics that make them ineligible for TBA trading. They could, for example, contain jumbo loans or mortgages with high loan-to-value ratios. Interdealer trades make up a far smaller proportion of specified pool trades than TBA trades. As we show later, interdealer TBA trades are used to manage both TBA and specified pool inventory.

Panel B of Table I provides information on trade sizes. The MBS market is a market for financial institutions, not individual investors, so trade sizes are large. The average size of an outright TBA trade between a dealer and customer is $32.64 million dollars. The distribution is right-skewed, but still, over 37% of the TBA trades between dealers and customers are for more than $10 million. Dollar rolls are especially large. The mean size of interdealer dollar roll trades is $59.64 million while the mean size for trades with customers is over $100 million. Trade sizes are far smaller for specified pools than for TBA

[2] See Song and Zhu (2014) for a discussion of the economics of dollar rolls.

trades. Interdealer specified pool trades have an average size of only $3.32 million dollars, but, the great majority of trade sizes are smaller. Only 6.7% of specified pool interdealer trades are for $10 million or more. It is interesting that specified pool trades with customers tend to be larger than interdealer specified pool trades. The mean size trade with customers is for $6.49 million par value, and 10.7% of the trades are for $10 million or more.

Panel C of Table I reports the proportion of trades of different types for dealers with different levels of activity. There are over 750 dealers in our sample, but most trades are handled by a small number of them. Panel C shows that the top ten dealers, ranked by number of trades, account for 54.9% of all trades and 64.6% of all volume. The next 20 dealers account for an additional 27.3% of trades and 29.3% of volume. Active dealers tend to do most of their trading in the TBA market, while inactive ones trade mainly in specified pools. The table doesn't show results for individual dealers, but the single most active dealer accounts for 17.3% of all trades, but made almost no trades in the specified pool market. For the ten most active dealers, the average proportion of volume from specified pools is 13.55%. For the twenty next most active dealers, the proportion of volume from specified pools averages 26.16%. For dealers ranked 101 – 758 by number of trades, the proportion of volume from specified pools reaches 87.82%. As we have seen, TBA trades are usually much larger than specified pool trades. To compete effectively as a dealer in the TBA market requires more capital than it takes to trade specified pools – capital that the less active dealers may not have.

Panel C also reveals that the proportion of trades that are interdealer trades is higher for more active dealers than for less active ones. Even for the least active dealers, however, the average proportion of trades that are interdealer is over 44%.

During the sample period, both TBA and specified pool prices increased. This can be attributed to falling mortgage interest rates over this time period. Figure 1 shows weekly national average mortgage rates, from Freddie Mac, for 15 and 30-year mortgages for the period from April, 2011 through April, 2013. Over this time, 30-year rates were consistently higher than 15-year rates by about 75 basis points. Rates decline approximately 125 basis points between April, 2011 and October, 2012. The decline in rates led to increased prices of mortgage backed securities over the sample period, and made prepayment an attractive option to many mortgage holders.

Lower mortgage rates also means that the MBS issued later in the sample period had lower coupon rates than the MBS issued earlier. We obtain from JP Morgan the gross production, net production, and outstanding balance of MBS with each coupon and maturity from each issuer. Gross production is the value of new MBS issued and net production is the gross production minus the reduction in value of current MBS from mortgage payments. Figure 2 shows the net production in millions of dollars, across all issuers, of 30 year MBS with 3%, 3.5%, 4%, and 4.5% by month. At the beginning of our sample period, in May, 2011, net production of 30-year 4.5% MBS is positive. With declining mortgage rates, production of 4.5% 30-year MBS quickly declined however, and turned negative in September, 2011. Production of 30-year MBS with coupons of 4% rose from almost nothing in May 2011 to over $20 billion in September, 2011. After June of 2012, low mortgage rates lead to negative production of 30-year 4% MBS. Production of 3.5% MBS began in September, 2011, and production of 3% 30-year MBS did not begin until 2012.

Figure 2B depicts net production of 15-year MBS. Patterns of net production are similar to those of 30-year MBS. As mortgage rates fell, production of MBS with high coupon rates declined and turned negative. Production of MBS with lower coupon rates began. Production can be expected to affect liquidity.

One of the major sources of TBA volume is from mortgage originators who hedge by selling mortgages forward. When mortgage rates fall, originators will shift their hedging demand toward TBA trades with lower coupons. We would expect liquidity to be greatest for the TBA trades with demand from originators. Hence we would expect the low coupon TBA trades to become more liquid over our sample period.

III. Prices in the Specified Pool and TBA Markets

To compare prices in the TBA and specified pool markets, we first calculate the average price of interdealer trades in the TBA market for combinations of maturity and coupon for each issuer, and each settlement date each day. We also calculate the average price for interdealer trades of specified pools by each issuer for maturity and coupon combinations each day. We show results for Fannie Mae MBS in this section because they are the most common, but results are similar for other issuers.

Prices of TBA and specified pool securities cannot be directly compared because they have different settlement dates. To adjust for this, we calculate the "drop" as the difference in price between the Fannie Mae TBA with the nearest settlement, and the Fannie Mae TBA with the second nearest settlement. The daily drop is the drop divided by the number of days between the two settlement dates. We then multiply the daily drop by the number of days between a Fannie Mae specified pool's settlement date and the nearest TBA settlement date and add this to the specified pool price.[3] This adjusted specified pool price can then be compared with TBA prices. In practice, adjusting for the drop does not have a big impact on the difference between TBA and specified pool prices.

The number of specified pool trades of Fannie Mae MBS with specific coupon and maturity combinations varies across days and is sometimes small or zero. So, after omitting days with no specified

[3] See Atanasov and Merrick (2013).

pool trades, we calculate five-day moving averages of Fannie Mae TBA and specified pool prices. To calculate the specified pool moving averages, we weight each of the five previous days by the number of interdealer specified pool trades on that date. There are always several interdealer TBA trades, so the TBA moving average price is just a simple average of the five average daily prices.

Figure 3 presents the moving averages of prices of Fannie Mae TBA and specified pool trades of MBS with 1) 15 years to maturity and a 3.5% coupon yield, 2) 15 years to maturity and a 4% coupon yield, 3) 30 years to maturity and a 4% coupon yield and 4) 30 years to maturity and a 5% coupon yield. There are two things to notice in these graphs. First, specified pool prices for all maturity-coupon combinations increase relative to TBA prices over the sample period. Recall, as shown in Figure 1, that mortgage rates were falling over this period. Prepayment options became more valuable with lower rates. Early in the sample period, when prepayment was unlikely, there was little difference in values of MBS with different prepayment characteristics. Later in the period, when the prepayment option was more valuable, MBS with better prepayment characteristics commanded a large premium in the specified pool market.

A second thing to notice in these graphs is that TBA and specified pool prices track each other very closely. This is particularly clear in the early part of the sample period when prepayment is less important, but even when specified pool prices move to a premium over TBA prices, changes in the prices are positively correlated. This suggests that TBA trades can be used to hedge positions in specified pools.

IV. Trading Costs in the Specified Pool and TBA Markets

To date, there has been little academic research on the microstructure of MBS markets. Bessembinder et al (2013) examine trading of MBS and other structured credit products for the period from May 16, 2011 through January 31, 2013. They estimate trading costs by regressing differences in price between successive trades on a variable for change from a dealer purchase to a dealer sale (+1) or dealer sale to a dealer purchase (-1), along with variables for changes in bond and equity indices over the trade period. Their estimates of one-way trading costs are 40 basis points for specified pools, and just 1 basis point for TBA trades. In this section we extend the MBS portion of the work of Bessembinder et al by examining the impact of TBA eligibility and MBS production on trading costs.

To estimate trading costs for MBS we employ a regression methodology like that in Bessembinder et al (2013). Each observation is two consecutive trades in an MBS with a specific CUSIP, but each regression includes observations from all CUSIPs with a particular maturity. We include only

30-year MBS with coupon rates of 2.5%, 3.0%, 3.5%, 4.0%, 4.5%, 5%, 5.5% and 6%, and 15-year MBS with coupon rates of 2.5%, 3.0%, 3.5%, 4.0%. Together, these MBS account for 96% of our sample trades. Atanasov and Merrick (2013) show that small lots of MBS are particularly illiquid because they are not considered suitable for small investors and are difficult to aggregate into larger lots. Hence, we omit trades of less than $10,000 par value. To calculate trading costs, we estimate the following regression:

$$\Delta P_t = \alpha_0 + \alpha_1 \Delta Q_t + \alpha_2 \Delta Q_t \cdot \left(\ln(\text{Size}_t / 1{,}000{,}000) + \ln(\text{Size}_{t-1}/1{,}000{,}000)\right) + \alpha_3 \Delta Q_t \cdot \text{TBA Eligible}$$
$$+ \alpha_4 \Delta Q_t \cdot \text{TBA Eligible} \cdot \left(\ln(\text{Size}_t/1{,}000{,}000) + \ln(\text{Size}_{t-1}/1{,}000{,}000)\right)$$
$$+ \alpha_5 \Delta Q_t \cdot \ln\left(\frac{\text{MBS Production}_t}{\text{Avg Production}}\right) + \alpha_6 \Delta Q_t \cdot \ln\left(\frac{\text{MBS Balance}_t}{\text{Avg Balance}}\right) + \Sigma\beta_i \, \text{Ret}_{i,t} + \varepsilon_t. \quad (1)$$

where ΔP_t is the percentage change in prices between trade t and trade t-1, $\Delta Q_{t,}$ is 1 if the dealer purchases in trade t-1 and sells in trade t and -1 if the dealer sells in trade t-1 and purchases in trade t, Size is the par value of the traded securities, TBA Eligible is a dummy variable that equals one if the specified pool is eligible to be traded TBA, MBS Production is the gross amount of new MBS with that coupon and maturity that was created in the previous month, and MBS Balance is the value of MBS with that coupon and maturity outstanding at the end of the previous month. Five return variables are also included to capture changes in MBS values when consecutive trades take place on different days. They are the percentage changes in 1) the Barclay Capital's U.S. MBS index, 2) the Barclay Capital's 7-10 Year U.S. Treasury Bond index, 3) the Barclay Capital's U.S. Corporate Bond Index, 4) the Barclay Capital's U.S. Corporate High-Yield Bond Index, and 5) the S&P 500 index. These are the same indices used in the study of structured credit products by Bessembinder et al (2013). Index values are available daily, so if consecutive trades occur on the same day, all of these return values are zero. This regression is run separately for SP and TBA trades, but the variables for TBA eligibility are, of course, omitted in the regressions using TBA trades.

Regression estimates are reported in Table II. Panel A reports estimates for TBA trades while Panel B reports results for specified pools. The first regression in Panel A measures trading costs for 30-year TBA trades. It reports a highly significant coefficient of 0.0357 on ΔQ. In estimating this regression, we incorporate the size of the trade by taking the natural logarithm of the par value of the trade divided by $1,000,000. Similarly, for our MBS production and outstanding balance variables, we use natural logarithms of the variable divided by its average. Hence the coefficient estimate of 0.0357 on ΔQ is an estimate of the round-trip TBA trading costs for $1,000,000 par value trades when monthly production and the balance of the MBS are at their average. The dependent variable is the percentage change in the price of the MBS, hence 0.0357 means 3.57 basis points.

Trading costs decrease with trade size for every regression in Table II. This is similar to the findings of Bessembinder et al (2013). The coefficient on the interaction between ΔQ and the logarithm of the trade size is a highly significant -0.0056 in the first regression. The natural logarithm of 2,000,000/1,000,000 is about 0.69, so an increase in the trade size from $1,000,000 par value to $2,000,000 would reduce trading costs by about 0.69 x -.0056 = 0.39 basis points.

The second regression includes an interaction between ΔQ and the natural logarithm of the ratio of the gross production of MBS with the same coupon and maturity to the average gross production. Gross production is the dollar value of new mortgage backed securities created during the previous month with the same coupon and maturity. It is highly autocorrelated, so one month's production is a good predictor of the next month's production. Gross production does, however, vary significantly across coupon rates during a month. Greater gross production implies greater demand by originators to hedge new mortgages in the TBA market, and could affect trading costs in this way. The coefficient is negative, suggesting that greater production is associated with lower TBA trading costs. The t-statistic of -2.44 suggests statistical significance, but isn't impressive in a regression with over 650,000 observations.

The third regression in the table includes the interaction between ΔQ and the log of the ratio of the previous month's balance of outstanding MBS with that coupon and maturity to the average balance. A greater outstanding balance of MBS with a given maturity and coupon implies a deeper market for TBA trading. It suggests that dealers may know more potential buyers (or sellers) for MBS with the particular coupon and maturity characteristics. It also suggests higher volume in the future as investors unwind positions. The coefficient on the log of the balance ratio is negative and highly significant. TBA trading is cheaper if there are a lot of MBS securities with the same maturity and coupon. The fourth regression includes the interactions between ΔQ and both the balance and production ratios. The log of the balance ratio remains negative and highly significant, but the gross production ratio is no longer significant. To summarize, a $1,000,000 par value round-trip TBA trade costs about 3.5 basis points, with costs falling for larger trade sizes and during times when there is a large balance of outstanding 30-year MBS with the same coupon.

The remainder of Panel A reports results for regressions using 15-year TBA trades. Round-trip costs for a $1,000,000 par value trade are about 3.1 basis points. Trading costs decline with trade size. While trading costs do decline with the balance of outstanding MBS with the same coupon and maturity, they appear to anomalously increase with MBS production.

Panel B provides regression estimates of trading costs for specified pool MBS. In the first regression, the percentage change in price for consecutive trades of 30-year specified pools is regressed on ΔQ and interactions between ΔQ and the trade size ratio and between ΔQ and a dummy variable for TBA eligibility. The coefficient of 0.6324 on ΔQ indicates that the round-trip trading cost for $1,000,000 of 30-year specified pools that were not TBA eligible was 63.24 basis points – far greater than the 3.5 basis points for similar TBA trades. For TBA eligible specified pools, the round-trip trading costs were 63.24 – 39.57 or 23.47 basis points. This is much less than the trading costs for TBA-ineligible specified pools, but much more than TBA trades. The first regression also indicates that trading costs for specified pools, like TBA trading costs, decline with trade size. The second regression includes an interaction between the TBA eligibility dummy and the trade size ratio. It is positive and significant, indicating that trading costs do not decline as fast with trade size for TBA eligible pools as with TBA ineligible specified pools.

The next three regressions in Panel B estimate the effects of gross production of MBS and the balance of outstanding MBS on specified pool trading costs. A large balance of outstanding MBS with a particular coupon and maturity means that there is a large supply of these MBS and that dealers are probably aware of institutions that may want to buy or sell MBS with these characteristics. For 30-year specified pools, both high gross production and a large balance of outstanding MBS are associated with lower trading costs.

The next two rows report results for specified pools with maturities ranging from 16 through 30 years. All of these maturities are eligible for delivery in 30-year TBA trades. Now we include an extra dummy variable which takes a value of one if the maturity is exactly 30 years. Specified pools with maturities between 16 and 29 years are seasoned pools. They can be compared to off-the-run bonds. When these odd maturities are included in the regressions, trading costs still decline with trade size, with TBA eligibility, with the previous month's gross production of mortgages, and with the balance of mortgages at the end of the previous month. The coefficient on the dummy variable for 30-year maturity is negative and highly significant. Specified pools with 30 years to maturity are cheaper to trade than the seasoned SPs with maturities from 16-29 years.

The remaining rows of the table report regression estimates of trading costs for specified pools with 15 years to maturity. Trading costs are, again, much higher than for similar TBA trades. The first regression for 15-year MBS has a coefficient on ΔQ of 0.6193. Round-trip trading costs for a $1,000,000 par value trade of 15-year specified pools is 61.93 basis points if the specified pool is not TBA-eligible, and 61.93 – 32.12 = 29.81 basis points if the pool is TBA eligible. As with 30-year specified pools, trading costs decline with trade size and with greater gross production of MBS with the same coupon and maturity. The outstanding balance of 15-year MBS with the same coupon seems to have little impact on trading costs of 15-year specified pools. Shorter maturities are eligible for delivery as 15-year MBS, so the last two regressions include all specified pools with 15 years or less to maturity. The coefficient on the dummy for 15 years to maturity is negative, indicating that seasoned specified pools with less than 15 years to maturity are more expensive to trade than specified pools with 15 years to maturity.

To estimate round-trip trading costs from the regression estimates in Table II, it is necessary to multiply trade sizes and dummy variables for TBA eligibility and maturity by their respective coefficients. We use coefficients from the regressions that include production and the outstanding balance of mortgages and only specified pools with 30 or 15 years to maturity to estimate round-trip trading costs for trades of $100,000, $1 million, $5 million and $10 million. Results are reported in Table III. The median trade size for specified pools is around $1 million in par value (it is about $3 million for TBA trades). Table III indicates that for $1 million trades, the round-trip trading costs are about 3.77 basis points for 30-year TBA MBS and about 23.5 basis points for 30-year TBA eligible specified pools. Round-trip trading costs are 76.68 basis points for $1 million round-trip trades of specified pools with 30-years to maturity that are not TBA eligible. The last two rows of estimates for 30-year MBS report trading costs when production and the balance of outstanding MBS is twice the average level. For $1,000,000 TBA trades, round-trip trading costs fall from 3.77% to 2.41%. For $1,000,000 trades of TBA eligible specified pools, trading costs decline from 23.52 basis points to 21.75 basis points.

Estimates of round-trip trading costs for 15-year specified pools are reported in the last five rows of the table. Trading cost estimates are somewhat lower for 15-year MBS than for 30-year MBS. For both 30 and 15-year MBS though, four conclusions can be drawn about MBS trading costs. First, larger trades have lower trading costs, as a percentage of value, than smaller trades. Second, TBA trades are much cheaper than specified pool trades of similar size. These findings are similar to those of Bessembinder et al (2013). In addition, TBA-eligible specified pools are cheaper to trade than TBA ineligible SPs. Fourth, trading costs fall with greater production and with a greater amount of outstanding MBS with the same coupon and maturity.

