Disagreement and Asset Prices*

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Abstract

How do differences of opinion affect asset prices? Do investors earn a risk premium when disagreement arises in the market? Despite their fundamental importance, these questions are among the most controversial issues in finance. In this paper, we use a novel data set that allows us to directly measure the level of disagreement among Wall Street mortgage dealers about prepayment speeds. We examine how disagreement evolves over time and study its effects on expected returns, return volatility, and trading volume in the mortgage-backed security market. We find that increased disagreement is associated with higher expected returns, higher return volatility, and larger trading volume. These results imply that there is a positive risk premium for disagreement in asset prices. We also show that volatility in and of itself does not lead to higher trading volume. Rather, it is only when disagreement arises in the market that higher uncertainty is associated with more trading. Finally, we are able to distinguish empirically between two competing hypotheses regarding how information in markets gets incorporated into asset prices. We find that sophisticated investors appear to update their beliefs through a rational expectations mechanism when disagreement arises.

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1 Introduction

Understanding how disagreement affects security prices in financial markets is one of the most important issues in finance. When participants in a market disagree with each other, an investor who goes out on a limb and takes a position based on his unique expectations may face a greater risk of being wrong. Such trading risk or adverse-selection risk differs fundamentally from the traditional types of market risks that are priced in asset values. This means that investors who trade when there is disagreement may require additional compensation for bearing this risk. Despite the fundamental nature of this issue, though, there still remains significant controversy in the literature about how disagreement risk affects expected returns and asset prices.

On one hand, there is an extensive theoretical literature that implies that divergence in beliefs or opinions should lead to a positive risk premium. For example, Varian (1985, 1989), Abel (1989), David (2008), and many others argue that the equity premium puzzle may be explained in terms of a risk premium for heterogeneous beliefs, differences of opinion, or both. As such, it appears that investors should be compensated for bearing trading risk or the risk due to adverse selection when disagreement arises.

On the other hand, Miller (1977) argues that differences of opinion in the market can lead to lower expected returns (higher prices) when short-sale constraints are present. This occurs because pessimists sit out of the market and asset prices reflect only the valuation of optimists. Chen, Hong, and Stein (2002) and Diether, Malloy, and Scherbina (2002) find compelling support for the Miller hypothesis in several markets in which there are

binding short-sale constraints. However, Boehme, Danielsen, Kumar, and Sorescu (2009) and Avramov, Chordia, Jostova, and Philipov (2009) find evidence to the contrary. Either way, this still leaves open the more fundamental issue of how disagreement is priced in general markets without significant short-sale constraints, illiquidity, or other trading frictions.

To best resolve the controversy, we would ideally want to study a market with several key characteristics. First, the market should be highly liquid and essentially free from short-sale constraints. Second, the key drivers of the asset's value should be easily defined and common knowledge. Finally, disagreement about these key drivers among the institutions that actually trade the assets should be directly observable. This latter condition bypasses the measurement uncertainty that results when an indirect proxy for disagreement is used.

In this paper, we study how disagreement affects asset pricing in such a setting. Specifically, we analyze a time series of prepayment speed (PSA) forecasts issued by major Wall Street mortgage dealers and then analyze how disagreement affects expected returns, return volatility, and trading volume in the agency mortgage-backed security market.[1]

This market provides unique advantages. First, since the PSA forecasts are given for various interest rate scenarios and the mortgage-backed securities are guaranteed by the U.S. government, credit risk and interest rate risk do not affect the dealers' PSA estimates. Thus, the only cash flow uncertainty associated with a mortgage-backed security is the timing of prepayments. In turn, the timing of cash flows is a key factor affecting how investors value

[1]Providers of PSA estimates included Barclays, Bank of America, Bear Stearns, Credit Suisse, Deutsche Bank, Donaldson, Lufin, and Jenrette, Goldman Sachs, HSBC, JP Morgan Chase, Lehman Brothers, Merrill Lynch, Morgan Stanley, Nations Bank, Prudential, Greenwich Capital, Salomon Brothers, Smith Barney, and UBS Warburg.

mortgage-backed securities. This allows us to precisely correlate disagreement with the return characteristics of mortgage-backed securities. Second, the PSA forecasts are made by the same institutions that trade mortgage-backed securities. Therefore, we know directly what the dealers' best estimate is for the key input to valuing the assets under consideration, and this allows us to best study the relationship between disagreement and asset prices.

Using PSA estimates during the period from July 1993 to January 2012, we construct a disagreement index and document a surprisingly high level of disagreement among the participants in the survey. We show that disagreement is time-varying, correlated with financial and macroeconomic variables, and magnified when major events occur in financial markets (e.g., the failure of Long Term Capital Management, the September 11 attacks, and Lehman Brothers default).

Following this, we study whether disagreement is priced in the market. To examine whether disagreement about prepayment rates affects the expected returns of mortgage-backed securities, we use the standard approach of regressing ex post realized returns on the ex ante measures of disagreement and other proxies for risk premia. For disagreement to be priced in expected returns, the disagreement index should have predictive power for subsequent returns on mortgage-backed securities even after controlling for the other ex ante risk premium proxies. Using a proprietary data set of daily returns on the Fannie Mae (FNMA) "To Be Announced" (TBA) security closest to the current coupon mortgage rate, we construct a measure of monthly returns.[2] Including the disagreement index in

[2]The "To Be Announced" (TBA) market is a highly liquid market in which buyers and sellers agree on the future sale prices of mortgage-backed securities, but do not specify which particular assets will be delivered. Details about this market are in Section 3.2.

the regression increases the predictive power nearly two-fold, and the coefficient on the disagreement variable is positive and highly significant. Based on this, we can conclude that increased disagreement is associated with higher expected returns, which supports the thesis that disagreement is associated with a positive risk premium, as posited by Varian (1985, 1989) and Abel (1989). Further, since we control for several measures of market risk in our empirical specification (e.g., interest rate risk, the S&P 500 volatility index (VIX), and the monthly excess return on the CRSP Value Weighted Index), this implies that disagreement risk is likely to be a form of trading risk or risk due to adverse selection.