V. The Impact of TBA Trading on Specified Pool Liquidity

The TBA market is much more liquid than the SP market. It appears that consolidating trades from thousands of different SPs into a handful of TBA contracts creates liquidity for those MBS that are traded in the TBA market rather than as SPs. A different issue is whether the existence of TBA trading increases liquidity for the MBS that are traded as SPs. There are several reasons to expect a liquidity spillover from TBA trading to SP trading. One is that TBA prices may provide a benchmark for SP pricing. Price discovery may take place in the TBA market rather than the SP market. Another is that an active TBA market may allow dealers to hedge SP positions with minimal basis risk.

It is not straightforward to test whether TBA trading affects SP liquidity. We would expect that many of the factors that affect TBA trading also directly affect SP liquidity. We have, however, identified an exogenous factor that directly affects the trading volume in the TBA market but not the SP market. This exogenous factor is TBA settlement dates. TBA contracts for a given maturity and issuer settle on one day during a month. Fannie Mae and Freddie Mac 30-year TBA trades settle on the same Class A schedule. Their settlement dates are typically around the 12th or 13th of each month. The Class B schedule is for 15-year TBA trades. Settlement dates for these trades are typically three trading days after class A settlement dates. The Class C schedule is for Ginnie Mae 30-year TBA trades. Settlement dates are about two trading days after Class B dates. The monthly settlement dates lead to a pronounced monthly seasonal in TBA trading volume, particularly for dollar rolls. Specified pools, on the other hand, can be settled on any day of the month.

Recall that the purchaser of a dollar roll buys a TBA contract for settlement in the current month and simultaneously sells a TBA contract for settlement in a future (usually the next) month. Likewise, the seller of a dollar roll sells a TBA contract for settlement in the current month and simultaneously buys a TBA contract for settlement in a future month. Investors who trade dollar rolls typically either terminate or roll over their positions before settlement. To avoid being assigned a delivery, TBA traders must terminate positions at least 48 hours before the settlement date. This results in a spike in trading volume from seven trading days through two trading days before each settlement date.

Figure 4a shows daily trading volume from dollar rolls of 30-year TBA trades over our sample period. It is easy to see monthly trading volume spikes in which daily volume is three to five times the daily volume in the rest of the month. These volume spikes are two to five days before the Schedule A settlement dates. It is clear from the figure that timing relative to the settlement date is a major determinant of daily dollar roll trading volume. And, since dollar roll trading accounts for most of the dollar volume of TBA trading, we can say that the settlement date is a major determinant of TBA trading in general.

Specified pool trades, on the other hand, may be settled on any day during the month. And, unlike dollar rolls and other TBA trades, specified pool trades almost always lead to delivery. The monthly settlement dates and the corresponding trades to avoid delivery that are so important in the TBA market are unimportant for specified pool trades. Figure 4b depicts daily trading volume for 30-year specified pools. There are monthly spikes in trading volume for the specified pools around the TBA volume spikes but they are much less pronounced. This is not surprising.[4] If dollar roll trading makes the market for

[4] Dealers often choose to settle specified pool trades on TBA settlement dates for convenience. Atanosov and Merrick (2012) show that 71.5% of 30-year specified pool trades of more than $250,000 settle on TBA settlement dates. A smaller proportion of smaller trades and 15-year specified pool trades are settled on TBA settlement dates.

specified pools more liquid, we would expect specified pool trading to peak when dollar roll trading is high.[5] The correlation between the daily 30-year dollar roll and specified pool volumes is 0.45.

Table I shows that dollar roll volume accounts for more than half of all TBA volume. TBA trading could make the market for specified pools more liquid by providing a means for dealers to hedge inventory, by providing benchmark prices, or by providing a competing venue for trading specified pools. In any of these cases, we would expect greater TBA volume to be associated with lower specified pool trading costs.

We test whether TBA trading affects specified pool liquidity by running the following regression:

$$\Delta P_t = \alpha_0 + \alpha_1 \Delta Q_t + \alpha_2 \Delta Q_t \cdot \left(\ln(\frac{Size_t}{1{,}000{,}000}) + \ln(\frac{Size_{t-1}}{1{,}000{,}000})\right) + \alpha_3 \Delta Q_t \cdot lnPredicted\ DollRollVol_t$$
$$+\alpha_4 \Delta Q_t \cdot lnPredicted\ DollRollVol_t \cdot (\ln Size_t + lnSize_{t-1}) + \Sigma\beta_i\ Ret_{i,t} + \varepsilon_t. \quad (2)$$

For days that are between two and seven days before a Class A (30-year Fannie Mae and Freddie Mac) TBA settlement date or between two and seven days before a Class B (15-year) TBA settlement date, we use the dollar roll volume from the corresponding day in the previous month as the prediction of dollar roll volume.[6] For other days, we use the average volume from days t-40 to t-20, excluding days that were two to seven days before a settlement date, as a forecast of volume. Hence our predicted dollar roll volume is based only on volume from the previous month and the publicly known settlement date. Other factors that would simultaneously affect TBA dollar roll volume and SP trading costs would be most likely show up in unexpected dollar roll volume. Results are reported in Table IV.

Here, the α_3 coefficient on the interaction between the change in trade type, ΔQ, and the predicted Dollar Roll Volume shows how trading volume affects trading costs. For 30-year outright TBA trades and 30-year TBA eligible specified pools, the coefficients are negative and highly significant. Increases in dollar roll volume are associated with lower trading costs. For TBA ineligible specified pools, the α_3 coefficient is also negative and of similar magnitude, but, as a result of the smaller sample size, is less significant. So, dollar roll volume seems to reduce trading costs for ineligible specified pools about as much as for TBA-eligible specified pools. The trading costs for TBA ineligible specified pools are much higher, however. So, dollar roll trading reduces trading costs for 30-year TBA eligible and ineligible specified pools by about the same amount, even though TBA ineligible SPs are much more expensive to

[5] See Admati and Pfleiderer (1988) for a model in which liquidity traders with discretion over the timing of their trades may endogenously choose to concentrate their trading in the same period.

[6] We find that Class B Settlement dates, which apply to 30-year Ginnie Mae trades, have little predictive power for volume. Ginnie Mae TBA volume in general is significantly less than Fannie Mae and Freddie Mac TBA volume.

trade. Some of the regressions include a further interaction between ΔQ, the predicted dollar roll volume, and the trade size. Dollar roll volume has a smaller impact on trading costs for large trades.

The last five rows of the table report results for similar regressions using 15-year TBA and specified pool trades. Trading costs decline significantly with predicted dollar roll trading volume both for TBA trades and for trades of TBA eligible specified pools. The volume of dollar roll trading seems, however, to have little impact on trading costs for 15-year TBA ineligible specified pools. The t-statistic for the interaction between ΔQ and the predicted dollar roll volume is only -0.12 when the interaction between ΔQ, the predicted dollar roll volume and trade size is included and -0.10 when it is not in the regression. It is true that only 1,656 observations are included in the regression with 15-year TBA ineligible specified pools, but the coefficients on ΔQ and the interaction between ΔQ and trade size remain highly significant in the regression.

To summarize, predictable dollar roll volume spikes that occur before exogenously determined settlement dates are associated with lower specified pool trading costs. Specified pool trades can be settled at any time within a month, and there is no reason why specified pool trading should spike in the same way as dollar roll trading. This suggests that TBA volume, as measured by dollar roll volume, increases liquidity for specified pools.

VI. Does TBA Eligibility Reduce Trading Costs for Specified Pools?

We have shown that trading costs are significantly lower for TBA eligible specified pools than for other specified pools. It is possible that TBA eligibility itself lowers trading costs. The option to sell SPs in the more liquid TBA market may be valuable, particularly when the specified pools are not worth much more than TBA prices. It is also possible though, that TBA eligibility per se has nothing to do with trading costs and that TBA eligibility is instead associated with characteristics of specified pools that make them more liquid. These common characteristics could mean that holdings of TBA eligible SPs could be hedged more easily with offsetting TBA trades. Or, the greater similarity between TBA traded securities and TBA eligible SPs could mean that TBA trades could provide more information about the value of TBA eligible SPs than those that are not eligible for TBA trading. In this section, we explore whether it is TBA eligibility or MBS characteristics associated with TBA eligibility that lead to greater liquidity for specified pools.

There are several characteristics of loans that make them eligible for unlimited inclusion in TBA eligible pools. Loans with loan-to-value ratios greater than 1.05 are ineligible for inclusion in TBA pools. For 30-year TBA pools, maturities must be greater than 15 years and less than or equal to thirty years. For 15-year TBA pools, maturities must be less than or equal to 15 years. In addition, there are several characteristics mortgages must have for unlimited inclusion in TBA-deliverable pools. They include a fixed rate, a first lien on the property, level payments, be fully amortizing, a servicing fee of at least 25 basis points. The loan should not include a prepayment penalty, should not have an extended buydown provision, should not be a cooperative share loan, should not be a relocation loan, and should not have biweekly payments. Loans that violate any of these provisions can be included in TBA eligible pools only to a limited extent.

We obtain data from eMBS on characteristics of specified pools to see if it is TBA eligibility or pool characteristics that create liquidity. The data consists of summary statistics about pool characteristics rather than data on individual loans. The data includes the average FICO score, the maximum and minimum loan size, the percentage of the loans that are for owner-occupied houses, the percentage that have been refinanced, the percentage of the loans that are for single family homes, the state with the largest percentage of mortgages, and the originator that provided the most mortgages.

For our first tests of whether TBA eligibility affects trading costs, we employ a regression that makes use of the breakpoint for TBA eligibility that occurs for loan-to-value (LTV) ratios greater than 1.05. For specified pools with various ranges of LTVs, we run the following regression:

$$\Delta P_t = \alpha_0 + \alpha_1 \Delta Q_t + \alpha_2 \Delta Q_t \cdot \left[\ln\left(\frac{Size_t}{1{,}000{,}000}\right) + \ln\left(\frac{Size_{t-1}}{1{,}000{,}000}\right) \right] + \alpha_3 \Delta Q_t \cdot LTV + \alpha_4 \Delta Q_t \cdot D_{LTV>105} + \alpha_6 \Delta Q_t \cdot FICO + \Sigma \beta_i \, Ret_{i,t} + \varepsilon_t \quad (3).$$

As before, ΔP_t is the percentage change in price between two successive trades in the same specified pool, while ΔQ_t takes a value of one (negative one) if trade t-1 was a dealer purchase (sale) and trade t was a dealer sale (purchase). We include the interaction between ΔQ and the loan-to-value ratio to capture any effects that the LTV ratio has on trading costs other than helping to determine whether a pool is TBA eligible. We also include the interaction between ΔQ and the average FICO score for loans in the MBS and the fixed income index returns used previously. Our main interest is in α_4, the coefficient on the interaction between ΔQ and a dummy variable for LTVs greater than 1.05. If TBA eligibility affects trading costs we would expect this coefficient to be positive and significant.[7]

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[7] Some mortgage originators have been accused of artificially inflating property values and hence understating the true LTV ratio. See for example Superior Court of Washington for King County (2010), Federal Home Loan Bank of Seattle vs Goldman Sachs. If some LTVs are understated, any economic relation between the *true* LTV and trading costs is likely to be blurred. TBA-eligibility, on the other hand, only depends on whether the *stated* LTV is ≤ 1.05. Biases in stated LTVs will not affect tests of whether TBA eligibility, as affected by LTV ratios, influences trading costs.

The first row of Table V reports results for 30 year SPs with mean LTV ratios of 0.95 to 1.15.[8] We could use a wider range of LTV values and try to capture a nonlinear relation between trading costs and LTV values using interactions between ΔQ and a polynomial function of LTV. Instead, we restrict the range of LTV ratios to 0.95 to 1.05 because the impact of LTV ratios on trading costs may be better approximated with a linear relation over this narrow range of LTV values than over a wider range. A disadvantage of restricting the range of LTV ratios to 0.95 to 1.05 is that there are a small number of SPs with LTV ratios this high, and hence the number of observations is limited to 5,450.

In this regression, the estimated coefficient on the interaction between ΔQ and the loan-to-value ratio is -0.0290 with a t-statistic of -4.04. Higher LTV ratios mean lower trading costs. This is not surprising. Mortgages with higher LTV ratios are harder to refinance, making prepayment less common. Hence there is less risk and less uncertainty about SP values when the LTV ratio is high. Of more interest though is that the coefficient on the interaction between ΔQ and a dummy variable for a loan-to-value ratio above 1.05 is 0.4505 with a t-statistic of 3.87. Trading costs increase abruptly when the LTV ratio slips above 1.05, the highest LTV level at which SP remains eligible for TBA trading. This is what we would expect if TBA eligibility itself, not characteristics that are correlated with TBA eligibility, makes TBA eligible SPs cheaper to trade. The next row repeats the regression but extends the sample by including SPs with LTV ratios from 0.85 to 1.25. This increases the sample size to 33,838. The interaction between ΔQ and the loan-to-value ratio remains negative and statistically significant while the coefficient on the interaction between ΔQ and a dummy variable for a loan-to-value ratio above 1.05 remains positive and statistically significant. Both coefficients, however, are closer to zero than in the original regression.

To summarize, the regressions in the first two rows of Table V show that trading costs generally decline with the LTV ratio, but they increase sharply at the 1.05 breakpoint between TBA eligibility and ineligibility. This suggests that TBA eligibility itself, rather than characteristics correlated with TBA eligibility, is responsible for lower trading costs.

The next two rows of the table provide the results of "placebo" regressions. In the third regression, the range of LTVs is from 0.85 to 1.05 and a dummy variable for LTVs in excess of 0.95 is included. In the fourth regression, the range of LTVs is from 1.05 to 1.25 and there is a dummy variable for LTV ratios of 1.15 or greater. For both of these regressions, the coefficient on the interaction between

[8] We use only SPs with maturities of 15 or 30 years even though SPs with shorter maturities can be used to settle TBA trades. Our LTV measure is a snapshot taken at one time. As SPs age, the LTV can change as a result of prepayments or defaults. A small number of SPs with LTVs in our data hat are greater than 1.05 become TBA eligible as they age. There are no SPs with 15 or 30 years to maturity with LTVs greater than 1.05 that are TBA eligible.

ΔQ and the dummy variable is the wrong sign. It is the breakpoint of 1.05, above which an SP is not TBA eligible, which is important.

The next four rows of the table report results of identical regressions with 15-year SPs. In the first two rows, the coefficient on the interaction between ΔQ and the dummy variable is positive, the expected sign. There are far fewer observations for 15-year than for 30=year SPs though, so the t-statistic is only 1.51 when the range of LTV ratios is from 0.95 to 1.15, and 2.10 when the range is from 0.85 to 1.25. The last two rows of the table present the placebo regressions for the 15-year SPs. There are far fewer observations with 15-year SPs, so we would expect lower significance levels in these regressions. As with the 30-year SPs, the coefficient on the interaction between ΔQ and the dummy variable is negative, the opposite of what we find with the 1.05 breakpoint. To summarize, for the 15-year SPs, like the 30-year SPs, it appears that there is a sharp increase in trading costs when LTV ratios exceed 1.05 and the SP is not eligible for TBA trading. TBA eligibility appears to reduce trading costs.

We employ a type of propensity score matching as an additional test to see if TBA eligibility affects trading costs. In a first step, we use a logistic regression and characteristics of the specified pools to predict whether a specified pool is TBA eligible. The predictive variables include the average FICO score of the home buyers in the pool, the maximum and minimum sizes of loans in the pool, the proportion of loans that are for owner-occupied housing, the percentage of loans that have been refinanced, and the proportion of mortgages that are on single family properties. These logistic regressions are run separately for specified pools with maturities of 16 to 30 years and for specified pools with maturities of 15 years or less. Pools with 16 to 30 years to maturity may be traded as 30-year TBAs if they are eligible for TBA trading, while SPs with 15 or fewer years to maturity may be traded as 15-year TBAs if they eligible for TBA trading. Henceforth, we will refer to SPs with 16 to 30 years to maturity as 30-year SPs and SPs with 15 or fewer years to maturity as 15-year SPs.[9]

Logistic regression estimates are reported in Table VI. Panel A reports results for 30-year SPs. Coefficients on minimum and maximum loan size are negative and highly significant. Jumbo loans cannot be included in TBA-eligible SPs, so it is not surprising that TBA eligibility is strongly negatively correlated with minimum and maximum loan size. The percentage of mortgages that are for owner-occupied houses is positive and highly significant. The coefficient on the percent refinanced is positive with a z-statistic of 8.98 while the coefficient on the proportion of the mortgages that are for single family homes is negative and highly significant. The coefficient on LTV is positive and significant while the

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[9] In our regressions that exploited the discontinuity of TBA eligibility at an LTV ratio of 1.05, we used only new SPs with 15 or 30 years to maturity. The LTV ratio of new SPs is accurate at the time of the trade. As SPs season, LTV ratios can change and an SP that had an LTV ratio greater than 1.05 make become TBA eligible.

coefficient on a dummy variable for LTV greater than 1.05 is negative and highly significant.[10] These mortgage characteristics have a significant ability to predict TBA eligibility. For 30-year SPs the pseudo R^2 is 0.3809.

Results for 15-year SPs are similar. Coefficients on the minimum loan size and percent of mortgages that are for single family homes are negative and significant, while coefficients on the percent of mortgages that are for owner occupied houses and the percentage refinanced are positive and statistically significant. For 15-year SPs the coefficient on the average FICO score is positive and significant. For SPs with longer maturities, FICO score is insignificant. As with 30-year SPs, the coefficient on LTV is positive and significant, while the coefficient on the dummy variable for LTVs in excess of .05 is negative and highly significant. The logistic regression does a better job of explaining TBA eligibility for 15-year SPs than for 30-year SPs. Here the pseudo R^2 is 0.8277.

We use the probability that a specified pool is TBA eligible from the first stage to then see if TBA eligibility itself, rather than variables correlated with TBA eligibility are associated with lower trading costs. For the second stage we estimate

$$\Delta P_t = \alpha_0 + \alpha_1 \Delta Q_t + \alpha_2 \Delta Q_t \cdot (\ln Size_t + lnSize_{t-1}) + \alpha_3 \Delta Q_t \cdot TBA\ Eligible + \alpha_4 \Delta Q_t \cdot Probability\ TBA\ Eligible\ + \Sigma\beta_i\ Ret_{i,t} + \varepsilon_t. \quad (4)$$

We estimate this regression separately for different levels of probability that a specified pool is TBA eligible. We also include the interaction between ΔQ and the probability that a specified pool is TBA eligible in the regressions. Any remaining impact of TBA eligibility on trading costs is likely to reflect the impact of TBA eligibility itself, not other characteristics associated with TBA eligibility. Regressions are run separately for specified pools with probabilities of less than 10% of being TBA eligible, of 10% to 19.99% of being TBA eligible, and so forth. Results are reported in Table VII.