Finally, we analyze the relationship between disagreement, return volatility, and trading volume. We use a simple vector-autoregression (VAR) framework in which we include all three variables with lags and controls. We find that increasing disagreement is followed by periods of higher volatility and trading volume. This is consistent with Shalen (1993) and Zapatero (1998) who posit that disagreement and price volatility should be positively correlated. More strikingly, though, we find that volatility in and of itself does not lead to higher trading volume. Rather, it is only when there exists more disagreement that trading volume increases. Our findings lend support to the predictions of Harris and Raviv (1993) who predict that differences in opinion is the primary channel through which uncertainty leads to higher trading volume. To our knowledge, our study is the first paper to empirically document the importance of this channel. Our results are also consistent with the empirical findings of Kandel and Pearson (1995) who document that dispersion in analyst forecasts affects trading volume, particularly around anticipated earnings announcements. Interest-

ingly, we find that higher trading volume is associated with lower subsequent disagreement. We view this as intuitive: as investors learn through trade, this gives them opportunities to update their beliefs about the drivers of asset value.

Besides providing evidence that disagreement is associated with a positive risk premium, we are able to distinguish between two competing hypotheses regarding how information in markets gets incorporated into asset prices. As Banerjee (2011) highlights, investors may update their beliefs via a rational expectations mechanism or may agree to disagree, which results in persistent differences in opinion. According to Banerjee (2011), these two mechanisms can be distinguished empirically by comparing how return-volume characteristics vary with disagreement in the market. We find that higher disagreement is associated with higher expected returns, higher subsequent return volatility, and higher trading volume. These results directly support the rational expectations channel. Especially given our finding that higher trading volume is associated with lower subsequent disagreement, this makes it more likely that rational investors do learn from prices and opinions in the market, updating their beliefs using Bayes rule via a rational expectations channel.

The rest of the paper is organized as follows. In Section 2, we review the literature in this area to highlight our contribution. In Section 3, we review the data that we collect and some important institutional details regarding the estimation of prepayment speeds, the agency mortgage-backed security markets, and the TBA market. In Section 4, we construct a measure of disagreement and describe its empirical properties. In Section 5, we characterize the relationship between disagreement and expected returns, return volatility, and trading

volume. Section 6 provides some concluding remarks.

2 Literature Review

2.1 Disagreement and Learning

At any point in time, disagreement may arise due to heterogeneous beliefs or due to persistent differences of opinion. Much attention has been devoted to whether the former eventually leads to asymptotic agreement when learning occurs. Starting with Blackwell and Dubins (1962), Aumann (1976), and Geanakoplos and Polemarchakis (1982), investigators have focused on conditions that make disagreement impossible in a rational setting. As Aumann (1976) shows in a remarkably clear way, if agents share a common prior and have common knowledge of each other's posterior beliefs, they cannot agree to disagree. Geanakoplos and Polemarchakis (1982) extend this analysis showing that communication, either direct or indirect, results in an equilibrium with common posterior beliefs. In their words, "we can't disagree forever".

Later work, however, shows that permanent disagreement can arise even when agents have common priors and observe the same time series of public information. As Acemoglu, Chernozhukov, and Yildiz (2006) point out, there are many empirical settings where such permanent disagreement arises. As such, they study a setting in which individuals are uncertain about the interpretation of the signals they receive, which implies they have non-degenerate probability distributions over the conditional distribution of signals given the

underlying parameter of interest. In such case, Acemoglu, Chernozhukov, and Yildiz (2006) show that agreement may be impossible, despite the fact that all agents update their beliefs as Bayesians.

Given this, at any given time there may be several mechanisms whereby disagreement in a financial market may arise. First, investors may update according to Blackwell and Dubins (1962), but at the time of observation investors' beliefs have yet to fully converge. Second, investors update their beliefs rationally, but because they are uncertain about the quality of their signal, may fail to converge. Last, market participants may simply "agree to disagree", in that they observe the same public information but adhere to different models. This etiology may have an added behavioral component, but has been used by Varian (1985), Harris and Raviv (1993), and David (2008).

Given this, the evolution of beliefs may occur via two learning mechanisms. Investors may learn over time via a rational expectations channel in which heterogeneous beliefs are more likely to converge. Alternatively, disagreement may persist as differences of opinion lead to dispersion in forecasts. As pointed out by Banerjee (2011) in a theoretical model, these two channels can be distinguished empirically. With the rational expectations channel, Banerjee (2011) predicts that increased disagreement should induce higher expected returns, higher volatility, higher market betas, and higher covariance between volume and absolute returns, but lower return autocorrelation. When investors agree to disagree (i.e., differences in opinion persist), the opposite trends should be present. In both channels, disagreement is positively correlated with trading volume.

2.2 Disagreement and Risk-Premia

As mentioned earlier, much of the extant theoretical work posits that there should be a positive risk premium associated with disagreement in the market. Following the seminal work of Mehra and Prescott (1985), several authors rationalized the equity premium puzzle by considering that investors may have heterogeneous beliefs or differences of opinion. Varian (1985) considers an Arrow-Debreu economy with agents who have different subjective probabilities. In equilibrium, an increase in the range of probability beliefs typically decreases asset values, as long as risk aversion is not abnormally high. As such, disagreement is associated with a positive risk premium under reasonable preferences. Varian (1989) provides an elegant summary of these results.

Likewise, Abel (1989) investigates an equilibrium asset pricing model in which investors' demands for risky stocks and riskless bonds depend on their subjective belief about payoffs to the risky capital. When beliefs are more heterogeneous, this reduces the stock's price, and can dramatically increase the equity premium relative to bonds. Abel (1989) concludes that the equity premium under homogenous beliefs understates the premium that would arise under heterogeneous beliefs.