Panel A of Table VII reports results for SPs with 16 to 30 years to maturity. If TBA eligible, these SPs can be delivered to settle 30-year TBA trades. The number of SPs in the regression that are actually TBA eligible and ineligible are reported for each regression. As expected, the proportion of SPs that are TBA eligible increases with the probability of TBA eligibility estimated in the first stage. In each regression though, there are enough eligible and ineligible SPs to allow a meaningful estimation of the impact of TBA eligibility on trading costs. The coefficient on the interaction between ΔQ and TBA eligibility is negative for all of the regressions except for the one that includes SPs with probabilities of

[10] An LTV greater than 1.05 makes an SP ineligible for TBA trading. Our MBS characteristics are taken from a snapshot at one point in time and LTV ratios are as of that time. LTVs can change as a result of prepayments and defaults and MBS can become or cease being TBA eligible. We find that a very small number of seasoned SPs with LTVs in excess of 1.05 when our characteristics were recorded are TBA eligible at the time of a trade.

less than 0.10 of being TBA eligible. For seven of the ten regressions, the coefficient on the interaction between ΔQ and TBA eligibility is negative and significant at the 1% significance level. It appears that TBA eligibility, not just specified pool characteristics that are associated with TBA eligibility, increases liquidity. In most cases, after adjusting for the probability of TBA eligibility, actual eligibility is estimated to decrease round-trip trading costs by 60 to 80 basis points.

Panel B reports results for the regressions with 15-year SPs. We are unable to estimate the regression for SPs with a predicted probability of being TBA eligible that is between 0.60 and 0.70. There are only 33 observations in this category, and each is TBA eligible. For all of the others, the coefficient on TBA eligibility is negative. For seven of the nine probability categories, the coefficient is statistically significant. After adjusting for SP characteristics that are associated with TBA eligibility, it appears that trading costs for SPs that are actually TBA eligible are lower than for SPs that are not eligible for TBA trading.

To summarize, our regressions around the LTV threshold of 1.05 and our propensity score matching tests suggest that TBA eligibility itself, not just characteristics associated with TBA eligibility, are associated with smaller SP trading costs. TBA eligibility gives the dealer the option to sell a specified pool quickly in the more liquid TBA market. Dealers value this option enough to accept a smaller spread to trade these SPs.

VII. TBA Market Hedging and Specified Pool Liquidity

Our results suggest that TBA trading creates liquidity not only for the MBS that are traded in the TBA market, but also for SPs. In this section, we examine one way in which TBA trading can make the specified pool market more liquid: it provides a way for dealers to hedge specified pool positions. Because each specified pool is unique, it may take some time for dealers to sell them. The low trading costs in the TBA market allow dealers to hedge the inventory they intend to sell in the specified pool market cheaply. They also have the option, in most cases, to deliver the SP to close out the TBA position. In addition, hedging with TBA trades rather than, say, treasury securities, minimizes basis risk for the dealer. Prepayment risk changes with interest rates. This can be at least partly captured with a hedge from a TBA trade, but not by hedging with derivatives on treasuries.

A. *Hedging with TBA Trades*

We study dealers' use of the TBA market to hedge the risk of specified pool inventory by examining daily changes in TBA and specified pool inventory for each dealer i each day. For a given maturity-coupon combination (i.e. 30 years, 3.5%) we calculate the change in dealer i's TBA inventory each day using all of the dealer's trades with customers and with other dealers. In calculating the changes in dealer inventory, we aggregate across all issuers (e.g. Fannie Mae) and all settlement dates. For each dealer each day, we also calculate changes in inventory of specified pools with the same maturity and coupon. For each dealer i, we then regress daily changes in TBA inventory on same-day changes in TBA-eligible and TBA-ineligible SP inventory with the same coupon and maturity. That is,

$$\Delta TBA\ Inv_{i,c,t} = \alpha_{1i} + \alpha_{2i}\Delta TBAElig.Spec.Pool\ Inv_{i,c,t} + \alpha_{3i}\Delta TBAInelig.Spec.Pool\ Inv_{i,c,t} + \varepsilon_{i,t} \quad (5).$$

Here, the c subscript refers to maturity-coupon combination c and t refers to day t.

A simple way to hedge is to offset a long (short) position in specified pools by selling (buying) an equivalent amount of MBS with the same maturity and coupon in the TBA market. If a dealer follows this strategy the coefficients in the regression should equal -1. If the dealer hedges some specified pool positions but not others, we would expect the coefficients to be negative, but between negative one and zero. If a dealer hedges more TBA-eligible SP positions than TBA-ineligible SP positions, we would expect the α_2 coefficients to be closer to -1 than the α_3 coefficients.

Some maturity-coupon combinations are not traded actively throughout the sample period. For example, 30 year 5%, 5.5%, and 6% MBS were only traded in the TBA market in the early part of the sample period. By 2013, trading in these maturity-coupon combinations had virtually disappeared from the TBA market. Hence, in estimating the inventory regressions, we use only days when the dealer had a change in either TBA-eligible or TBA-ineligible specified pool inventory.

Panel A of Table VIII provides the weighted median of individual dealer regression coefficients where the coefficients are weighted by the number of observations in the dealer regression. The number of observations is the number of days when the dealer had positive or negative changes in SP inventory. Hence these weighted medians can be interpreted as the proportion of positions hedged. As an example, for 3% 30-year maturity TBA-eligible SPs, the weighted median is -0.9131, so about 91% of the SP positions taken in that maturity-coupon combination are hedged. Across maturity-coupon combinations, the weighted median coefficients for TBA eligible SP inventory range from -0.9220 to -0.1130. A coefficient of -1.0 would imply that SP trades were offset one-for-one with TBA trades. So, our results imply partial hedging.

Panel A also provides the simple median and 25^{th} and 75^{th} percentile of individual dealer regression coefficients for each maturity-coupon combination. For example, for 3% 30-year maturity TBA-eligible SP, the median coefficient is -0.7719. This implies that the median dealer hedged 77.19% of his TBA-eligible SP inventory with TBA trades. For this maturity-coupon combination, and in general, the simple median is less than the weighted median. This suggests that more active dealers, who contribute more observations to the weighted median, are more inclined to offset SP trades with TBA trades. The 75th percentile of dealer coefficients is negative for all maturity-coupon combinations of TBA-eligible SP inventory changes, implying that more than 75% of dealer coefficients are negative regardless of maturity or coupon. The great majority of dealers seem to hedge at least some of their positions in TBA-eligible specified pools. Median coefficients are typically closer to -1 for more actively traded maturity-coupon combinations. Dealers are more likely to hedge a position when the SP has an actively traded TBA counterpart.

Another way to look at dealers' use of TBA trades to offset SP trades is that the dealers are selling forward the MBS that they have purchased in the SP market. That is, rather than maintaining an offsetting TBA position, they intend to deliver the SPs to settle their TBA trades but also have an option to deliver other MBS. It is not clear that there is a useful distinction between hedging and selling their SP positions in the forward market. TBA-ineligible SPs, however, cannot be delivered to fulfill a TBA trade. For TBA ineligible SP positions, offsetting TBA trades would instead be hedges that the dealer would expect to maintain until the SP was sold.

The last five columns of the table report the weighted-median, the median, and the 25th and 75th percentile of individual dealer regression coefficients for each maturity-coupon combination for TBA ineligible SPs along with the number of dealers for which the coefficients can be estimated. Weighted median and median coefficients are negative for TBA-ineligible SPs, suggesting that dealers hedge TBA-ineligible SPs. They are not selling them forward as they cannot deliver them to settle the TBA trades. As a rule, both weighted median and median coefficients are closer to -1 for TBA eligible trades than for TBA ineligible trades. This suggests that the median dealer is less inclined to hedge TBA-ineligible SP inventory than TBA-eligible SP inventory. Or, alternatively, that some dealers with TBA eligible positions expect to deliver the SPs to settle the TBA trade rather than looking at the TBA trade as one to be reversed when the SP position is closed.

We have not reported mean coefficients across dealers because there are large differences in the number of observations in each individual dealer regression and large differences across dealers in the standard errors of the regression coefficients. So, in calculating mean coefficients, we use a Bayesian framework employed by Panayides (2007), and Bessembinder et al (2009). It assumes that the estimated α coefficient for each dealer i is distributed

$$\tilde{\alpha}_i | \, \alpha_i \sim i.i.d. N\left(\alpha_i,\, s_i^2\right)$$

And

$$\alpha_i \sim i.i.d. N\ (\alpha, \sigma^2)$$

The average α estimate across N dealers is given by

$$\tilde{\alpha} = \frac{\sum_{i=1}^{N} \frac{\tilde{\alpha}_i}{\left(s_i^2 + \tilde{\sigma}_{m.l.e.}^2\right)}}{\sum_{i=1}^{N} \frac{1}{\left(s_i^2 + \tilde{\sigma}_{m.l.e.}^2\right)}} \quad (6)$$

With independence across dealers, the variance of the aggregate estimate is

$$Var\,(\widetilde{\alpha}) = \frac{1}{\sum_{i=1}^{N} \frac{1}{\left(s_i^2 + \tilde{\sigma}_{m.l.e.}^2\right)}} \quad (7)$$

So, we run regression (5) to get estimates of α_{2i} and α_{3i} for each dealer i. These regressions also produce sample variances s_{i2}^2 and s_{i3}^2 for each dealer i. We then use maximum likelihood to jointly estimate the mean coefficient α_2 its variance and $\sigma_{2,m.l.e.}^2$, and separately, the mean coefficient α_3 its variance and $\sigma_{3,m.l.e.}^2$.

Panel B of Table VIII summarizes the distribution of α regression coefficients, that is the coefficients on the change in specified pool inventory, across individual dealer regressions for different maturity-coupon combinations. We include a dealer in the summary statistics if we are able to calculate a standard error for the α coefficient.

The 30-year specified pools with yields of 5.0%, 5.5% and 6.0% trade relatively infrequently. Mean coefficients on TBA-eligible SP inventory range from -0.2594 to -0.1314 for these maturity coupon combinations. They are not significantly different from zero. The mean coefficients for the other maturity-coupon combinations are closer to -1 and are significantly different from zero. On average, for the actively traded TBA-eligible SPs, dealers hedge most of their SP inventory with TBA trades, and the coefficients are significantly less than zero.

Mean coefficients on TBA-ineligible SP inventory changes and their t-statistics are reported in the next two columns. These coefficients are almost all closer to zero than the corresponding coefficients for TBA-eligible SP inventory changes. Dealers hedge a larger proportion of TBA-eligible inventory than TBA-ineligible inventory. Coefficients are all negative though, and most are significantly less than zero. Dealers do hedge a proportion of their positions in TBA-ineligible SPs.

B. *Hedging with TBA Trades Versus Hedging with Derivatives Tied to Treasuries*

Our evidence suggests that dealers hedge SP positions with offsetting TBA trades. Dealers could, alternatively, hedge using derivatives on treasury securities. Agency mortgage backed securities, like treasuries, are default free securities with prices that vary inversely with interest rates. For MBS though, changes in interest rates affect the likelihood of prepayment as well as the present value of future cash flows. This implies that hedging with TBA trades should mean lower basis risk as the value of TBA positions, like the value of SPs, is affected by changes in the likelihood of prepayment.

To examine the effectiveness of hedging, we estimate returns on dealer positions and see how well these returns can be replicated by returns from TBA or treasury trading. We estimate returns on dealer positions by identifying cases where dealers bought and sold the exact same par value of the same specified pool. We include only purchases from and sales to customers. We miss cases where a dealer split the position into multiple transactions, or cases where an SP position was liquidated by delivering it to fulfill a TBA trade. We omit positions that were opened and closed on the same day. Nevertheless, we have identified over 100,000 round trip positions and can use these to compare the effectiveness of TBA hedging versus hedging with treasuries.

We categorize SP positions on three dimensions: the maturity of the SPs (≤ 15 years versus 16-30 years), whether they are TBA eligible or ineligible, and whether the position was held for one to five days, six to 20 days, 21 – 60 days, or more than 60 days. For each group of SP positions, we run the following cross-sectional regression:

$$\Delta P_i = \quad \alpha_0 + \alpha_1 \Delta Q_i + \alpha_2 \Delta Q_i \cdot \ln\left(\frac{Size_i}{1{,}000{,}000}\right) + \beta_i \, Ret_{i,j}^{Hedge} \quad + \varepsilon_i \ (8)$$

where ΔP_i is the percentage price change in the specified pool position i, ΔQ_i takes a value of one if i was a long position and negative one if it was a short position. We include these variables to adjust for trading costs in the return regression to enable a more accurate reading of how well the hedges could work. The regressions are run separately for hedges with TBA positions and hedges with treasuries. To obtain the TBA hedge return, we first find the last interdealer TBA trade each day with the same coupon and maturity as the SP. If there are TBA trades with multiple settlement dates, we choose the earliest settlement date. The TBA return over the life of the hedge is the ratio of the TBA price on the day the position is established to the TBA price on the day the position was closed. Hedge returns for treasuries are the total returns of a CRSP treasury index over the life of the positon. We use the CRSP five, seven, and ten year treasury indices.

Results are reported in Table IX. To compare how well different hedges work, we compare the adjusted R^2's across the otherwise identical regressions. A higher R^2 indicates that the hedging variable explains a larger portion of the SP return and therefore provides a hedge with less basis risk. We also report coefficients and t-statistics for the hedging variables.

Panel A reports the results for SPs with 16 to 30 years to maturity. If they are TBA eligible, SPs with these maturities can be delivered to settle TBA trades. There are 15,833 30-year TBA-eligible SP positions that are held for one to five days. With no hedge variable in the regression, the adjusted R^2 is 0.1710. This is the proportion of position returns that can be explained by transaction costs. When the TBA hedge is included the coefficient on the hedge return is positive and a significant 3.56, but the adjusted R^2 increases only slightly to 0.1716. For this short time period, adjusted R^2 are slightly higher for five and seven year treasuries at 01717, and slightly lower for ten tear treasuries at 0.1714. For this short holding period, none of the potential hedges explain much of the SP returns.

The next three rows of Panel A look at SP positions of 30-year TBA eligible SPs that were held for 6-20 days, 21-60 days, and more than 60 days. As we move to longer and longer holding periods, going from no hedge to a TBA hedge means a larger and larger increase in the adjusted R^2. When positions held more than 60 days are considered, the adjusted R^2 goes from 0.0423 to 0.2815. This is much higher than the adjusted R^2 from five, seven, or ten year treasuries. Hence a hedge with an offsetting TBA trade can reduce uncertainty far more than a hedge with treasuries. Notice also that as we go toward longer holding periods, the coefficient on the TBA return approaches one, indicating that returns on a TBA position get closer to offsetting returns on the SP position one-for-one. That is not true for the coefficients on treasury returns.

The next four rows of Panel A report results for positions of TBA-ineligible SPs. Note that positions without hedges have much higher R^2's than comparable TBA-eligible positions without hedges. This is because trading costs explain a larger proportion of returns for TBA-ineligible positions than for TBA-eligible positions. Notice also that for TBA-ineligible SPs, the increase in adjusted R^2's is much smaller when the return on the TBA hedge is included in the regression. So, for example, when the holding period is 21-60 days, the adjusted R^2 increases from 0.1420 to 0.2126, or 0.0706 when the TBA returns are added to the TBA-eligible regression, but only from 0.4354 to 0.4840, or 0.0486 when the TBA returns are added to the TBA-ineligible regression. Finally, notice that for TBA ineligible securities R^2s when treasuries are the hedging variable are similar to R^2s for the TBA hedge. The advantages of hedging with TBA trades appear to be smaller for TBA-ineligible SPs than for TBA-eligible SPs.

Panel B of Table IX reports analogous regressions for TBA-eligible and ineligible SPs with 15 years or less to maturity. The patterns displayed for longer maturity SPs in Panel A also appear here. For TBA eligible SPs, adjusted R^2s are greater when TBA returns are included in the regression than when five, seven, or ten-year treasuries are included. Hence hedging with TBA trades can be more effective than hedging with treasuries. Also, as in Panel A, increases in adjusted R^2s from hedging are greater for longer holding periods. Finally, the results in Panel B indicate that hedging is likely to be less effective for TBA-ineligible SP than for TBA-eligible SPs. Adjusted R^2s do not increase much by including returns of TBA positions or treasuries in the regressions.

C. Does Issuer Matter for Hedging?

Up to this point, we have assumed that dealers did not differentiate between issuer (Fannie Mae, Freddie Mac, or Ginnie Mae) in their hedging. That is, we assume that all specified pool inventories are pooled together for hedging purposes, and dealers do not match TBA issuers to specified pool issuers when hedging. This could occur if TBA trades with different MBS issuers are good substitutes. There are, however, a couple of reasons why TBA trades with different issuers may be poor substitutes. First, if the dealer is selling the SP forward rather than taking a temporary offsetting position, the SP and TBA issuer must be the same. Second, there are differences in prepayment characteristics across issuers, with Ginnie Mae pools thought to be particularly desirable.

To examine this issue, we calculate daily inventory changes for specified pools from each issuer for every dealer every day. We then run two separate regressions for each dealer-coupon-maturity- issuer combination. In the first, we regress the change in the dealer's TBA inventory from each issuer on the change in the dealer's specified pool inventory from the same issuer. That is,

$$\Delta\, IssuerTBA\ \ Inv_{i,t} = \alpha_1 + \alpha_2 \Delta IssuerSpec.Pool\ Inv_{i,t} + \varepsilon_{i,t} \quad (9).$$

If dealers hedge specified pool inventory fully with TBA trades from the same issuer, we would expect the α_2 coefficient in the above regression to equal -1. If they hedge only a portion of their specified pool inventory with TBA trades in MBS from the same issuer, we would expect the coefficient to be between -1 and 0.