Subsequent theoretical work has confirmed these findings. Basak (2005) provides a good survey. More recently, David (2008) studies a general equilibrium exchange economy in which two types of agents have heterogeneous beliefs. The agents have a difference of opinion and "agree to disagree", in that they update their beliefs differently about the state of the economy even though they observe the same signals. Agents trade and may speculate on

the relative accuracy of their respective models. David (2008) shows that less risk-averse agents speculate more, but demand higher risk premia. Chen, Joslin, and Tran (2010) study an equilibrium model with "affine" disagreement about fundamentals, which allows them to consider stochastic disagreement about growth rates, volatility dynamics, and the likelihood and size of jumps. They show that the risk premium depends on whether disasters strike: in normal times, optimistic agents accumulate wealth and there is a decline in the risk premium, whereas when disasters strike, pessimistic agents become more wealthy, which causes the risk premium to increase.

One important exception in this literature is Miller (1977), who posits that short-sale constraints should cause disagreement to have a positive effect on stock prices. The intuition is that when pessimists are forced to sit out of the market, stock prices only reflect the demand from optimists, which causes prices (returns) to increase (decrease). This intuition is supported in Liu and Seasholes (2011) who study dual-listed shares in China and Hong Kong. They show that when there is a short-sale ban in China, the prices of Chinese stocks are 1.8 times higher compared to those in Hong Kong.

Miller (1977) has been tested in several empirical studies and has been shown to be plausible. Chen, Hong, Stein (2002) develop a stock market model in which an increase in divergence of opinion results in a decrease in the breadth of stock market ownership, causing a high stock price and a lower expected return. Then, they show empirically that reducing the breadth of mutual fund ownership of stocks forecasts a lower stock return. Diether, Malloy, and Scherbina (2002) analyze the role of dispersion in analysts' earnings

forecasts in predicting the cross section of future stock returns. They find that stocks with higher dispersion in analysts' earnings forecasts earn significantly lower future returns than otherwise similar stocks. Park (2005) extends this work by testing whether the aggregate stock market also becomes overpriced when differences in expectations are high. According to Park (2005), the dispersion in expectations among market analysts has predictive power for future stock returns: higher dispersion predicts lower stock returns. Similarly, Yu (2011) uses the Institutional Brokers' Estimate System (I/B/E/S) database on analyst forecast and finds that the ex post market return is negatively related to the bottom-up disagreement.

These findings have led others to study disagreement and expected returns in other settings where short-sale constraints exist. Moeller, Schlingermann, and Stulz (2007) study the impact of divergence of opinion on acquirer returns in M&A activity. They find that increasing diversity of opinion about an acquirer's value causes the acquirer's return in stock payment acquisitions to decrease, but have no effect in cash transactions. Chatterjee, John, and Yan (2012) show that the total takeover premium, pre-announcement target stock price run-up, and post-announcement target stock price run-up are all higher when investors have a higher divergence of opinion. They use analysts forecasts, change of breadth of mutual fund ownership, and idiosyncratic volatility as three proxies for divergence of analyst opinions.

In contrast, Avramov, Chordia, Jostova, and Philipov (2009) show that the negative relationship between dispersion in analysts' forecasts and stock returns may be simply explained by financial distress risk. Specifically, they show that the profitability of dispersion-based trading is only high when credit conditions deteriorate and is concentrated in a small number

of firms with the worst credit ratings. However, the authors find that when their dispersion measure is adjusted by credit risk, even for this small group of firms, the negative dispersion-return relationship disappears. Likewise, Boehme, Danielsen, Kumar, and Sorescu (2009) demonstrate a positive relationship between dispersion of beliefs and expected returns, after controlling for short-interest and investor recognition as proxied by institutional ownership.

Given this, the support for Miller (1977) is mixed. However, as we note in the introduction, this still leaves open the more fundamental issue of how disagreement is priced in general markets without short-sale constraints, illiquidity, or other trade frictions. Indeed, as described by Fama and French (2007), disagreement or differences in tastes can rationalize empirical deviations from the capital asset pricing model (CAPM) in either direction. In their framework, sophisticated investors choose the correct tangency portfolio, whereas unsophisticated investors choose portfolios that deviate. Unless the unsophisticated investors choose the right portfolio in aggregate on average, the observed market portfolio will deviate from optimal. Fama and French (2007) posits that empirical deviation from the CAPM, either to portfolios with higher expected returns or lower, may be explained by the disagreement by unsophisticated investors. As such, it remains an unresolved issue whether disagreement is associated with a risk premium empirically.

2.3 Disagreement, Trading Volume, and Price Volatility

The earlier literature, both theoretical and empirical, has documented a positive relationship between disagreement, trading volume, and price volatility. Harris and Raviv (1993) study

the effect of news announcements on trading prices and volume. They assume that traders receive the same common information, but differ in the way they interpret the information. Additionally, each trader believes absolutely in the validity of his own interpretation, so there is difference in opinion. Some of their key findings are that absolute price changes and volume are positively correlated, and that absolute changes in the mean forecast of the final payoff and volume are positively related.

Shalen (1993) examines a two-period noisy rational expectations model of a futures market and studies the effect that dispersion in expectations has on price volatility and trading volume. Higher dispersion causes higher price volatility, higher expected trade volume, and increases the correlation between absolute price changes and both contemporaneous and lagged trade volume.

Kandel and Pearson (1995) study how dispersion in analyst forecasts affects trading volume and asset prices. They analyze trading activity around anticipated announcements and document increases in trading volume, even when there are no changes in price. Authors posit that this occurs because traders are using different likelihood functions when they Bayesian update.

Zapatero (1995) considers a model with two logarithmic utility maximizers that observe aggregate consumption but disagree about its expected rate of change. Additional information, which induces heterogeneous beliefs, causes higher volatility of interest rates in the economy.

Finally, Banerjee and Kremer (2010) study the relationship between disagreement and the

dynamics of trade in a theoretical model in which investors disagree about the interpretation of public signals. They show that disagreement exacerbates volatility and leads to higher trading volume, and that there is a positive correlation between volatility and trading volume.