In the second regression we regress the change in TBA inventory from all issuers on the change in specified pool inventory from a specific issuer. That is,

$$\Delta\, AllTBA\ \ Inv_{i,t} = \alpha_1 + \alpha_2 \Delta IssuerSpec.Pool\ Inv_{i,t} + \varepsilon_{i,t} \quad (10).$$

If dealers hedge specified pools using TBAs from all issuers, we would expect the coefficient on changes in specified pool inventory to be closer to -1 when changes in TBA inventory from all issuers is the dependent variable.

These regressions are run separately for each dealer. The median coefficients and median t-statistics on the coefficients across the dealer regressions are reported in Table X. As before, we weight each coefficient and t-statistic by the number of observations in the dealer regression to obtain the medians.

The first 12 regressions correspond to specified pools issued by Fannie Mae. The number of individual dealer regressions varies from 22 to 68 across the different maturity-coupon combinations. Median coefficients when Fannie Mae TBA inventory change is the dependent variable are close to zero for some maturity-coupon combinations, and close to negative one for others. For example, when the same issuer TBA change is the dependent variable, the coefficient on changes in inventory of 30 year

3.0% Fannie Mae Specified Pools is -0.0348. This can be interpreted to mean that when the median dealer acquires a position in a Fannie Mae 30-year 3% specified pool, he hedges 3.48% of that position with an offsetting Fannie Mae TBA trade. When the dependent variable is the change in all-issuer TBA inventory, the coefficient is -1.0812. So, the median dealer hedges his entire Fannie Mae 30-year 3% inventory in the TBA market, but hedges very little of it with Fannie Mae 30-year 3% TBA trades. On the other hand, when the dependent variable is changes in 30-year 4.5% Fannie Mae MBS, the median coefficient for specified pool inventory is -0.8973 for. The median dealer hedges almost all Fannie Mae 30-year 4.5% specified pool inventory with 30-year 4.5% TBA trades of Fannie Mae. To summarize, the results for Fannie Mae specified pool inventory suggest that dealers hedge most of their Fannie Mae specified pools with Fannie Mae TBA trades for some maturity-coupon combinations but not all.

Results are similar for specified pools issued by Freddie Mac or Ginnie Mae. The coefficient for Freddie Mac 30-year 4.5% inventory changes is -0.1651 when changes in Freddie Mac TBA inventory is the dependent variable, suggesting that about 16.5% of the changes in Freddie Mac 30-year 4.5% specified pool inventory are hedged with Freddie Mac TBA trades. The coefficient on changes in Freddie Mac 30-year 4.5% inventory is -0.9901 when changes in all TBA inventory is the dependent variable. So, the median dealer seems to hedge all of his 30-year, 4.5% Freddie Mac specified pool inventory with TBA trades, but only 16.5% with Freddie Mac TBA trades. In general, regardless of the issuer, specified pool positions are hedged with TBA trades. In a few cases, they are hedged primarily by trades of securities from the same issuer in the TBA market, in other cases they are hedged in the TBA market, but not by trading securities from the same issuer.

One way to interpret these results is that dealers hedge by trading a maturity-coupon combination from one issuer in the TBA market regardless of the specified pool issuer. For example, 15-year 2.5% and 15-year 3.0% specified pool trades appear to be hedged by TBA trades in Freddie Mac securities, regardless of the specified pool issuer. This could occur if some maturity-coupon combinations are actively traded in the TBA market for some, but not all issuers.

As a whole, the results of Table X suggest that dealers hedge specified pool inventory with TBA trades, but do not feel the need to match specified pool and TBA issuers. This suggests that dealers in general do not expect to deliver SPs to settle their TBA trades. Offsetting TBA trades are instead temporary offsetting positions for SPs. It also indicates that dealers view TBA trades with different issuers to be good substitutes for hedging purposes.

D. Hedging and Inventory Volatility

Dealers who hedge are exposed to less risk from price fluctuations and should therefore be willing to hold more inventory. To test this, we estimate the following regression,

$$\left|\Delta Inv_{d,t}\right| = \alpha_0 + \alpha_1 DistHedge_d + \alpha_2 DtoDTrades_{d,t} + \alpha_3 DtoCTrades_{d,t} + \varepsilon_{d,t} \quad (11)$$

where $\Delta Inv_{d,t}$ is the change in inventory for dealer d on day t, $DistHedge_d$ is the absolute value of the difference between the coefficient of the dealers TBA inventory change on SP inventory change and -1 (a complete hedge), $DtoDTrades_{d,t}$ is the number of dealer to dealer trades executed by dealer d on day t and $DtoCTrades_{d,t}$ is the number of dealer to customer trades executed by dealer d on day t.

If hedging affects dealers' willingness or ability to hold inventory, we would expect changes in inventory to be negatively related to the distance to a complete hedge. Dealers who hedge all their SP inventory and have a coefficient of -1 should be willing to hold more inventory than those who hedge a smaller amount. We also include variables for the number of times a dealer trades. We control for trading activity so that a negative coefficient on distance to hedge does not merely reflect inactive dealers who take in very little inventory and are also inactive in hedging.

Results are shown in Table XI. Panel A shows results when the regressions control for TBA trades and Panel B shows results when the regressions control for SP trades. Separate regressions are shown for changes in inventory of 30-year TBA-eligible SPs, 30-year TBA-ineligible SPs, 15-year TBA-eligible SPs, and 15 year TBA-ineligible SPs. Date fixed effects are used in each regression and standard errors are clustered on dealers.

Coefficients on the number of trade variables in the regressions are almost always positive, and most are statistically significant. A dealer who trades a lot is likely to have larger changes in SP inventory than one who trades little. More important though is that the coefficients on the distance to complete hedging are negative in all eight of the regressions, and statistically significant in seven of them. The less a dealer hedges, the smaller are the changes in his SP inventory. Without hedging, dealers are reluctant to take large positions in SPs.

F. Prearranged Trades as a Way of Reducing Risk When Dealers Can't Hedge

If a dealer is unwilling to take the risk of holding inventory, he can act as a broker and find a buyer for specified pools that a customer wants to sell rather than take the securities into inventory before finding a buyer. These brokered trades should play an especially important role for specified pools that cannot be easily hedged with TBA trades. To examine this, we look at all purchases of all specified pools – regardless of coupon or maturity - by dealers from customers. We then see if the dealer who purchased the specified pool sold the same par value of the same specified pool within five minutes. We define purchases that were sold within five minutes as brokered or prearranged trades.[11]

We separate these prearranged trades into those in which the dealer sold to another dealer and those in which the dealer sold to a customer. We view these as very different transactions. When a dealer sells to a customer in a prearranged trade, the dealer takes no inventory risk. We hypothesize that brokered trades should be especially common for specified pools that are difficult to hedge with TBA sales. On the other hand, when a dealer purchases from a customer and immediately resells to another dealer, the second dealer almost always takes the specified pool into inventory and assumes inventory risk. We find that it is unusual for the second dealers to have a prearranged trade with a customer. A dealer sale to another dealer may occur because the second dealer specializes in a particular type of specified pool. It is possible that some of the cases in which a dealer sells to another dealer within five minutes are not actually prearranged, but reflect dealers' knowledge of the positions and interests of other dealers.[12]

Panel A of Table XII describes the proportion of trades of various types of specified pools that are prearranged with other dealers and with customers. In total, we have 699,263 purchases of specified pools by dealers from investors. Of these, 3.99% represent trades that are prearranged with customers and 29.28% are trades that are prearranged with other dealers. When we subtract out the trades that are prearranged with other dealers, we are left with 494,513 trades that dealers elected to handle themselves. Of these, 5.65% were prearranged, and dealers took the other 94.35% into inventory.

The next two rows of the table report the proportion of prearranged trades that are larger than the median size and the proportion that are smaller than the median size. Almost half of the small trades are prearranged with another dealer, but less than 9% of the large trades are immediately resold to another dealer. When we look at the trades that dealers handled themselves, we find that 7.73% of the trades that are smaller than the median are prearranged with customers, but only 4.49% of the large trades. Trades that are prearranged with customers tend to be small, but the difference between the proportions of small and large trades that are prearranged is not as dramatic as it is for trades that are prearranged with other dealers.

The next two rows show the proportion of prearranged trades for TBA eligible and TBA ineligible specified pools. TBA ineligible pools are more difficult to hedge than the eligible pools, so we

[11] The choice of five minutes is arbitrary. We tried to pick a time interval that would allow dealers enough time to get back to the other leg of a prearranged trade and execute it, but not so long as to include trades that are not prearranged. When we use two minutes instead of five, the proportion of trades that are prearranged with customers falls from 3.99% to 3.21%. Other results are qualitatively the same.

[12] Zitzewitz (2010) finds that 46% of dealer trades of corporate bonds with customers are followed by the opposite transaction with another dealer within 60 seconds if the trade size is less than $100,000. Only 4.5 of customer trades of over $500,000 are matched with the opposite transaction with another dealer within 60 seconds.

might expect dealers to be especially likely to prearrange trades for ineligible specified pools. This is indeed true for trades that are prearranged with customers. Looking just at the trades that dealers chose to handle themselves, we see that dealers prearrange trades with customers for 5.08% of the TBA eligible specified pools and 13.41% of the TBA ineligible pools. Trades of specified pools that are difficult to hedge are more likely to be prearranged.

Here, the contrast between trades that are prearranged with customers and trades that are prearranged with other dealers is striking. TBA eligible specified pools trades are much more likely to be prearranged with other dealers than TBA ineligible trades. This is the opposite of what we observe for prearranged trades with customers. One possible reason why prearranged trades of TBA ineligible specified pools with other dealers are less common than prearranged interdealer trades of TBA eligible pools is that other dealers can't hedge the TBA ineligible trades either, and are therefore reluctant to take them into inventory.

Finally, in the last two rows of Panel A we compare the proportion of prearranged trades of specified pools with coupons that match TBA coupons with the proportion of prearranged trades for specified pools that do not match TBA coupons. If the specified pool had a coupon yield that ended in an even percent or half percent and was in the range from 2.5% to 6% we define it as having a matching yield among TBA trades. Specified pools with coupons that ended in a quarter or three-quarter percent, like 3.25%, or with coupons greater than 6% are among those that do not match TBA coupons. Because prepayment is a complicated non-linear function of yields, it is difficult to hedge specified pools with TBA trades with different yields.

Because they are more difficult to hedge, we expect that specified pools with coupons that do not match TBA coupons are more likely to be purchased by dealers in combination with a prearranged trade to a customer than are specified pools with coupons that do match TBA coupons. When we omit prearranged interdealer trades and look only at the trades that dealers chose to handle themselves, we see that 13.36% of specified pool trades are prearranged with customers if the specified pool has a coupon that does not match TBA coupons. For the specified pools with coupons that do match TBA coupons, the proportion that is prearranged is only 4.17%. In this case, the difference between prearranged trades with dealers and prearranged trades with customers is, again, striking. Of the trades of specified pools with yields that match TBA coupons, 29.79% are prearranged with other dealers. For trades of specified pools with yields that do not match TBA coupons, only 26.47% are prearranged with other dealers. Prearranged trades with other dealers are again less common if the specified pool is difficult to hedge.

In Panel B of Table XII, we report regressions that test more formally how specified pool characteristics influence the decision to prearrange a trade with another dealer. In all regressions in this panel, the dependent variable takes the value of one when a trade is prearranged with another dealer. In each regression we cluster standard errors by dealer. In the first regression, the explanatory variables are a dummy variable that equals one when coupon of the specified pool matches a coupon rate used for TBA trades, the TBA market share of the dealer who originally bought the MBS from a customer, a dummy variable that equals one if the specified pool is TBA eligible, and the natural log of the size of the trade. The coefficient on the yield match dummy variable is 0.0824 with a t-statistic of 2.87. If the specified pool has a coupon rate that is used for TBA trades, it is easier to hedge and is more likely to be sold to another dealer in a prearranged trade. The coefficient on the dealer TBA share is -3.4089, with a t-statistic of -3.75. Dealers with larger TBA market shares are much less likely to prearrange trades with other dealers. The coefficient on TBA eligibility is 0.0394, with a t-statistic of 1.00. The coefficient on the natural logarithm of the trade size is -0.0581 and is highly significant. Larger trades are less likely to be sold to a dealer in a prearranged trade.

In the next regression, we drop dealers' TBA market share. The coefficient on log trade size remains negative and highly significant, while the yield match dummy and TBA eligible dummy remain insignificant. The third regression is the same as the second, but includes dealer fixed effects. The R^2 in the regression leaps from 0.2496 to 0.7336. There are a number of dealers who handle a small number of trades and prearrange all or none of them with other dealers. The coefficient on the yield match dummy is 0.038 with a t-statistic of 2.38. This, again, is evidence that dealers are more likely to prearrange trades with other dealers for specified pools that are easy to hedge. The regression on log trade size remains negative and significant.

The next two report logistic regressions that are analogous to the OLS regressions. Here, z-statistics are reported in parentheses under the coefficients, and odd ratios in brackets under the z-statistics. As with the OLS regressions, when dealer TBA market share is included, its coefficient is negative and highly significant. When dealer TBA share is included in the logistics regression, the coefficient on the dummy for a coupon is equal to a TBA coupon is positive and significant. Trade size is also negative and highly significant, indicating that dealers are less likely to prearrange large trades with other dealers.

To summarize, large specified pool trades are less likely to be prearranged with other dealers, as are trades by dealers who have a large TBA market share. Specified pools with coupons that equal TBA coupons are more likely to be prearranged with other dealers. Hence there is some evidence that trades that are easy to hedge are prearranged with other dealers, but it is weak.

Panel C reports similar regressions, but now the dependent variable is a dummy variable that equals one if the trade is prearranged with a customer. In each regression, we use only trades that were not prearranged with another dealer. The decision to prearrange a trade with a customer differs from the decision to prearrange a trade with another dealer in important ways, so the results here are very different from those of Panel B.

The first three regressions are OLS regressions and the last two are logistic regressions. Each has standard errors clustered by dealer. In all of the regressions, the coefficient on the dummy variable for a coupon that equals a TBA coupon is negative and significant. Specified pools with coupons that are the same as TBA coupons are easier to hedge, and are less likely to be passed on to customers in a prearranged trade. In each of the regressions, the coefficient on the dummy variable for TBA eligibility is negative and significant. Specified pools that are TBA eligible are easier to hedge, are more likely to be brought into the dealer's inventory, and are less likely to be sold to customers in a prearranged trade. Trade size, which is an important variable in determining whether a trade is prearranged with another dealer, is insignificant in all of the regressions.

The results in Panel C suggest that dealers are more likely to take a specified pool into inventory if it can be hedged with a TBA trade. If it cannot be hedged, the investor who owns the specified pool may have to bear risk himself until the dealer can find a buyer. This suggests a benefit to TBA trading that is not captured by trading costs. If similar MBS trade in the TBA market, an investor doesn't need to hold an unwanted specified pool while a dealer searches for a buyer.

While these results are suggestive, we need to be cautious about concluding that it is ease of hedging that determines whether a dealer will take a specified pool into inventory. We have shown that specified pools that are most similar to MBS traded in the TBA market are less likely to be purchased in conjunction with a prearranged sale. We have also shown that these same specified pools are more likely to be hedged. Our results in Table VIII indicate that hedging is very important to dealers, and hence it is reasonable to conclude that inability to hedge makes it more likely that dealers will prearrange trades.

Our findings indicate that dealers hedge SP positions with TBA trades, and are reluctant to hold inventory that they cannot hedge. We do not, however, mean to imply that the only reason TBA trading improves SP liquidity is that it provides a superior hedging option. We can posit other ways in which TBA trading could contribute to specified pool liquidity. It could, for instance, provide benchmark prices for specified pools[13]. MBS trade frequently in the TBA market with low trading costs and minimal price impact. Less frequently traded specified pools can be priced off of the TBA trades. We hope to explore this in future work.

[13] Duffie, Dworczak, and Zhu (2014) analyze the use of benchmarks in over-the-counter markets. They demonstrate that benchmarks can lower search costs, increase trading volume, and generate more efficient trade matching between dealers and investors.

VIII. Conclusions

The secondary market for agency mortgage backed securities is among the largest and most liquid securities markets in the world. In a way, this is surprising because each of the tens of thousands of MBS is a claim on the cash flows of a different set of mortgages, and is therefore unique. An important reason for the liquidity of this market is the existence of TBA trading, in which different MBS are traded in a forward market on a cheapest-to-deliver basis. TBA trading takes thousands of thinly-traded MBS and combines them into a few thickly traded forward contracts.

We present evidence that the existence of parallel trading in the TBA market also increases liquidity for the MBS that are traded individually in the specified pool (SP) market. For a given issuer and maturity, all TBA trades settle on the same day of the month. Most traders do not want to take delivery or deliver on the TBA trades they have made, and so will reverse their positions in the few days just before the settlement date. This leads to high TBA volume, particularly from dollar rolls, just prior to the settlement date. This high volume is easily predicted well in advance of the actual trading. SPs can settle any day of the month. Nevertheless, trading costs for SPs decrease significantly on days of predictable high TBA volume. Exogenous increases in TBA trading volume lowers SP trading costs.

We also provide evidence that TBA eligibility makes SPs more liquid. SPs can be ineligible for TBA trading if they contain jumbo loans, are not fully amortizing, include a prepayment penalty or have LTV ratios above 1.05. Nevertheless, we present evidence that it is TBA eligibility itself, not SP characteristics, that lead to greater SP liquidity. We show that trading costs in general decrease with LTV ratios, but increase abruptly when the 1.05 threshold is crossed. In addition, we use characteristics of the SPs to predict the likelihood that the SP is TBA eligible. After adjusting for the estimated probability that the SP is TBA eligible, actual eligibility decreases trading costs significantly.

One way in which TBA trading can increase the liquidity of the SP market is by providing a way for dealers to hedge their SP inventory positions. Consistent with this, we find that when we regress dealers' daily changes in TBA inventory on the same day changes in SP inventory are consistently negative and usually between -0.5 and -1.0. Dealers offset most of their positions in SPs with TBA trades. Coefficients are smaller for TBA ineligible SPs, indicating that a smaller proportion of these trades are hedged. We also find that dealers do not seem to care whether they offset SP trades with same-issuer TBA trades or other issuer TBA trades. This suggests that in most cases dealers are not expecting to deliver the SPs to settle the offsetting TBA trades.