3 The Data

In this paper, we focus on generic agency mortgage-backed securities (MBS) in which the monthly principal and interest payments are pooled in a passthrough and distributed to investors on a pro-rata basis.[3] The speed at which homeowners prepay their mortgages is a key driver of value for these securities. In what follows, we describe PSA estimates that were made by major MBS dealers for Ginnie Mae (GNMA) mortgage-backed securities. We then describe how we construct a return series of Fannie Mae (FNMA) forward contracts that are traded in the "To Be Announced" (TBA) market.

3.1 Prepayment Speed Forecasts

In the mortgage industry, prepayments speeds are typically quoted according to the Public Securities Association (PSA) convention in which an annualized constant prepayment rate (CPR) is adjusted for the age of the underlying mortgages. New mortgages tend to have very low prepayment speeds and the rate of prepayment rises with age until the mortgages become seasoned, at which point the rate of prepayment remains constant. The PSA benchmark curve was introduced in the 1980's and is often referred to as the 100% curve. At 100%,

[3]For in-depth discussions of passthough securities and the MBS market, see Hayre (2001) and Fabozzi, Bhattacharya, and Berliner (2007).

the prepayment rate starts at 0% for new mortgages, rises by 0.2% per month until month 30, after which the prepayment speed remains constant at 6%. PSA estimates are quoted relative to this benchmark. For example, a GNMA with a PSA of 200% would experience prepayments at a rate twice that of the usual benchmark rate and a GNMA with a PSA of 50% would experience prepayments at a rate that is half the usual benchmark rate.

The expected rate of mortgage prepayment is a key driver of value for valuing MBS, but is challenging to forecast. Many factors affect prepayments: home sales, refinancings, defaults, and curtailments. In turn, these are driven by changes in housing supply, mobility, inflation, interest rates, income, employment, and consumer confidence. Estimating prepayment speeds requires careful modeling, and given the degree of complexity involved may be a significant source of heterogeneous beliefs about the value of generic MBS.

Major Wall Street dealers in the MBS market participate in a monthly survey, in which they provide Bloomberg with their best estimate of what the PSA would be for a generic GNMA with a given coupon rate.[4] PSA estimates are given for several interest rate scenarios, ranging from 300 basis points below the current rate to 300 basis points above. As such, the forecasts not only reflect the dealers' expectations of current prepayment speeds, but also how those speeds would change in response to interest rate shocks. This has important ramifications to our analysis: since the PSA estimates offered by the dealers vary with interest

[4]Although there may be slight differences in the characteristics of the mortgage-backed securities for which the dealers provide forecasts, these differences have a negligible effect on prepayment speeds. This is because any mortgage-backed security that does not have a generic prepayment speed behavior is excluded from the pool of mortgages that are traded in the TBA markets and for which dealers have provide forecasts. Instead, mortgage-backed securities with non-generic prepayment behavior are traded in the separate specified pool market (Hayre, 2001).

rate changes, any difference of opinion or beliefs that they exhibit is only a function of their calculation of prepayment risk, not of expected interest rate dynamics. As such, the dealers' opinions regarding the prepayment speeds are the only source of variation driving returns of the MBS. In Section 5, this will allow us to study the relationship between disagreement and asset prices.

Table 1 provides an illustration of the prepayment forecasts provided by survey participants for a generic GNMA I 4.0 percent passthrough security as of January 31, 2012. Figures 1 plots the forecasts. Not surprisingly, forecasted prepayment speeds are very sensitive to changes in interest rates. As interest rates decline, PSA forecasts increase and vice versa. More interestingly, however, there is considerable cross-sectional variation in the pattern of PSA forecasts across dealers. In particular, these PSA forecasts differ by a factor of roughly two at current and lower rate levels, but tend to converge for rate levels substantially above the current rate level.

Another way to compare prepayment forecasts is to consider measures based on normalized values. For each date and each MBS, we normalize the PSA forecasts provided by a participant in the survey by their PSA forecast for the current rate level. As such, the normalized value represents the relative change or slope in the PSA forecast for a given change in the level of rates. Figure 2 plots the normalized version of the data in Table 1. Even with this normalization, Figure 2 shows that there remains significant cross-sectional variation across the various dealers in terms of their estimates of the sensitivity of prepayment speeds to changes in the level of mortgage rates.

Figure 3 provides three more snapshots of disagreement during extreme market events: the failure of Askin Capital Management in 1994, the attacks of September 11, 2001, and the failure of Lehman Brothers in 2008. In the top three plots, there is substantial cross-sectional variation in dealer prepayment forecasts for nine interest rate scenarios ranging from 300 basis above the current rate to 300 basis points below. The three bottom plots use normalized prepayment forecasts for the same nine interest rate scenarios. As is evident, not only is disagreement present during the three distinct time periods, but also its severity is time-varying.

We collected monthly survey data from Bloomberg during July 1993 to January 2012. In total, 18 dealers participated in the survey at some time during the sample period. The participants are listed in Table 2. On average, in each month the survey includes forecasts from 8.42 dealers, with the actual number ranging from 3 to 14. Table 2 also reports the average ratio of each dealer's forecast relative to the cross-sectional average across all dealers for a given date and coupon rate. As shown, the average ratios are all in the range from 0.90 to 1.10, suggesting that none of the dealers are producing forecasts that are, on average, fundamentally different from the others on average. This last point highlights the fact that disagreement about prepayment speeds are not likely due to asymmetric access to public or private information.

Indeed, the very nature of the mortgage passthrough market inherently makes it unlikely that differences in access to public information drives variation in PSA estimates. All of the dealers in the survey are large financial institutions that have devoted extensive resources

to the mortgage market and each has the ability to obtain all publicly available information about the term structure of interest rates, interest rate forecasts, volatility, fixed income markets, mortgage prepayment rates, market liquidity, funding availability, and macroeconomic fundamentals. As such, the inputs to most PSA models are readily available to the dealers.