In some cases, dealers act as brokers and find a purchaser for an SP before buying it from a customer. This appears in the data as dealer purchases followed by offsetting sales within five minutes. We find that prearranged or brokered trades are most common for the SPs that are least likely to be hedged with TBA trades – that is TBA ineligible SPs, or SPs with coupons that are unmatched by TBA coupons.

There are a number of other fixed income securities that trade in relatively illiquid over-the-counter markets. Parallel trading in the securities themselves and a forward contract on a generic security may increase the liquidity of those markets. Specific municipal bonds, for example, could trade in parallel with forward contracts on, say, 30-year, AA-rated, general obligation New York municipals. Our results suggest that a forward contract of this type could lower trading costs for the municipal bonds themselves by allowing dealers to hedge inventory. A forward contract on municipal bonds could also lower the risk to underwriters by allowing them to hedge while selling a bond issue. The unique structure of parallel trading in SPs and the forward TBA market looks like it could enhance liquidity in other markets as well.

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Table I

Summary Statistics for MBS Trading in the TBA and Specified Pool Markets

The sample consists of all secondary market MBS trades from May 16, 2011 – April, 2013. Volume is in $1,000,000's of face value.

Panel A: Total Trading by Trade Type

	Number Sells	Volume Sells	Number Buys	Volume Buys	Number Interdealer	Volume Interdealer
	TBA Trades					
Outright Trades	342,350	13,794,567	494,661	13,568,672	1,531,919	25,807,536
Dollar Rolls	139,134	16,415,923	147,964	17,020,740	544,153	32,525,031
Stipulated Trades	34,460	1,001,036	39,936	1,125,391	14,624	170,244
Stip. Dollar Rolls	8,456	429,988	17,665	1,026,649	1,711	28,310
Total TBA trading	533,664	32,238,176	691,017	32,144,801	2,092,407	58,531,121
	Specified Pool Trades					
TBA Eligible	291,404	2,459,120	657,974	3,822,160	472,574	1,394,371
Non-Eligible	75,787	394,383	74,512	476,542	89,625	474,355
Total Specified Pool	367,191	2,853,503	732,486	4,298,702	562,199	1,868,726

Panel B: Trade Sizes by Trade Type

	Interdealer Trades			Trades with Customers		
	Number	Avg. Trade Size ($millions)	Percent > $10 million	Number	Avg. Trade Size ($millions)	Percent > $10 million
Specified Pools	562,067	$3.32	6.7%	1,099,260	$6.49	10.7%
TBA Outright	1,531,919	$16.71	37.1%	837,011	$32.64	37.2%
TBA Dollar Roll	544,153	$59.64	60.8%	287,158	$116.43	68.1%
TBA Stipulated	14,624	$11.64	12.0%	74,396	$28.58	36.4%
TBA Stip. Rolls	1,711	$16.55	32.0%	26,121	$55.77	66.1%

Panel C: Dealer Activity Levels and Trade Type

Dealer Ranking by Number of Trades	Percentage of Trades that are Specified Pools	Percentage of Volume from Specified Pools	Percentage of Trades that are Interdealer	Percentage of All Trades	Percentage of All Volume
1-10	23.83%	13.55%	56.37%	54.9%	64.6%
11-30	42.86%	26.16%	55.09%	27.3%	29.3%
31-50	56.44%	42.08%	53.73%	8.9%	4.2%
51-100	75.35%	63.29%	51.37%	6.5%	1.5%
101-758	91.36%	87.82%	44.73%	2.3%	0.4%

Table II

Estimates of Trading Costs from Regressions of Price Changes on Changes in Trade Type and Other Variables

We regress percentage changes in price between two consecutive trades of the same MBS on the change in trade type (ΔQ), on the interaction between ΔQ and the sum of the natural logs of the trade sizes of the two consecutive trades, on the interaction between ΔQ and a dummy variable for TBA eligible specified pools, on the interaction between ΔQ, trade size and TBA eligibility, on the interaction between ΔQ and the number of MBS with the same coupon and maturity created in the previous month, on the interaction between ΔQ and the outstanding balance of MBS with the same coupon and maturity created in the previous month, and on changes in the 1) a U.S. Agency Fixed Rate MBS index, 2) a U.S. Treasury 7-10 year Bond index, 3) a U.S. Investment Grade Corporate Bond Index, 4) a U.S. Corporate High-Yield Bond Index, and 5) the S&P 500 index:

$$\Delta P_t = \alpha_0 + \alpha_1 \Delta Q_t + \alpha_2 \Delta Q_t \cdot (\ln Size_t + lnSize_{t-1}) + \alpha_3 \Delta Q_t \cdot TBA\ Eligible + \alpha_4 \Delta Q_t \cdot TBA\ Eligible \cdot (\ln Size_t + lnSize_{t-1})$$
$$+\alpha_5 \Delta Q_t \cdot 30\ (15) YearMat + \alpha_6 \Delta Q_t\ 30\ (15) YearMat \cdot (\ln Size_t + lnSize_{t-1}) + \alpha_7 \Delta Q_t \cdot \text{MBS Production} + \alpha_8 \Delta Q_t \cdot$$
$$\text{MBS Balance} + \Sigma \beta_i\ Ret_{i,t} + \varepsilon_t. \quad (1)$$

ΔQ is positive one when the current trade is a dealer sale and the previous trade was a dealer purchase. It is negative one when the current trade is a dealer purchase and the previous trade was a dealer sale. Consecutive trades are always of the same MBS, but trades from all MBS with the same coupon and maturity are included in the regressions. Trades of less than $10,000 face value are deleted. Robust t-statistics are in parentheses.

Panel A: TBA Trades

Maturity	ΔQ	ΔQ x Trade Size	ΔQ x Gross Production	ΔQ x Balance	Return Variables	Obs.	R^2
30 Years	0.0357	-0.0056			Yes	651,234	0.0473
	(25.47)	(-23.33)					
30 Years	0.0357	-0.0055	-0.0009		Yes	650,643	0.0477
	(24.30)	(-23.18)	(-2.44)				
30 Years	0.3692	-0.0055		-0.0202	Yes	650,643	0.0503
	(30.25)	(-23.02)		(-24.15)			
30 Years	0.0377	-0.0055	0.0003	-0.0199	Yes	650,643	0.0504
	(25.55)	(-22.97)	(0.82)	(-23.71)			
15 Years	0.0313	-0.0052			Yes	144,531	0.0991
	(11.29)	(-10.75)					
15 Years	0.0316	-0.0054	0.0054		Yes	144,531	0.0994
	(11.39)	(-10.93)	(4.59)				
15 Years	0.0191	-0.0054		-0.0099	Yes	144,531	0.0996
	(5.14)	(-11.36)		(-7.37)			
15 Years	0.0140	-0.0058	0.0089	-0.0145	Yes	144,531	0.1003
	(3.59)	(-11.91)	(6.55)	(-8.99)			

Panel B: Specified Pools										
Maturity	1	Trade Size	TBA Eligible	TBA Elg x Size	30/15 Year Maturity	Gross Production	Balance	Return Variables	Obs.	R^2
30 Years	0.6324	-0.0548	-0.3957					Yes	134,119	0.4594
	(46.05)	(-51.23)	(-28.53)							
30 Years	0.7877	-0.1351	-0.5672	0.0890				Yes	134,119	0.4637
	(47.51)	(-34.30)	(-32.71)	(21.77)						
30 Years	0.7864	-0.1345	-0.5608	0.0891		-0.0099		Yes	133,426	0.4639
	(45.90)	(-33.36)	(-30.95)	(21.45)		(-4.03)				
30 Years	0.7620	-0.1323	-0.5297	0.0859			-0.0198	Yes	134,119	0.4637
	(41.57)	(-32.47)	(-26.49)	(20.29)			(-6.92)			
30 Years	0.7668	-0.1324	-0.5316	0.0864		-0.0052	-0.0203	Yes	133,426	0.4641
	(41.57)	(-32.14)	(-26.52)	(20.23)		(-1.93)	(-5.92)			
16-30 Yrs	1.2707	-0.1811	-0.4498	0.0433	-0.5039			Yes	444,360	0.1687
	(106.33)	(-53.31)	(-36.62)	(11.87)	(-76.79)					
16-39 Yrs	1.0953	-0.1793	-0.4199	0.0513	-0.3034	-0.0743	-0.0318	Yes	443,346	0.1713
	(89.34)	(-52.55)	(-32.19)	(14.05)	(-40.28)	(-37.94)	(-10.21)			
15 Years	0.6193	-0.0415	-0.3212					Yes	49,063	0.4379
	(14.60)	(-24.53)	(-7.55)							
15 Years	0.7605	-0.1514	-0.4652	0.1117				Yes	49,063	0.4392
	(13.65)	(-7.65)	(-8.28)	(5.63)						
15 Years	0.7582	-0.1496	-0.4690	0.1109		-0.0175		Yes	49,063	0.4396
	(13.57)	(-7.53)	(-8.32)	(5.57)		(-4.09)				
15 Years	0.7617	-0.1514	-0.4650	0.1117			0.0011	Yes	49,063	0.4392
	(13.60)	(-7.65)	(-8.27)	(5.63)			(0.16)			
15 Years	0.7688	-0.1493	-0.4682	0.1110		-0.0196	0.0111	Yes	49,063	0.4396
	(13.68)	(-7.50)	(-8.30)	(5.57)		(-4.53)	(1.56)			
0-15 Yrs.	1.0243	-0.1089	-0.6242	0.0712	-0.1379			Yes	92,980	0.2524
	(18.19)	(-5.30)	(-11.36)	(3.46)	(-14.14)					
0-15 Yrs.	1.0351	-0.0978	-0.6530	0.0609	-0.1354	-0.0185	-0.0064	Yes	92,973	0.2612
	(21.40)	(-5.65)	(-13.39)	(3.50)	(-14.86)	(-4.91)	(-0.78)			

Table III
Estimates of Round-Trip Trading Costs for TBA Trades, Specified Pools that are TBA Eligible, and Other Specified Pool Trades.

We regress percentage changes in price between two consecutive trades of the same MBS on the change in trade type (ΔQ), on the interaction between ΔQ and the sum of the natural logs of the trade sizes of the two consecutive trades, on the interaction between ΔQ and a dummy variable that is one when the specified pool is TBA eligible, on the interaction between ΔQ, trade size and TBA eligibility, on the interaction between ΔQ and the number of MBS with the same coupon and maturity created in the previous month, on the interaction between ΔQ and the outstanding balance of MBS with the same coupon and maturity created in the previous month, and on changes in the 1) a U.S. Agency Fixed Rate MBS index, 2) a U.S. Treasury 7-10 year Bond index, 3) a U.S. Investment Grade Corporate Bond Index, 4) a U.S. Corporate High-Yield Bond Index, and 5) the S&P 500 index:

$$\Delta P_t = \alpha_0 + \alpha_1 \Delta Q_t + \alpha_2 \Delta Q_t \cdot \left(\ln\left(\frac{Size_t}{1{,}000{,}000}\right) + ln\left(\frac{Size_{t-1}}{1{,}000{,}000}\right)\right) + \alpha_3 \Delta Q_t \cdot TBA\ Eligible + \alpha_4 \Delta Q_t \cdot TBA\ Eligible \cdot \left(\ln\left(\frac{Size_t}{1{,}000{,}000}\right) + ln\left(\frac{Size_{t-1}}{1{,}000{,}000}\right)\right) + \alpha_5 \Delta Q_t \cdot \ln\left(\frac{\text{MBS Production}}{AVG.Production}\right) + \alpha_6 \Delta Q_t \cdot \ln\left(\frac{\text{MBS Balance}}{\text{Avg Balance}}\right) + \Sigma\beta_i\ Ret_{i,t} + \varepsilon_t. \quad (1)$$

ΔQ is positive one when the current trade is a dealer sale and the previous trade was a dealer purchase. It is negative one when the current trade is a dealer purchase and the previous trade was a dealer sale. Consecutive trades are always of the same MBS, but trades from all MBS with the same coupon and maturity are included in the regressions. Trades of less than $10,000 face value are deleted. Coefficient estimates from Table 2, are used for various trade sizes to produce the following trading cost estimates.

		$100,000	**$1,000,000**	**$5,000,000**	**$10,000,000**
		30 Year Maturity			
TBA	Avg Balance & Prod.	0.0630%	0.0377%	0.0200%	0.0124%
TBA Eligible	Avg Balance & Prod	0.4470%	0.2352%	0.0871%	0.0234%
TBA Ineligible	Avg Balance & Prod	1.3765%	0.7668%	0.3406%	0.1571%
TBA	2 x Balance & Prod.	0.0494%	0.0241%	0.0064%	-0.0012%
TBA Eligible	2 x Balance & Prod	0.4294%	0.2175%	0.0695%	0.0057%
		15 Year Maturity			
TBA	Avg Balance & Prod.	0.0407%	0.0140%	-0.0047%	-0.0127%
TBA Eligible	Avg Balance & Prod	0.4770%	0.3006%	0.1773%	0.1242%
TBA Ineligible	Avg Balance & Prod	1.4564%	0.7688%	0.2882%	0.0813%
TBA	2 x Balance & Prod.	0.0368%	0.0101%	-0.0086%	-0.0166%
TBA Eligible	2 x Balance & Prod.	0.4710%	0.2947%	0.1714%	0.1183%

Table IV
Trading Costs and Predicted Exogenous Dollar Roll Volume

Dollar roll volume predictions are obtained from the previous month's volume around the settlement date. For days from two to seven days before settlement date, we use the volume from dollar rolls with the same coupon and maturity from the same day relative to the settlement in the previous month as a prediction of current month volume. For other days, we use the average daily volume from 20-40 days before, not including days from two to seven days before the settlement date. To estimate trading costs, we then estimate the following regression using including predicted dollar roll volume:

$$\Delta P_t = \alpha_0 + \alpha_1 \Delta Q_t + \alpha_2 \Delta Q_t \cdot \left(\ln(\frac{Size_t}{1{,}000{,}000}) + \ln(\frac{Size_{t-1}}{1{,}000{,}000})\right) + \alpha_3 \Delta Q_t \cdot lnPredicted\ DollRollVol_t$$
$$+\alpha_4 \Delta Q_t \cdot lnPredicted\ DollRollVol_t \ \cdot (\ln Size_t + lnSize_{t-1}) + \Sigma\beta_i\ Ret_{i,t} + \varepsilon_t. \ (2)$$

Years to Mat.	Type of MBS	ΔQ	ΔQ x Ln Trade Size	ΔQ x Pred. Dollar Roll Volume	ΔQ x Size x Pred. Dollar Roll Vol. x e^6	Obs.	R^2
30	TBA	0.3603	-0.0051	-0.0079		614,805	0.0359
		(22.04)	(-21.10)	(-17.52)			
30	TBA Eligible SP	1.7787	-0.0438	-0.0292		111,319	0.4564
		(17.81)	(-39.59)	(-9.85)			
30	TBA Eligible SP	1.7997	-0.0442	-0.0297	0.0812	111,319	0.4566
		(18.26)	(-39.42)	(-10.01)	(4.72)		
30	TBA Ineligible SP	3.7312	-0.1469	-0.0266		11,772	0.3343
		(8.73)	(-34.08)	(-2.08)			
30	TBA Ineligible SP	3.8056	-0.1485	-0.0282	2.5300	11,722	0.3358
		(8.89)	(-34.21)	(-2.20)	(5.84)		
15	TBA	0.3108	-0.0050	-0.0071		137,666	0.0730
		(11.41)	(-9.99)	(-8.68)			
15	TBA Eligible SP	1.7161	-0.0380	-0.0304		44,817	0.3910
		(20.27)	(-22.05)	(-10.94)			
15	TBA Eligible SP	1.7385	-0.0386	-0.0309	0.0881	44,817	0.3912
		(20.24)	(-21.87)	(-11.06)	(2.46)		
15	TBA Ineligible SP	2.9054	-0.1519	-0.0019		1,656	0.3355
		(4.66)	(-7.86)	(-0.10)			
15	TBA Ineligible SP	2.9201	-0.1524	-0.0022	0.4740	1,656	0.3355
		(4.67)	(-7.91)	(-0.12)	(0.27)		

Table V

Regression Discontinuity Estimates Around Loan-to-Value Ratios

30 (15) year specified pools with mean LTV ratios within a certain range, we estimate the following regression using consecutive trades

$$\Delta P_t = \alpha_0 + \alpha_1 \Delta Q_t + \alpha_2 \Delta Q_t \cdot \left[\ln\left(\frac{Size_t}{1{,}000{,}000}\right) + \ln\left(\frac{Size_{t-1}}{1{,}000{,}000}\right)\right] + \alpha_3 \Delta Q_t \cdot LTV + \alpha_4 \Delta Q_t \cdot D_{LTV>x} + \alpha_6 \Delta Q_t \cdot FICO + \Sigma\beta_i\, Ret_{i,t} + \varepsilon_t \quad (3).$$

ΔP is the percentage change in the specified pool, ΔQ is 1 (-1) for a dealer purchase (sale) followed by a sale (purchase), LTV is the loan to value ratio. D is a dummy variable that equals 1 if LTV ratios are above a specific level. LTV ratio greater than 1.05 cannot be included in TBA eligible SPs.