It is also unlikely that variation in estimates rests on access to private information. This is simply because there is actually very little private information available to anyone about the mortgage pools underlying the MBS or TBA markets. For example, the generic pools traded on a forward basis in the TBA market tend to be based on recently-originated mortgages for which there is little prepayment history. In addition, the dealers generally do not hold or service the mortgage passthrough securities for which they provide forecasts. Thus, they are likely to have little or no private information about the performance of the underlying mortgages. Finally, all of the data about the characteristics of individual mortgage borrowers (such as income, FICO score, appraisals, etc.) are readily available to all market participants.

Taken together, these considerations suggest that asymmetric information is unlikely to drive disagreement about prepayment speeds. Rather, a more likely explanation is that variation in PSA estimates is driven by differences in interpretation and beliefs about the common set of information available to them. These differences in interpretation and beliefs might manifest themselves as differences in the assumptions and/or the structure of the models that each dealer uses to estimate mortgage prepayments.

Finally, one concern that might arise is whether the dealers have an incentive to dis-

close their best estimate of prepayment speed truthfully. We believe that they do. First, as Table 2 suggests, none of the dealers systematically provide different forecasts from their contemporaries. Second, based on a time series of disagreement that we present in Section 4, times of larger variation in estimates correspond to large economic events in which uncertainty is present in the market. Last, the estimates themselves are observable to potential clients of the dealers and therefore provide a signal of technical expertise. As such, dealers have a strong incentive to demonstrate their skills as they compete for customers.

3.2 Returns on TBA securities

The TBA market is an attractive setting to study returns on MBS since it is such a highly liquid market. In a TBA trade, the buyer and seller agree on a future sale price, but do not specify which particular securities will be delivered. Instead, only five additional parameters are promised: the settlement date, issuer, maturity, coupon, and par amount. According to Vickery and Wright (2010), this convention simplifies trade, but also ameliorates asymmetric information conflicts in the MBS market, leading to higher agency MBS liquidity. In the context of our analysis, though, this makes our study of the relationship between disagreement and returns more precise. That is, since the TBA market is so liquid, we can be confident that the asset pricing results we document are not merely due to time-varying transaction costs or other trading frictions.

To measure the returns on mortgage-backed securities, we make use of a proprietary data set provided to us by a major fixed-income asset management firm. This data set consists

of daily returns on Fannie Mae TBA's closest to the current coupon mortgage rate. Since TBA's are forward contracts, the return series consists of the return from going long a one-month TBA, investing the TBA price in a riskless margin account, and then rolling the portfolio over every month on the monthly TBA settlement date. Constructing it this way provides continuity over the monthly roll date in the TBA settlement. We then compute monthly returns by aggregating the daily returns during the month.

4 Measuring Disagreement

Our extensive data set of PSA forecasts provides us with a unique opportunity to measure the amount of disagreement in the market directly. Not only does the data set cover a broad cross section of dealers over nearly 20 years, but there are a number of key features of the data that allow us to obtain more accurate measures of disagreement. First, since dealers provide multiple forecasts for each passthrough security, we can normalize each dealer's forecasts before estimating cross-sectional variation among dealers. This allows us to control for the possibility that the levels of PSA forecasts might vary across dealers because of model calibration issues rather than because of actual disagreement. Second, each PSA forecast is conditional on a specific term structure scenario. Thus, we can compare forecasts across dealers while holding fixed assumptions about the evolution of the term structure. Finally, since all of the forecasts are visible in the Bloomberg system, dealers are aware of the extent to which they disagree with other dealers.

To measure the amount of disagreement in the mortgage markets about prepayments,

we construct a monthly index based on the cross-sectional dispersion among dealers in their normalized PSA forecasts. Specifically, we first identify the GNMA coupon that is closest to the current yield of par mortgage-backed securities (the current coupon) and for which three or more dealer forecasts are available. Generally, the GNMAs closest to the current coupon tend to have the greatest homogeneity across dealers in terms of their maturity, pricing, and information availability. Then, for each dealer providing forecasts for the GNMA with the closest coupon, we take the ratio of the PSA forecast for the -100 basis point scenario to the PSA for the $+100$ basis point scenario. Thus, this ratio is a measure of the relative (normalized) change in prepayment forecast as rates move from 100 basis points above the current level of interest rates to 100 basis points below. Alternatively, this ratio can be viewed as a measure of the slope or sensitivity (duration) of prepayments to changes in interest rates. Finally, we compute the simple standard deviation of the ratios across dealers providing forecasts for that month. We repeat the same process for all 223 months in the study period to form the index.

The top panel of Table 3 presents summary statistics for the disagreement index, and Figure 4 plots its time series. The index has a number of interesting features which may provide some insight into the nature of disagreement in financial markets. First, there is a surprisingly high level of disagreement among the participants in the survey. The average value of the index is 40.29 percent, and the median value is 35.43 percent. Thus, even after normalizing the data, there is wide dispersion among the dealers in their views about changes in prepayment rates. Second, there is considerable time series variation in the amount of

disagreement among dealers. In particular, the index varies from a low of 1.96 percent, reflecting almost perfect agreement among dealers, to a high of 138.60 percent, representing extreme diversity among dealers in terms of their forecasts. The standard deviation of the index is 24.80 percent. Thus, disagreement is a dynamic phenomenon. Finally, disagreement among the dealers tends to be persistent in nature; the first-order serial correlation coefficient for the index is 0.6298. On the other hand, the disagreement index is also strongly mean reverting as evidenced by the serial correlation of monthly changes in the index of -0.455. Intuitively, this suggests that the persistence of a period of higher (or lower) disagreement can be measured in terms of months, rather than years.

Figure 4 also shows that there is an strong episodic nature to period of higher disagreement. In particular, the graph illustrates that peaks in the level of disagreement tend to coincide with major events in the mortgage and financial markets. Important examples include the mortgage crisis in early 1994 during which the prominent mortgage hedge fund Askin Capital Management failed. Similarly, the highest level of disagreement during the study period occurred in August 1998 during the Long Term Capital Management crisis in the financial markets. Other major events associated with high levels of disagreement include September 11, 2001, and the Lehman Brothers default of September 2008. Clearly, disagreement increases during times of extreme uncertainty in the financial markets.