	ΔQ	ΔQ x ln Trade Size	ΔQ x LTV > D	ΔQ x LTV	ΔQ x FICO Score x e^6	Index Returns	Obs.	R^2
30 Year, D = 1.05	2.8020	-0.0339	0.4505	-0.0290	0.7090	Yes	5,450	0.0766
0.95 < LTV < 1.15	(3.65)	(-4.05)	(3.87)	(-4.04)	(0.17)			
30 Year, D = 1.05	2.0773	-0.0811	0.1666	-0.0189	1.4500	Yes	33,838	0.0609
0.85 < LTV < 1.25	(6.76)	(-25.73)	(2.49)	(-7.11)	(0.56)			
30 Year, D = 0.95	-1.5246	-0.0831	-0.4531	0.0174	5.6700	Yes	31,818	0.0665
0.85< LTV < 1.05	(-3.51)	(-25.94)	(-10.97)	(4.48)	(2.06)			
30 Year, D = 1.15	-1.4043	-0.0641	-0.1254	0.0152	-2.2500	Yes	2,106	0.1157
1.05< LTV < 1.25	(-0.40)	(-4.71)	(-1.28)	(0.53)	(-0.14)			
15 Year, D=1.05	4.4364	-0.1992	0.3259	-0.0202	-0.0027	Yes	275	0.3274
0.95< LTV < 1.15	(1.80)	(-3.15)	(1.51)	(-1.64)	(-1.08)			
15 Year, D=1.05	3.3310	-0.1151	0.3011	-0.0176	-0.0018	Yes	1,328	0.1405
0.85< LTV < 1.25	(3.61)	(-6.03)	(2.10)	(-3.49)	(-1.39)			
15 Year, D=0.95	3.5180	-0.1230	-0.0669	-0.0163	-21.8000	Yes	1,034	0.1540
0.85< LTV < 1.05	(2.98)	(-6.21)	(-0.53)	(-1.79)	(-1.61)			
15 Year, D = 1.15	-7.7204	-0.0071	-0.1553	0.0831	-0.0022	Yes	294	0.0786
1.05 < LTV < 1.25	(-1.08)	(-0.16)	(-0.51)	(1.18)	(-0.53)			

Table VI

Logistic Regression Estimates of TBA Eligibility on Specified Pool Characteristics

Panel A. Specified pools with 16-30 years to maturity. If one of these pools is TBA eligible, it can be traded as a 30-year TBA.

	Coefficient	Z-Statistic	Odds Ratio
Average FICO Score	-0.0000	-0.93	1.0000
Maximum Loan Size x e^{-3}	-0.0018	-70.01	1.0000
Minimum Loan Size x e^{-3}	-0.0131	-191.53	1.0000
Percent Owner Occupied	3.2986	101.42	27.0757
Percent Refinanced	0.4198	8.98	1.5216
Percent Single Family	-0.6092	-7.99	0.5438
LTV	0.0111	13.41	1.0111
LTV > 1.05	-9.7809	-61.36	0.0001
Constant	2.7844	55.86	16.1908
Observations	438,146		
Pseudo R^2	0.3809		

Panel B. Specified pools with 15 years to maturity or less. If one of these pools is TBA eligible, it can be traded as a 15-year TBA.

	Coefficient	Z-Statistic	Odds Ratio
Average FICO Score	0.0034	10.12	1.0026
Maximum Loan Size x e^{-3}	0.0002	1.10	1.0000
Minimum Loan Size x e^{-3}	-0.0261	-58.18	1.0000
Percent Owner Occupied	4.7025	18.25	16.6773
Percent Refinanced	9.9357	51.24	58.5864
Percent Single Family	-8.9143	-9.02	0.2090
LTV	0.0403	4.27	
LTV > 1.05	-30.5313	-34.95	
Constant	-0.0739	-0.64	
Observations	93,223		
Pseudo R^2	0.8277		

Table VII
Propensity Score Matching and the Impact of TBA Eligibility on Trading Costs

The probability that a specified pool is TBA eligible is estimated using a logistic regression with TBA eligibility as the dependent variable and the specified pool's average FICO score, maximum loan size, minimum loan size, percent owner occupied, percent refinanced, and percent single family used as explanatory variables. Using the estimated probability of TBA eligibility, we estimated trading costs using all maturity-coupon combinations and the following regression

$$\Delta P_t = \quad \alpha_0 + \alpha_1 \Delta Q_t + \alpha_2 \Delta Q_t \cdot (\ln Size_t + lnSize_{t-1}) + \alpha_3 \Delta Q_t \cdot TBA\ Eligible + \alpha_4 \Delta Q_t \cdot Probability\ TBA\ Eligible\ + \Sigma\beta_i\ Ret_{i,t} + \varepsilon_t. \quad (4)$$

ΔP is the percentage change in the specified pool price over consecutive trades, ΔQ is 1 (-1) for a dealer purchase (sale) followed by a sale (purchase), TBA Eligible is a dummy variable that takes a value of one for TBA eligible specified pools and TBA Ineligible is a dummy variable that takes a value of one if the SP is TBA ineligible. The regression is run separately for SPs with estimated probabilities of TBA eligibility of 0.0 to 0.1, 0.1 to 0.2, etc.

Panel A. Specified pools with 16-30 years to maturity. If one of these pools is TBA eligible, it can be traded as a 30-year TBA.

	ΔQ	ΔQ x ln Trade Size	ΔQ x TBA Eligible	ΔQ x Prob TBA Elg	Index Returns	TBA Eligible Observations	TBA Ineligible Observations	R^2
0.0 ≤ Prob < 0.1	0.3299	-0.1361	2.2124	24.2213	Yes	93	10,419	0.4526
	(8.08)	(-27.19)	(3.09)	(13.35)				
0.1 ≤ Prob < 0.2	0.6017	-0.1518	-1.2298	4.3653	Yes	99	665	0.3861
	(1.27)	(-8.36)	(-4.19)	(1.44)				
0.2 ≤ Prob < 0.3	1.0256	-0.1800	-0.6347	0.1972	Yes	175	1,412	0.4459
	(3.24)	(-14.17)	(-4.59)	(0.15)				
0.3 ≤ Prob < 0.4	0.2634	-0.1298	-0.6691	2.3098	Yes	516	2,218	0.3580
	(074)	(-10.65)	(-7.36)	(2.22)				
0.4 ≤ Prob < 0.5	-0.1699	-0.1128	-0.5885	2.8595	Yes	1,212	737	0.3032
	(-0.31)	(-10.47)	(-6.64)	(2.30)				
0.5 ≤ Prob < 0.6	1.5320	-0.1291	-0.6704	-0.5382	Yes	2,428	735	0.4511
	(2.10)	(-14.31)	(-6.82)	(-0.42)				
0.6 ≤ Prob < 0.7	2.2594	-0.1747	-0.8326	-1.1833	Yes	2,947	1,879	0.3593
	(2.74)	(-17.15)	(-9.59)	(-0.94)				
0.7 ≤ Prob < 0.8	2.2232	-0.1805	-0.0967	-1.6454	Yes	10,025	4,277	0.2537
	(3.12)	(-27.72)	(-1.97)	(-1.75)				
0.8 ≤ Prob < 0.9	0.0305	-0.2138	-0.0294	1.1250	Yes	48,404	9,393	0.3078
	(0.08)	(-73.51)	(-0.96)	(2.38)				
0.9 ≤ Prob < 1.0	14.4718	-0.1162	-0.7984	-13.4642	Yes	332,762	7,750	0.1474
	(53.93)	(-70.60)	(-26.83)	(-48.78)				

Panel B. Specified pools with 15 years or less to maturity. If one of these pools is TBA eligible, it can be traded as a 15-year TBA.

	ΔQ	ΔQ x ln Trade Size	ΔQ x TBA Eligible	ΔQ x Prob TBA Elg	Index Returns	TBA Eligible Observations	TBA Ineligible Observations	R^2
0.0 ≤ Prob < 0.1	0.6716	-0.1379	-1.4500	16.3172	Yes	75	1,644	0.1928
	(8.90)	(-5.88)	(-4.18)	(5.47)				
0.1 ≤ Prob < 0.2	1.9259	-0.0510	-1.0026	-6.0077	Yes	72	250	0.3821
	(3.64)	(-1.21)	(-4.16)	(1.58)				
0.2 ≤ Prob < 0.3	0.9430	-0.0300	-0.4990	-0.9411	Yes	34	233	0.2773
	(1.85)	(-0.95)	(-2.96)	(-0.49)				
0.3 ≤ Prob < 0.4	0.9965	-0.0550	-0.6407	-0.7448	Yes	106	355	0.2687
	(1.10)	(-1.88)	(-5.11)	(-0.29)				
0.4 ≤ Prob < 0.5	-0.3047	-0.0543	-0.0651	1.9034	Yes	225	323	0.1994
	(-0.27)	(-1.89)	(-0.51)	(0.74)				
0.5 ≤ Prob < 0.6	-4.5708	-0.1067	-0.9936	9.7273	Yes	39	35	0.5798
	(-0.51)	(-1.74)	(-1.35)	(0.62)				
0.6 ≤ Prob < 0.7	NA	NA	NA	NA	NA	33	0	NA
0.7 ≤ Prob < 0.8	-1.9420	-0.0622	-0.6383	4.1265	Yes	60	56	0.6485
	(-0.58)	(-1.37)	(-2.67)	(0.93)				
0.8 ≤ Prob < 0.9	-6.3413	-0.1081	-1.1753	9.1947	Yes	235	9	0.4026
	(-1.79)	(-3.90)	(-2.21)	(2.26)				
0.9 ≤ Prob < 1.0	5.2825	-0.0402	-1.1958	-3.7654	Yes	89,295	144	0.2795
	(7.12)	(-27.04)	(-3.20)	(-5.83)				

Table VIII

The Impact of Daily Changes in Specified Pool Inventory on Same Day changes in TBA Inventory of MBS with the Same Coupon and Maturity

For each dealer i and maturity-coupon combination c, day t changes in TBA inventory are regressed on same day changes in TBA eligible specified pools and TBA Ineligible specified pools. That is

$$\Delta\, TBA\ \ Inv_{i,c,t} = \ \alpha_{1i} + \alpha_{2i}\Delta TBAElig.Spec.Pool\ Inv_{i,c,t} + \alpha_{3i}\Delta TBAInelig.Spec.Pool\ Inv_{i,c,t} + \varepsilon_{i,t} \ \ (5).$$

Days are only included in the regression if there was a change in TBA eligible or TBA ineligible specified pools. Specified pool maturities of 16-30 (≤ 15) years are eligible for inclusion in 30 (15) year TBAs and are thus included in the regressions with 30 (15) year TBA inventory changes as the dependent variable. Medians and percentiles are of the distribution of individual dealer coefficients.

		Δ TBA Eligible SP Inventory (α_2) Coefficients					Δ TBA Ineligible SP Inventory (α_3) Coefficients				
		Dealers	Weighted Median	Median	25th Percentile	75th Percentile	Dealers	Weighted Median	Median	25th Percentile	75th Percentile
30 YR	2.5%	35	-0.4056	-0.5143	-0.8383	-0.1545	36	-0.0215	-0.0108	-0.0627	0.0046
30 YR	3.0%	65	-0.9131	-0.7719	-0.9801	-0.3609	62	-0.3980	-0.1323	-0.8530	-0.0028
30 YR	3.5%	82	-0.8776	-0.8153	-0.9664	-0.4615	76	-0.6484	-0.4335	-0.8700	0.0041
30 YR	4.0%	88	-0.7997	-0.6352	-0.8912	-0.1528	76	-0.5698	-0.2754	-0.7412	-0.0032
30 YR	4.5%	86	-0.6404	-0.4794	-0.7279	-0.1495	73	-0.5178	-0.2854	-0.8157	0.0092
30 YR	5.0%	76	-0.3027	-0.2415	-0.3583	-0.0851	66	-0.1643	-0.0844	-0.5270	0.0253
30 YR	5.5%	65	-0.1899	-0.1802	-0.2528	-0.0631	56	-0.0104	-0.0088	-0.1702	0.0194
30 YR	6.0%	60	-0.1130	-0.1314	-0.2300	-0.0238	44	-0.0046	-0.0000	-0.1211	0.0196
15 YR	2.5%	59	-0.9220	-0.8011	-0.9500	-0.3916	33	-1.1087	-0.5969	-1.3355	-0.1998
15 YR	3.0%	71	-0.6709	-0.5491	-0.7073	-0.2280	54	-0.8203	-0.2343	-0.9109	0.0109
15 YR	3.5%	78	-0.5667	-0.5626	-0.7680	-0.2242	47	-0.3030	-0.3030	-1.0845	0.0249
15 YR	4.0%	73	-0.4423	-0.3889	-0.5903	-0.1468	52	-0.2548	-0.0197	-0.6566	0.0660

Table VIII Panel B

Average coefficient estimates across dealers from regressions of daily changes in TBA inventory on changes in TBA eligible and TBA ineligible specified pool inventory. The average α estimate across N dealers is a weighted average where weights are determined by the sample variance of the dealer coefficient (s_i^2) and the sample variance of the maximum likelihood estimate of the average coefficient ($\tilde{\sigma}^2_{m.l.e.}$). That is

$$\tilde{\alpha} = \frac{\sum_{i=1}^{N} \frac{\tilde{\alpha}_i}{\left(s_i^2 + \tilde{\sigma}^2_{m.l.e.}\right)}}{\sum_{i=1}^{N} \frac{1}{\left(s_i^2 + \tilde{\sigma}^2_{m.l.e.}\right)}}$$

With independence across dealers, the variance of the aggregate estimate is

$$Var\,(\widetilde{\alpha}) = \frac{1}{\sum_{i=1}^{N} \frac{1}{\left(s_i^2 + \tilde{\sigma}^2_{m.l.e.}\right)}}$$

		Δ TBA Eligible SP Inventory (α_2) Coefficients		Δ TBA Ineligible SP Inventory (α_3) Coefficients	
Maturity	Coupon	Mean	t-statistic	Mean	t-statistic
30 Year	2.5%	-0.4985	-2.17	-0.0785	-0.28
30 Year	3.0%	-0.6454	-4.02	-0.3597	-3.14
30 Year	3.5%	-0.7085	-19.99	-0.3978	-4.56
30 Year	4.0%	-0.5466	-4.61	-0.2929	-2.53
30 Year	4.5%	-0.4440	-5.40	-0.3610	-3.51
30 Year	5.0%	-0.2594	-1.70	-0.2351	-3.27
30 Year	5.5%	-0.2122	-1.66	-0.0895	-0.87
30 Year	6.0%	-0.1620	-0.71	-0.0777	-0.35
15 Year	2.5%	-0.7012	-5.86	-0.7076	-3.46
15 Year	3.0%	-0.4844	-2.73	-0.3489	-2.42
15 Year	3.5%	-0.4328	-3.53	NA	NA
15 Year	4.0%	-0.3869	-2.98	-0.1751	-1.51

Table IX

Regressions of Returns of Dealer Positions in Specified Pools on Returns of Potential Hedging Instruments

We identify a dealer position as a purchase by a dealer from a customer followed by a sale of the same par value of the same specified pool from a dealer to a customer. We also include positions that are initiated with a sale and closed by a purchase. For each position that is held for at least one day, we estimate the following regression:

$$\Delta P_i = \alpha_0 + \alpha_1 \Delta Q_i + \alpha_2 \Delta Q_i \cdot \ln\left(\frac{Size_i}{1{,}000{,}000}\right) + \beta_i\, Ret_{i,j}^{Hedge} + \varepsilon_i$$

where ΔP_i is the percentage price change in the specified pool position i, ΔQ_i takes a value of one if i was a long position and negative one if it was a short position. Separate regressions include holding period returns of four potential hedges: TBA trades with the same maturity and coupon, five-year treasury notes, seven year treasury notes, and ten-year treasury notes. Adjusted R^2s from the regressions and coefficients on the hedging variables are reported in the table.

Panel A. Positions of specified pools with 16 to 30 years to maturity.

	Obs.	No Hedge	TBA Hedge		5 Year Treasury		7 Year Treasury		10 Year Treasury	
		Adj. R^2	Adj. R^2	Coef.	Adj. R^2	Coef.	Adj. R^2	Coef.	Adj. R^2	Coef.
TBA Eligible, ≤ 5 Days	15,833	0.1710	0.1716	0.1987	0.1717	0.2408	0.1717	0.1366	0.1714	0.0826
				(3.56)		(3.68)		(3.70)		(2.91)
TBA Eligible, 6-20 Days	14,857	0.1895	0.2092	0.5916	0.1957	0.3402	0.1957	0.1995	0.1965	0.1567
				(19.27)		(10.71)		(10.71)		(11.38)
TBA Eligible, 21-60 Days	16,992	0.1420	0.2126	0.7661	0.1731	0.4382	0.1754	0.2643	0.1724	0.1818
				(39.05)		(25.30)		(26.26)		(25.01)
TBA Eligible, > 60 Days	29,665	0.0423	0.2815	0.8702	0.0928	0.2913	0.1010	0.1912	0.1010	0.1431
				(99.39)		(40.65)		(44.03)		(44.03)
TBA Ineligible, ≤ 5 Days	1,983	0.3160	0.3156	0.0098	0.3159	0.1010	0.3157	0.0226	0.3157	0.0207
				(0.17)		(0.85)		(0.34)		(0.40)
TBA Ineligible, 6-20 Days	1,513	0.4487	0.4584	0.2638	0.4584	0.3255	0.4577	0.1790	0.4579	0.1327
				(5.28)		(5.29)		(5.10)		(5.16)
TBA Ineligible, 21-60 Days	1,479	0.4354	0.4840	0.5081	0.4805	0.5403	0.4800	0.3116	0.4782	0.2261
				(11.83)		(11.37)		(11.30)		(11.05)
TBA Ineligible, > 60 Days	2,239	0.2633	0.4656	0.5951	0.4266	0.5476	0.4203	0.3302	0.4105	0.2383
				(29.12)		(25.26)		(24.63)		(23.66)

Panel B. Positions of specified pools with 15 or fewer 30 years to maturity.