To explore this in more depth, we examine the relation between the disagreement index and a number of key financial and macroeconomic variables that could potentially affect aggregate prepayment behavior. It is important to stress that in estimating this regression,

we are not implying causality in the relation between the level of disagreement and these financial and macroeconomic variables. In fact, the level of disagreement and the financial variables are likely all endogenously determined. Rather, our objective is simply to describe the contemporaneous relation between the disagreement index and the other variables.

Table 4 reports the results from the regression and lists the independent variables that we included. As shown, a number of the variables are significantly related to the disagreement index. For example, the mortgage refinancing index is positively related to the level of disagreement. This is intuitive since an increase in prepayments is likely to result in greater dispersion among dealers in their estimates of subsequent prepayments. Similarly, both of the volatility measures are significantly related to the disagreement index. Interestingly, however, the sign of the two volatility measures differ. An increase in stock market volatility results in higher disagreement, while the opposite is true for Treasury yield volatility. An increase in the slope of the term structure is associated with an increase in disagreement. Stock returns are negatively related to disagreement. Finally, an increase in unemployment is associated with a decline in disagreement.

5 Is Disagreement Priced?

5.1 Disagreement and Expected Returns

To examine whether disagreement about prepayment rates affects the expected returns of mortgage-backed securities, we use the standard approach of regressing ex post realized

returns on the ex ante measures of disagreement and other proxies for risk premia. If disagreement is priced in expected returns, then the disagreement index should have predictive power for the subsequent returns on mortgage backed securities even after controlling for the other ex ante risk premium proxies.

As discussed in Section 3, we make use of a proprietary data set provided to us by a major fixed-income asset management firm to construct a monthly return series on mortgage-backed securities. The lower panel of Table 3 provides summary statistics for the FNMA TBA returns.

Table 5 reports the results from the regression of the monthly mortgage returns on the risk premium and disagreement proxies. The first specification in the table reports the results when only the risk premium proxies are included. The second specification reports the results when the change in the disagreement index added to the regression. To control for other factors besides disagreement that may drive the expected returns of mortgage-backed securities we include a number of ex ante financial and macroeconomic variables in the regression. Note that in forecasting the mortgage-backed security return for month $t+1$, we use only the ex ante values of these variables measured from the end of month $t-1$ to the end of month t. By including the lagged mortgage return, we control for the possibility of persistence in the returns. The various fixed income variables control for any term premia, credit risk premia, or liquidity premia that might be present in expected returns. The stock return and volatility variables potentially capture any equity risk or volatility risk premia in mortgage returns. The refinancing index, inflation, and unemployment variables are include

to control for any macroeconomic related risk premia not captured by the other variables.

As shown in the first specification, the risk premium proxies collectively have a significant amount of predictive power for the mortgage returns. The coefficients for the lagged mortgage return, the change in the mortgage rate, the stock return, and the inflation rate are significant at either the five-percent or ten-percent levels. The adjusted R^2 for the regression is 8.07 percent. Thus, variation in expected mortgage returns is clearly predictable on the basis of these risk premium proxies.

The second specification, however, shows that the predictive power of the regression nearly doubles to 13.83 percent when the disagreement variable is included. The coefficient is positive and highly significant with a t-statistic of 2.88. Thus, the expected return on mortgage-backed securities increases when disagreement increases. This is consistent with the existence of a risk premium for disagreement (i.e., Varian, 1985, 1989; Abel, 1989; David, 2008). Finally, the same risk premium proxies that are significant in the first panel remain significant when the change in disagreement is added to the regression specification.

5.2 Disagreement, Volatility, and Trading Volume

To explore the effects of disagreement on volatility and trading activity we use a simple vector-autoregression (VAR) framework in which we include measures of all three of these variables. To measure mortgage return volatility, we use the daily return data described previously to calculate the standard deviation of returns for each month in the sample period. As the measure of trading volume, we use the total agency mortgage trading volume

of primary government bond dealers reported by the Federal Reserve Bank of New York. This series is aggregated to the monthly level and includes both trading activity among primary government bond dealers and trading activity among customers of these bond dealers. An important advantage of this series is that it covers the trading activity of virtually every major dealer included in the PSA surveys. Summary statistics for the mortgage return volatility and trading volume measures are also presented in the lower panel of Table 3. We estimate the VAR using a specification that includes three lags of the monthly change in the disagreement index, mortgage return volatility, and trading volume.

Table 6 reports the results from the estimation of the VAR system. Focusing first on the regression for disagreement, Table 6 again shows that disagreement is strongly mean reverting since two of the three lagged changes in disagreement are negative and significant. Thus, an increase in disagreement this month tends to be followed by a decrease in disagreement in the next two months. There does not appear to be any significant relation between volatility and subsequent changes in disagreement. The results indicate that there is a relation between trading activity and subsequent changes in disagreement. In particular, changes in trading activity are significantly related to disagreement. The negative sign of the coefficient indicates that an increase in trading volume is associated with lower disagreement in the second subsequent month. This result is intuitive: as investors learn through trade, this gives them opportunities to update their beliefs about the drivers of asset value.

Turning next to the second regression for volatility, we also see that volatility is strongly mean reverting, with all three lagged values of changes in volatility significantly negative.

This is not surprising given the well known properties of return volatility. What is interesting, however, is that there is a strong positive relation between disagreement and subsequent volatility. In particular, the second lagged change in disagreement is positive and highly significant, indicating that an increase in disagreement tends to be followed by higher levels of mortgage return volatility. This effect can be viewed as providing support for Shalen (2003) and Zapatero (1998), who posit that there is a positive correlation between disagreement and price volatility. The results also show that increases in trading activity tend to be followed by higher levels of return volatility. All three lagged values of the change in trading volume are positive and significant.