	Obs.	No Hedge	TBA Hedge		5 Year Treasury		7 Year Treasury		10 Year Treasury	
		Adj. R^2	Adj. R^2	Coef.	Adj. R^2	Coef.	Adj. R^2	Coef.	Adj. R^2	Coef.
TBA Eligible, ≤ 5 Days	2,578	0.1713	0.2041	0.2944	0.1796	0.2066	0.1798	0.1184	0.1794	0.0887
				(10.35)		(5.21)		(5.28)		(5.16)
TBA Eligible, 6-20 Days	2,727	0.1415	0.4133	0.6069	0.2595	0.4033	0.2560	0.2320	0.2507	0.1714
				(35.54)		(20.86)		(20.50)		(19.96)
TBA Eligible, 21-60 Days	2,983	0.0410	0.4419	0.6196	0.2544	0.3439	0.2521	0.2003	0.2297	0.1395
				(46.28)		(29.22)		(29.02)		(27.03)
TBA Eligible, > 60 Days	9,911	0.0159	0.4389	0.6803	0.2180	0.2723	0.2384	0.1756	0.2268	0.1280
				(86.44)		(50.61)		(53.82)		(51.99)
TBA Ineligible, ≤ 5 Days	213	0.0364	0.0381	0.4713	0.0402	-0.7537	0.0630	-0.8182	0.0403	-0.3471
				(1.17)		(-1.36)		(-2.64)		(-1.36)
TBA Ineligible, 6-20 Days	93	0.0260	0.0174	-0.3081	0.0154	-0.1007	0.0151	-0.0193	0.0153	0.0306
				(-0.46)		(-0.19)		(-0.06)		(0.14)
TBA Ineligible, 21-60 Days	91	0.2118	0.3547	0.6787	0.2507	0.3204	0.2386	0.1573	0.2317	0.1030
				(4.53)		(2.36)		(2.02)		(1.81)
TBA Ineligible, > 60 Days	150	0.0287	0.0465	0.2559	0.0390	0.1249	0.0393	0.0774	0.0328	0.0458
				(1.93)		(1.60)		(1.62)		(1.27)

Table X

Hedging Specified Pool Inventory with TBA Trades for the Same Issuer and Other Issuers

For each dealer, run two regressions. We regress daily changes in TBA inventory from a specific issuer on changes in specified pool inventory from the same issuer, and we regress changes in all TBA inventory on changes in specified pool inventory of MBS from a specific issuer. That is,

$$\Delta\, IssuerTBA\ \ Inv_{i,t} = \alpha_1 + \alpha_2 \Delta IssuerSpec.Pool\ Inv_{i,t} + \varepsilon_{i,t}, \qquad (9)$$

$$\Delta\, AllTBA\ \ Inv_{i,t} = \alpha_1 + \alpha_2 \Delta IssuerSpec.Pool\ Inv_{i,t} + \varepsilon_{i,t}. \ (10)$$

The medians of the individual dealer coefficient are reported below for both regressions. Dealer coefficients are weighted by their number of trades to calculate medians. Days are only included in the regression if there was a change in specified pool inventory for that issuer on that day.

				Same Issuer TBA (3)		All Issuers TBA (4)	
Maturity	Coupon	Number Dealers	Sum of Obs.	Median Coefficient	Median T-statistic	Median Coefficient	Median T-statistic
				Fannie Mae			
30 Year	2.5%	22	431	-0.0035	-0.20	-1.2854	-6.88
30 Year	3.0%	50	2,818	-0.0348	-1.67	-1.0812	-7.66
30 Year	3.5%	61	4,866	-0.4756	-5.02	-1.0670	-6.32
30 Year	4.0%	67	4,826	-0.7775	-4.48	-0.9935	-5.14
30 Year	4.5%	54	2,914	-0.8973	-3.28	-1.1409	-4.07
30 Year	5.0%	37	1,166	-1.2914	-2.93	-1.3229	-2.67
15 Year	2.5%	53	2,748	0.0008	0.12	-0.9296	-8.58
15 Year	3.0%	68	3,857	-0.0003	-0.19	-0.8897	-3.26
15 Year	3.5%	48	2,519	-0.0430	-0.07	-1.1359	-2.04
15 Year	4.0%	38	1,170	-0.9631	-0.45	-0.8626	-0.46
				Freddie Mac			
30 Year	2.5%	47	1,173	-0.5200	-3.09	-0.5065	-2.99
30 Year	3.0%	70	3,414	-1.0446	-5.61	-1.0365	-5.34
30 Year	3.5%	84	5,527	-0.7788	-5.61	-0.8937	-6.63
30 Year	4.0%	71	4,568	-0.4202	-3.45	-1.1770	-5.14
30 Year	4.5%	68	2,800	-0.1651	-2.00	-0.9901	-3.71
30 Year	5.0%	48	1,458	-0.1423	-0.71	-0.9852	-2.28
15 Year	2.5%	64	2,339	-0.3575	-1.73	-0.3562	-1.73
15 Year	3.0%	61	3,198	-0.7464	-2.11	-0.7947	-2.40
15 Year	3.5%	60	2,084	-1.0168	-1.97	-0.8992	-2.22
15 Year	4.0%	46	1,262	-0.2046	-0.85	-0.6273	-0.80
				Ginnie Mae			
30 Year	2.5%	38	1,102	-0.0023	-0.02	-0.0287	-0.20
30 Year	3.0%	42	1,226	0.0000	0.08	0.1386	0.37
30 Year	3.5%	62	1,880	-0.6444	-7.24	-0.8448	-3.69
30 Year	4.0%	47	1,761	-0.7216	-5.19	-1.0001	-2.23
30 Year	4.5%	43	1,174	-0.8321	-5.86	-1.0261	-2.69
30 Year	5.0%	30	554	-1.0489	-2.69	-0.7755	-0.85
15 Year	2.5%	39	1,173	0.0059	0.28	-0.9046	-1.40
15 Year	3.0%	51	1,705	0.0239	0.37	-0.9293	-0.79
15 Year	3.5%	46	1,218	0.2634	0.35	0.0803	0.05
15 Year	4.0%	33	636	-0.4219	-1.00	-1.3078	-1.17

Table XI
SP Inventory Hedging and Willingness to Hold Inventory

For each dealer each day, we calculate the absolute value of its inventory change for all TBA-eligible and TBA-ineligible SPs belonging to a maturity and coupon bracket. Hedging distance is the distance between the dealer's estimated hedging coefficient and -1. The further a dealer's coefficient is away from the "perfect hedging" coefficient of -1, the less the dealer is hedging. The absolute value of daily inventory changes are regressed on the hedging distance and the number of TBA or SP trades with other dealers and customers. T-statistics are shown in parentheses under coefficients.

Panel A. Inventory volatility and hedging distance, controlling for TBA trading activities.

	30-Year TBA Eligible SPs	30-Year TBA Ineligible SPs	15-Year TBA Eligible SPs	15-Year TBA Ineligible SPs
Distance to Complete Hedge	-2.331	-1.545	-2.393	-0.107
	(-1.18)	(-4.14)	(-2.92)	(-2.03)
Number of Dealer to Dealer TBA Trades	0.112	0.00543	0.0440	-0.00122
	(5.09)	(2.05)	(5.59)	(-1.99)
Number of Dealer to Customer TBA Trades	0.217	0.0231	0.0483	0.00537
	(4.05)	(3.68)	(2.64)	(3.03)
Constant	0.981	1.453	2.737	0.159
	(0.65)	(4.40)	(3.73)	(3.32)
Date Fixed Effects	Yes	Yes	Yes	Yes
Cluster	Dealer	Dealer	Dealer	Dealer
Observations	148,104	148,104	97,768	97,768
Adjusted R^2	0.074	0.027	0.064	0.013

Panel B. Inventory volatility and hedging distance, controlling for SP trading activities.

	30-Year TBA Eligible SPs	30-Year TBA Ineligible SPs	15-Year TBA Eligible SPs	15-Year TBA Ineligible SPs
Distance to Complete Hedge	-9.609	-2.283	-8.824	-0.248
	(-2.37)	(-4.37)	(-4.16)	(-3.12)
Number of Dealer to Dealer SP Trades	0.0277	0.00114	0.0108	0.00158
	(0.40)	(0.18)	(0.46)	(1.22)
Number of Dealer to Customer SP Trades	0.343	0.0196	0.0830	0.00168
	(3.12)	(2.56)	(3.32)	(2.68)
Constant	16.48	2.930	8.666	0.248
	(3.43)	(5.10)	(4.85)	(4.18)
Date Fixed Effects	Yes	Yes	Yes	Yes
Cluster	Dealer	Dealer	Dealer	Dealer
Observations	148,104	148,104	97,768	97,768
Adjusted R^2	0.042	0.014	0.030	0.009

Table XII
Prearranged Trades

Observations include all purchases of specified pools by a dealer from a customer. The purchase is prearranged with a customer (other dealer) if the purchasing dealer sells the same par value of the specified pool to a customer (other dealer) within five minutes of the purchase. The specified pool has a matching TBA if it has a maturity of 15 years and a coupon of 2.5%, 3.0%, 3.5%, or 4%, or if it has a maturity of 30 years and a coupon of 2.5%, 3.0%, 3.5%, 4%, 4.5%, 5.0%, 5.5%, or 6.0%. The specified pool's yield matches TBA yields if it is 2.5%, 3.0%, 3.5%, 4%, 4.5%, 5.0%, 5.5%, or 6.0%. In the regressions in Panel B the dependent variable equals one if the trade is a prearranged trade with another dealer. In Panel C the dependent variable equals one if the trade is a prearranged trade with a customer. In all regressions, standard errors are clustered by dealer. T-statistics are shown in parentheses for OLS regressions, z-statistics for logistic regressions.

Panel A: The Proportion of Specified Pool Trades that are Prearranged

	All Observations			Prearranged Interdealer Omitted	
	Observations	Prearranged with Other Dealer	Prearranged with Customer	Observations	Prearranged with Customer
All	699,263	29.28%	3.99%	494,513	5.65%
Trade Size ≤ Median	350,087	49.54%	3.90%	176,646	7.73%
Trade Size > Median	349,176	8.97%	4.09%	317,867	4.49%
TBA Eligible	657,974	29.94%	3.56%	460,993	5.08%
TBA Ineligible	41,289	18.82%	10.88%	33,520	13.41%
Matching TBA	118,340	14.08%	3.14%	101,674	3.65%
No Matching TBA	580,923	32.38%	4.17%	392,839	6.16%
Coupon = TBA	591,296	29.79%	2.93%	415,128	4.17%
Coupon ≠ TBA	107,967	26.47%	9.83%	79,385	13.36%

Table XII - *Continued*

Panel B: Determinants of Prearranged Trades with Other Dealers

Regression Type	Dealer FE	Intercept	Coupon = TBA Coup.	Dealer TBA Share	TBA Eligible	Log Trade Size	Obs.	R^2
OLS	No	0.6455	0.0824	-3.4089	0.0394	-0.0581	698,770	0.3501
		(6.15)	(2.87)	(-3.75)	(1.00)	(-4.10)		
OLS	No	0.7279	0.0286		-0.0034	-0.0822	698,770	0.2496
		(5.63)	(0.090)		(-0.09)	(-4.42)		
OLS	Yes	0.3009	0.0386		0.0183	-0.0096	698,770	0.7336
		(14.79)	(2.38)		(0.91)	(-2.29)		
Logistic	No	1.1993	0.4819	-50.6225	0.2852	-0.3948	698,770	0.4034
		(2.45)	(2.74)	(-4.45)	(0.96)	(-5.26)		
		[3.318]	[1.619]	[1.03e^{-22}]	[1.330]	[0.674]		
Logistic	No	1.5344	0.2616		-0.1100	-0.5419	698,770	0.2471
		(2.91)	(0.70)		(-0.44)	(-6.54)		
		[5.295]	[1.075]		[0.902]	[0.593]		

Panel C: Determinants of Prearranged Trades with Customers.

Regression Type	Dealer FE	Intercept	Coupon = TBA Coup.	Dealer TBA Share	TBA Eligible	Log Trade Size	Obs.	R^2
OLS	No	0.1953	-0.0484	-0.7826	-0.0622	-0.0007	494,066	0.0522
		(5.30)	(-3.47)	(-3.74)	(-3.60)	(-0.28)		
OLS	No	0.1993	-0.0666		-0.0733	-0.0042	494,066	0.0286
		(5.01)	(-4.12)		(-4.25)	(-1.42)		
OLS	Yes	0.1082	-0.0305		-0.0483	0.0024	494,066	0.2646
		(5.85)	(-2.98)		(-3.70)	(1.93)		
Logistic	No	-1.0332	-0.7212	-23.5769	-0.6955	0.0005	494,066	0.1317
		(-2.41)	(-4.77)	(-5.09)	(-3.75)	(0.01)		
		[0.356]	[0.486]	[5.76e^{-11}]	[0.499]	[1.000]		
Logistic	No	-0.8257	-1.0809		-0.9209	-0.0847	494,066	0.0570
		(-1.88)	(-6.66)		(-5.31)	(-1.60)		
		[0.438]	[0.339]		[0.398]	[0.919]		

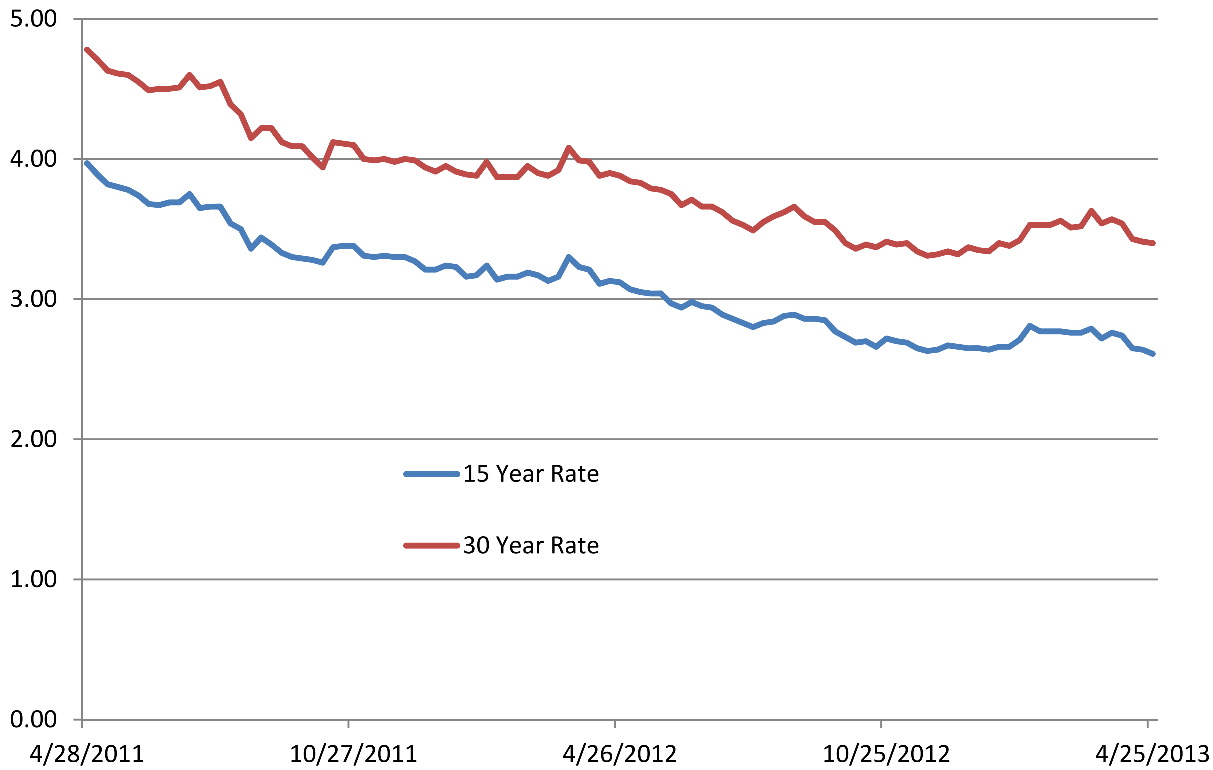
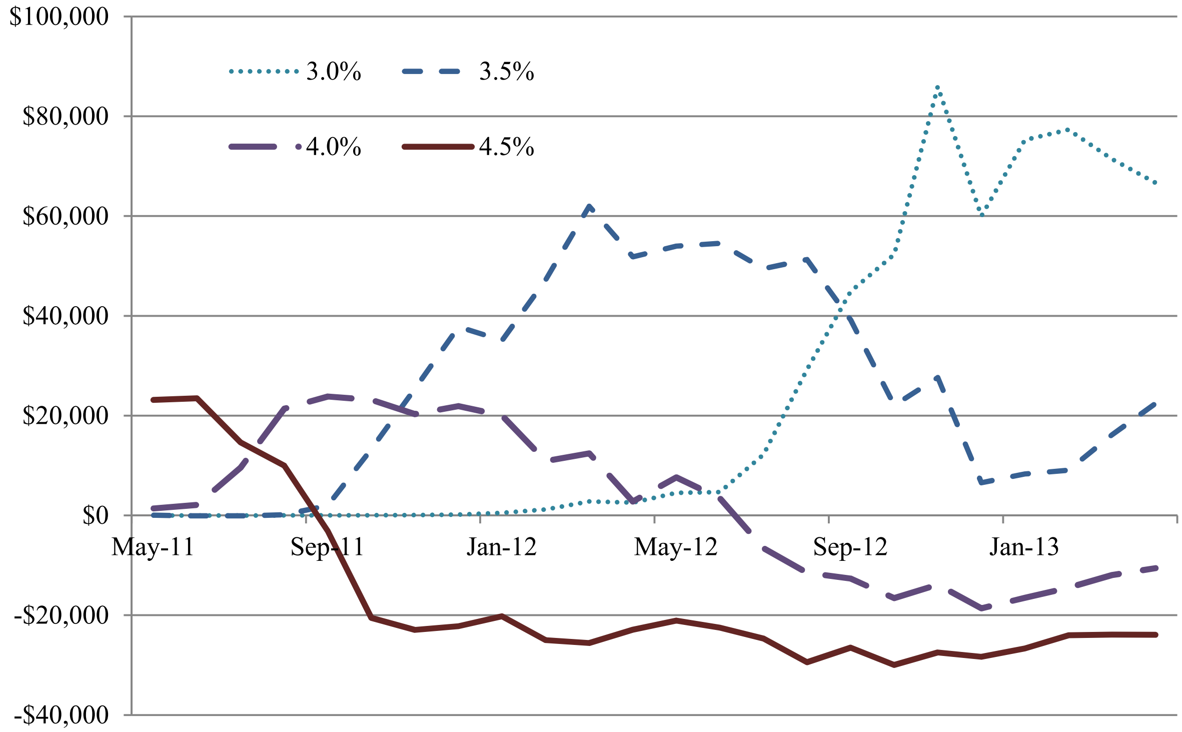
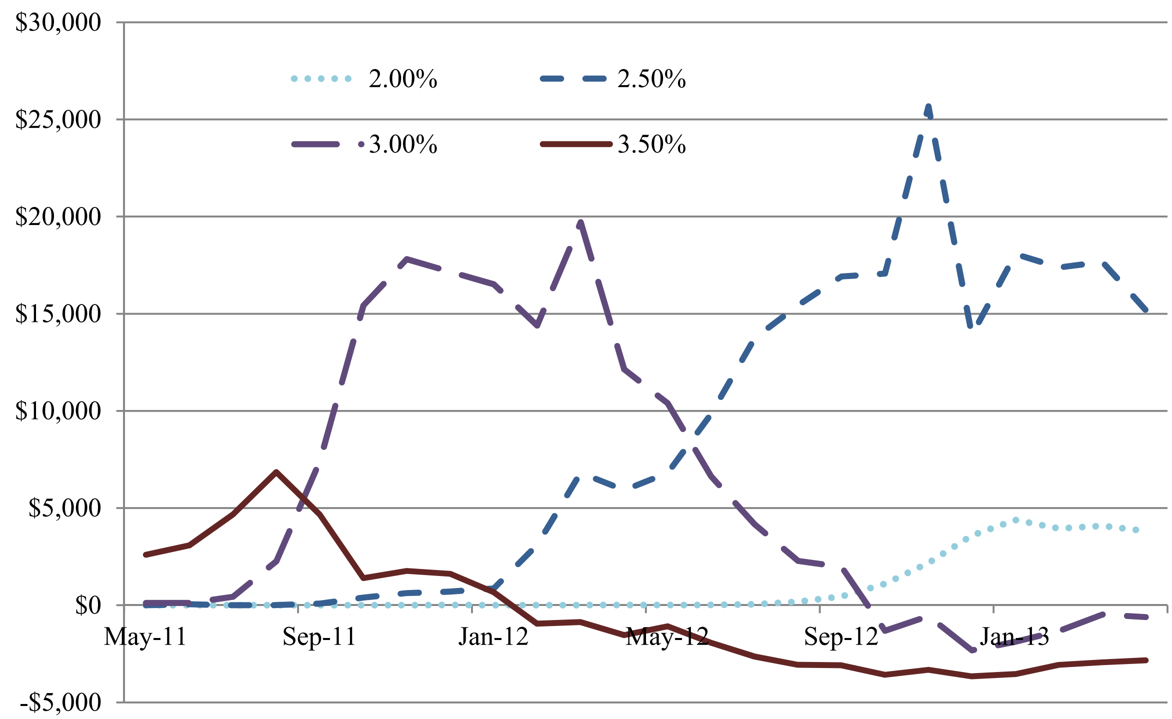


Figure 1. Weekly 15 and 30 year mortgage rates. Source: Freddie Mac.