Finally, turning to the third VAR equation in which changes in trading volume are the dependent variable, Table 6 shows that there is a strong relation between disagreement and trading activity. Both the first and second lagged changes in disagreement are significantly positively related to changes in trading volume. As discussed earlier, this effect can be viewed as providing support for Harris and Raviv (1993) and consistent with the empirical findings in Kandel and Pearson (1995). The results also show that increases in volatility are not significantly related to subsequent changes in trading volume, after controlling for disagreement. This provides evidence that uncertainty only increases trading volume when disagreement arises. Alternatively, disagreement is the mechanism by which uncertainty increases trading in the market. To our knowledge, this is the first paper to identify this relationship. Finally, we again find that trading volume has a mean reverting tendency as both the first and second lagged changes in trading volume and significant and negative in

sign.

6 Concluding Remarks

Understanding how information gets incorporated into asset prices may be one of the most fundamental issues in finance. This paper contributes by helping us to understand whether and how heterogeneous beliefs and differences in opinions are priced in the market. It also clarifies how investors take disagreement into consideration and what effect that has on the time-series of asset prices.

Previous theoretical work tends to support a positive risk premium that is associated with disagreement. Indeed, the equity risk premium as identified by Mehra and Prescott (1985) can be rationalized by introducing heterogeneous beliefs or differences of opinion (Varian, 1985, 1989; Abel, 1989). To our knowledge, this paper is the first academic study to document this fact empirically in a setting in which there are essentially no short-sale constraints or other trade frictions.

Disagreement is also associated with higher volatility and trading volume. This relationship has been studied in theoretical work (Harris and Raviv, 1993; Shalen, 1993; Zapatero, 1998) and documented empirically by Kandel and Pearson (1995). In our paper, we show that disagreement is the primary channel through which uncertainty leads to higher trading volume. That is, volatility in and of itself does not lead to higher trading volume. Rather, it is only when there exists more disagreement that trading volume increases with uncertainty. This distinction has not been identified empirically in previous work.

Finally, disagreement may become incorporated into asset prices via two different mechanisms. As Banerjee (2011) highlights, investors may update their beliefs via a rational expectations mechanism or may agree to disagree, which results in persistent differences in opinion. By studying how return-volume characteristics vary with disagreement in the market, we find support for the rational expectations channel. We find that higher disagreement is associated with higher expected returns, higher subsequent return volatility, and higher trading volume. Especially given our finding that higher trading volume is associated with lower subsequent disagreement, this makes it more likely that rational investors do learn from prices and opinions in the market, updating their beliefs using Bayes rule.

References

Abel, Andrew B. 1989. Asset Prices under Heterogeneous Beliefs: Implications for the Equity Premium. Working paper, University of Pennsylvania.

Acemoglu, Daron, Chernozhukov, Victor, and Yildiz, Muhamet. 2006. Learning and Disagreement in an Uncertain World. NBER Working Paper Series, No. 12648.

Aumann, Rober B. 1976. Agreeing to Disagree. *Annals of Statistics* 4:1236-1239.

Avramov, Doron, Chordia, Tarun, Jostova, Gergana, and Philipov, Alexander. 2009. Dispersion in analysts' earnings forecasts and credit rating. *Journal of Financial Economics* 91:83-101.

Banerjee, Snehal. 2011. Learning from Prices and the Dispersion in Beliefs. *Review of Financial Studies* 24:3025-3068.

Banerjee, Snehal, and Kremer, Ilan. 2010. Disagreement and Learning: Dynamic Patterns of Trade. *Journal of Finance* 65:1269-1302.

Basak, Suleyman. 2005. Asset Pricing with Heterogeneous Beliefs. *Journal of Banking and Finance* 29:2849-2881.

Blackwell, David, and Dubins, Lester. 1962. Merging of Opinions with Increasing Information. *Annals of Mathematical Statistics* 33:882-886.

Boehme, Rodney, Danielsen, Bartley, Kumar, Praveen, and Sorescu, Sorin. 2009. Idiosyncratic Risk and the Cross-Section of Stock Returns: Merton (1987) meets Miller (1997). *Journal of Financial Markets* 12:438-468.

Chatterjee, Sris, John, Kose, and Yan, An. 2012. Takeovers and Divergence of Investor Opinion. *Review of Financial Studies* 25, 227-277.

Chen, Hui, Joslin, Scott, and Tran, Ngoc-Khanh. 2010. Affine Disagreement and Asset Pricing. *American Economic Review: Papers and Proceedings* 100, 522-526.

Chen, Joseph, Hong, Harrison, and Stein, Jeremy C. 2002. Breadth of Ownership and Stock Returns. *Journal of Financial Economics* 66, 171-205.

David, Alexander. 2008. Heterogeneous Beliefs, Speculation, and the Equity Premium. *Journal of Finance* 63:41-83.

Diether, Karl B., Malloy, Christopher J., and Scherbina, Anna. 2002. Differences of Opinion and the Cross Section of Stock Returns. *Journal of Finance* 57:2113-2141.

Fabozzi, Frank, Bhattacharya, Anand, and Berliner, William. 2007. Mortgage-Backed Securities, Products, Structuring, and Analytical Techniques. John Wiley & Sons: Hoboken, NJ.

Fama, Eugene F., and French, Kenneth R. 2007. Disagreement, Tastes, and Asset Prices. *Journal of Financial Economics* 83:667-689.

Geanakoplis, John D., and Polemarchakis, Heraklis M. 1982. We Can't Disagree Forever. *Journal of Economic Theory* 28:192-200.

Harris, Milton, and Raviv, Artur. 1993. Differences of Opinion Make a Horse Race. *Review of Financial Studies* 6:473-506.

Hayre, Lakhbir. 2001. Salomon Smith Barney Guide to Mortgage Backed Securities. Lakhbir Hyre, ed., John Wiley & Sons: Hoboken, NJ.

Kandel, Eugene and Pearson, Neil D. 1995. Differential Interpretation of Public Signals and Trade in Speculative Markets. *Journal of Political Economy* 103, 831-872.