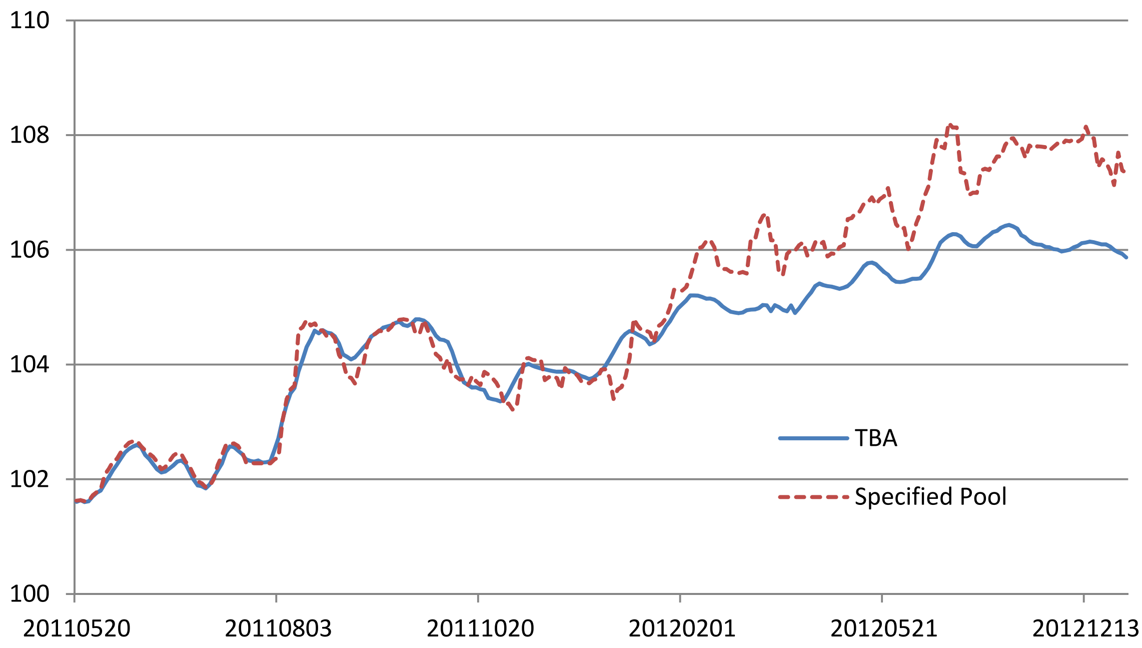
Panel A. Monthly production of 30-year MBS in $ millions. All issuers combined.



Panel B. Monthly production of 15-year MBS in $millions.

Figure 2. Monthly production of mortgage backed securities. All issuers are included.

Panel A: MBS with 15-year maturities and 3.5% coupon yields



Panel B: MBS with 15-year maturities and 4.0% coupon yields.

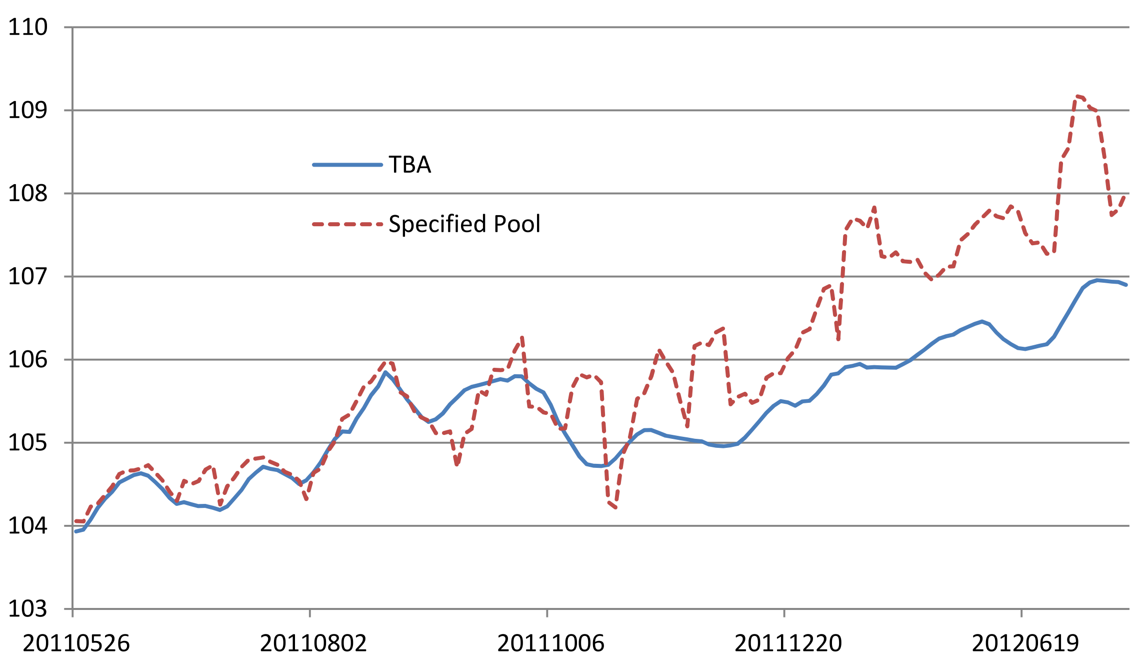
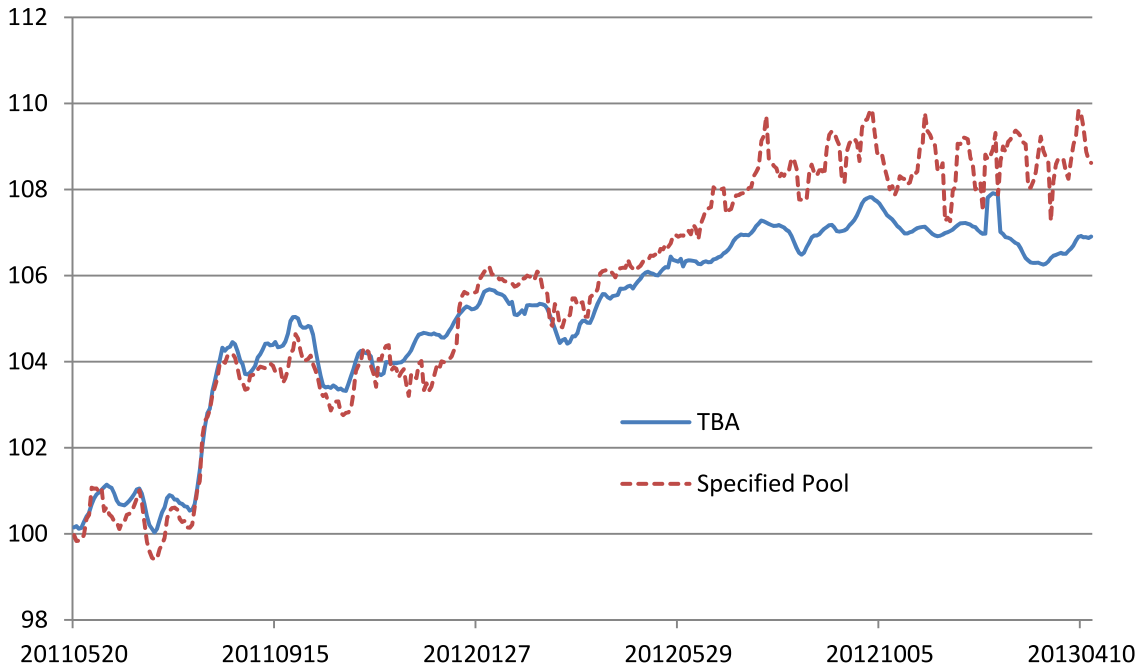


Figure 3. Five-day moving averages of prices of interdealer Fannie Mae TBA and Specified Pool Trades. TBA averages are a simple average price of five days average trades prices. Specified pool moving averages are weighted by the number of trades per day.

Panel C: MBS with 30-year maturities and 4.0% coupon yields



Panel D: MBS with 30-year maturities and 5.0% coupon yields

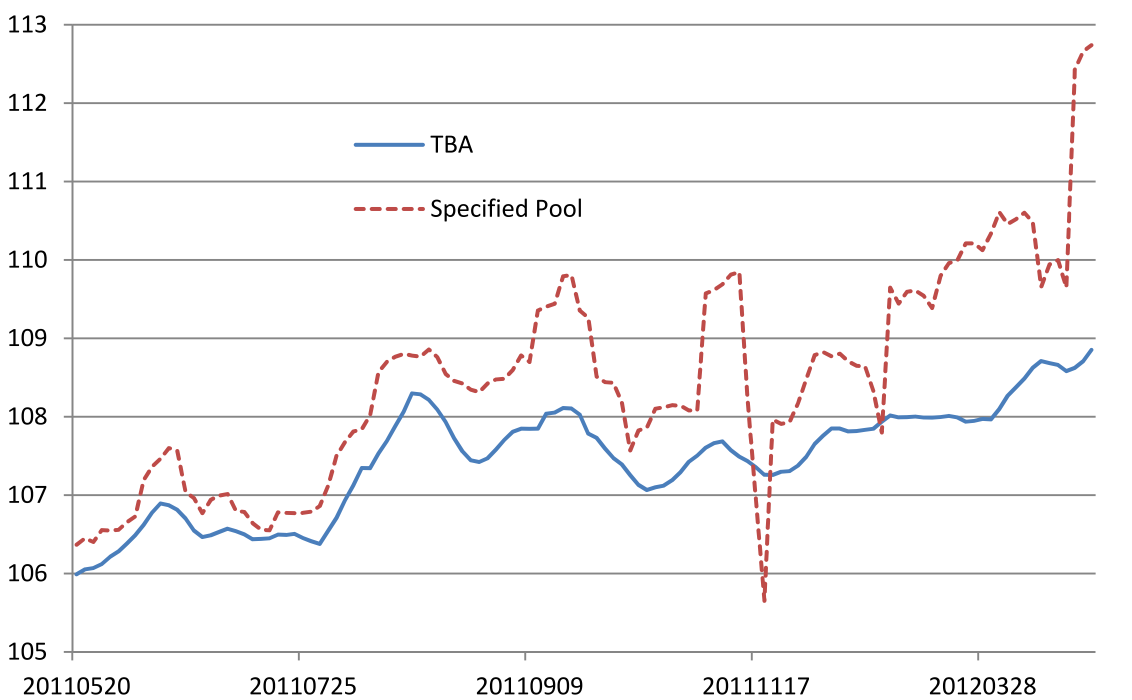
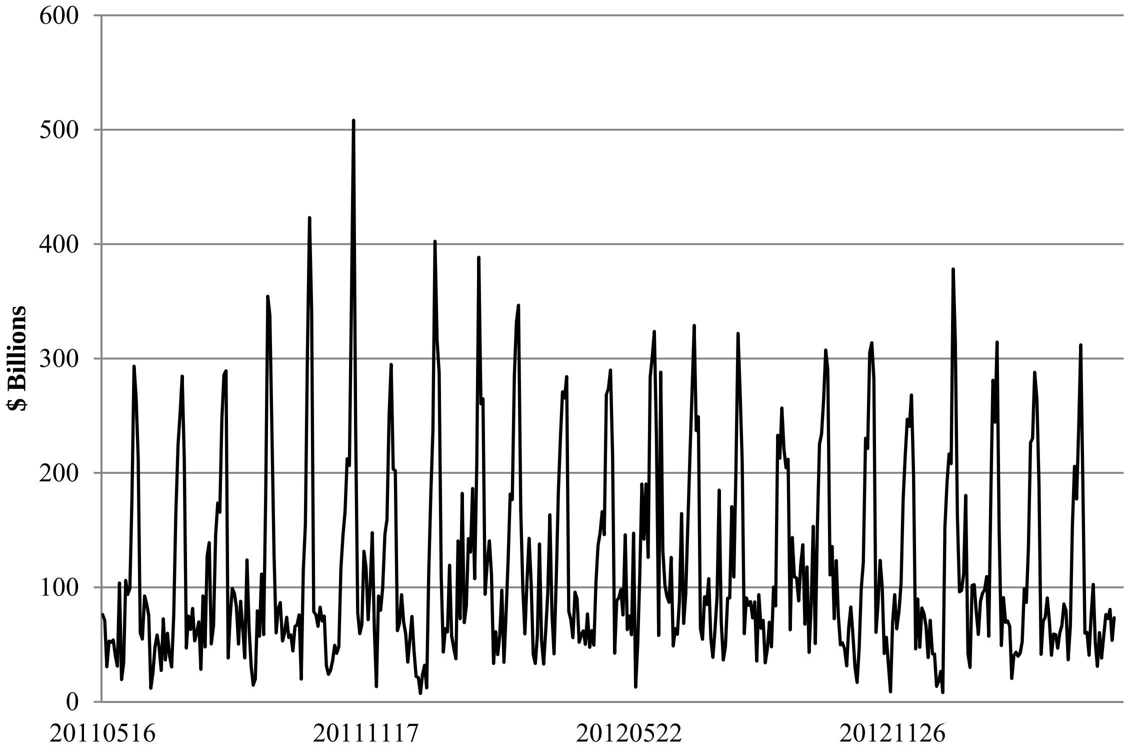
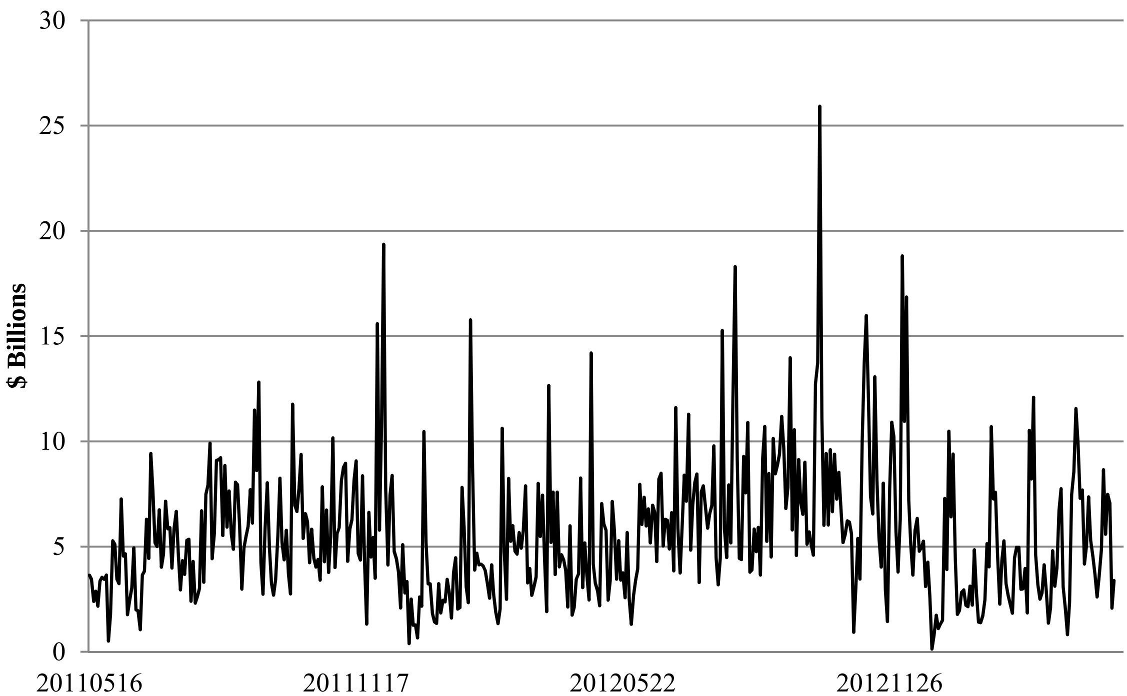


Figure 2 – *Continued.*



Panel A. Daily 30-Year Dollar Roll Trading Volume



Panel B. Daily 30-Year Specified Pool Trading Volume

Figure 4. Daily trading volume of 30-year TBA dollar rolls and 30-year specified pools.