Liu, Clark and Seasholes, Mark. 2011. Dual-Listed Shares and Trading. Working paper, Hong Kong University of Science and Technology.

Mehra, Rajnish and Prescott, Edward C. 1985. The Equity Premium: A Puzzle. *Journal of Monetary Economics* 15, 145-161.

Miller, Edward M. 1977. Risk, Uncertainty, and Divergence of Opinion. *Journal of Finance* 32:1151-1168.

Moeller, Sarah, Schlingemann, Frederik, and Stulz, Rene. 2007. How Do Diversity of Opinion and Information Asymmetry Affect Acquirer Returns? *Review of Financial Studies* 20, 2047-2078.

Park, Cheolbeom. 2005. Stock Return Predictability and the Dispersion in Earnings Forecasts. *Journal of Business* 78:2351-2376.

Shalen, Catherine T. 1993. Volume, Volatility, and the Dispersion in Beliefs. *Review of Financial Studies* 6:405-434.

Varian, Hal R. 1985. Divergence in Opinion in Complete Markets: A Note. *Journal of Finance* 40:309-317.

Varian, Hal R. 1989. Differences of Opinion in Financial Markets. Chapter 1 in *Financial Risk: Theory, Evidence, and Implication*, edited by Courtney C. Stone, Kluwer Academic Publishers, Boston, MA.

Vickery, James, and Wright, Joshua. 2010. TBA Trading and Liquidity in the Agency MBS Market. *Federal Reserve Bank of New York Staff Reports* no. 468.

Yu, Jialin. 2011. Disagreement and return predictability of stock portfolios. *Journal of Financial Economics* 99:162-183.

Zapatero, Fernando. 1998. Effects of financial innovations on market volatility when beliefs are heterogenous. *Journal of Economic Dynamics and Control* 22:597-626.

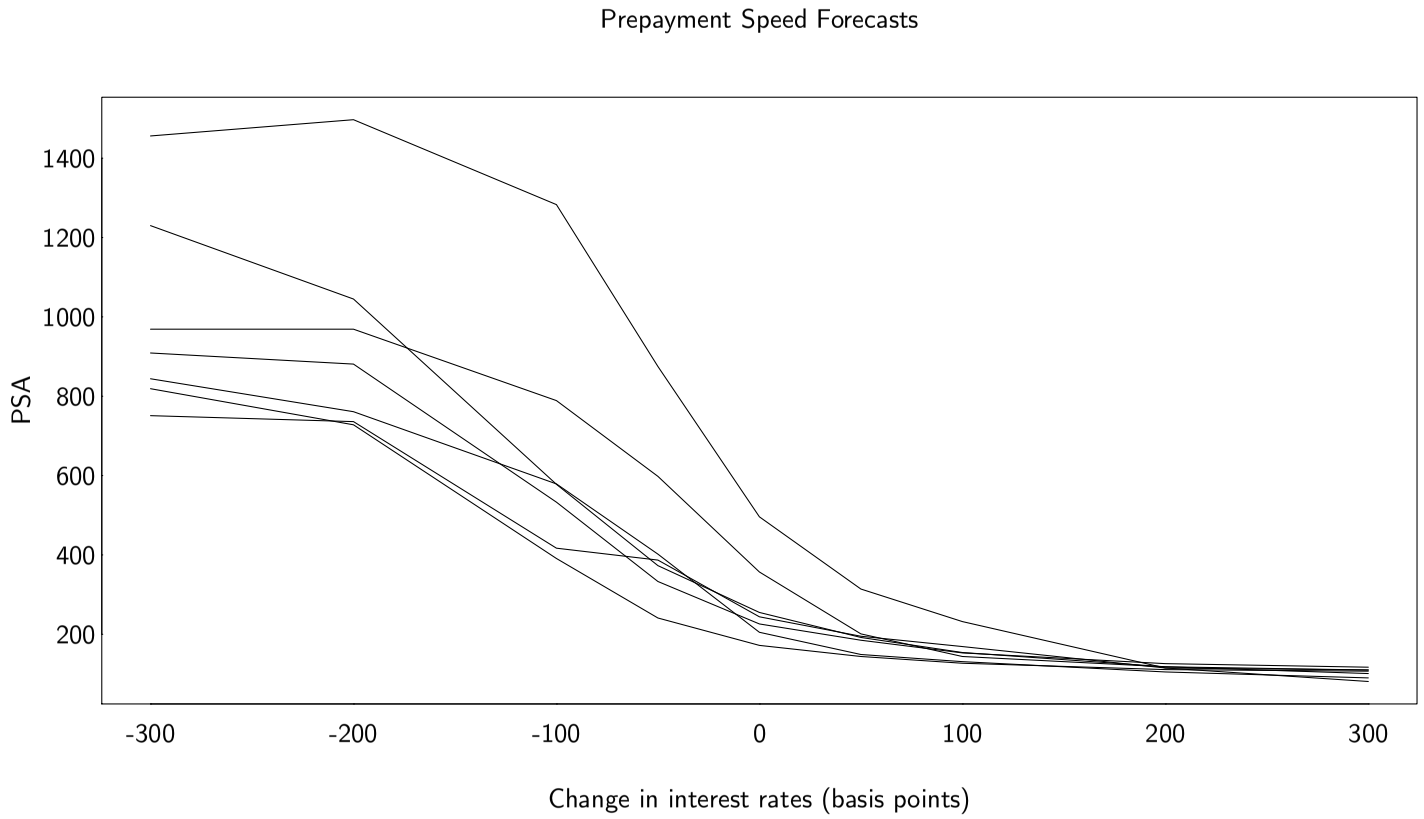


Figure 1. Prepayment speed forecasts. This figure plots the PSA forecasts from seven mortgage dealers for a GNMA mortgage security with a 4 percent coupon on January 31, 2012. Each dealer provided forecasts for nine term structure scenarios ranging from an upward shift of 300 basis points to a downward shift of 300 basis points.

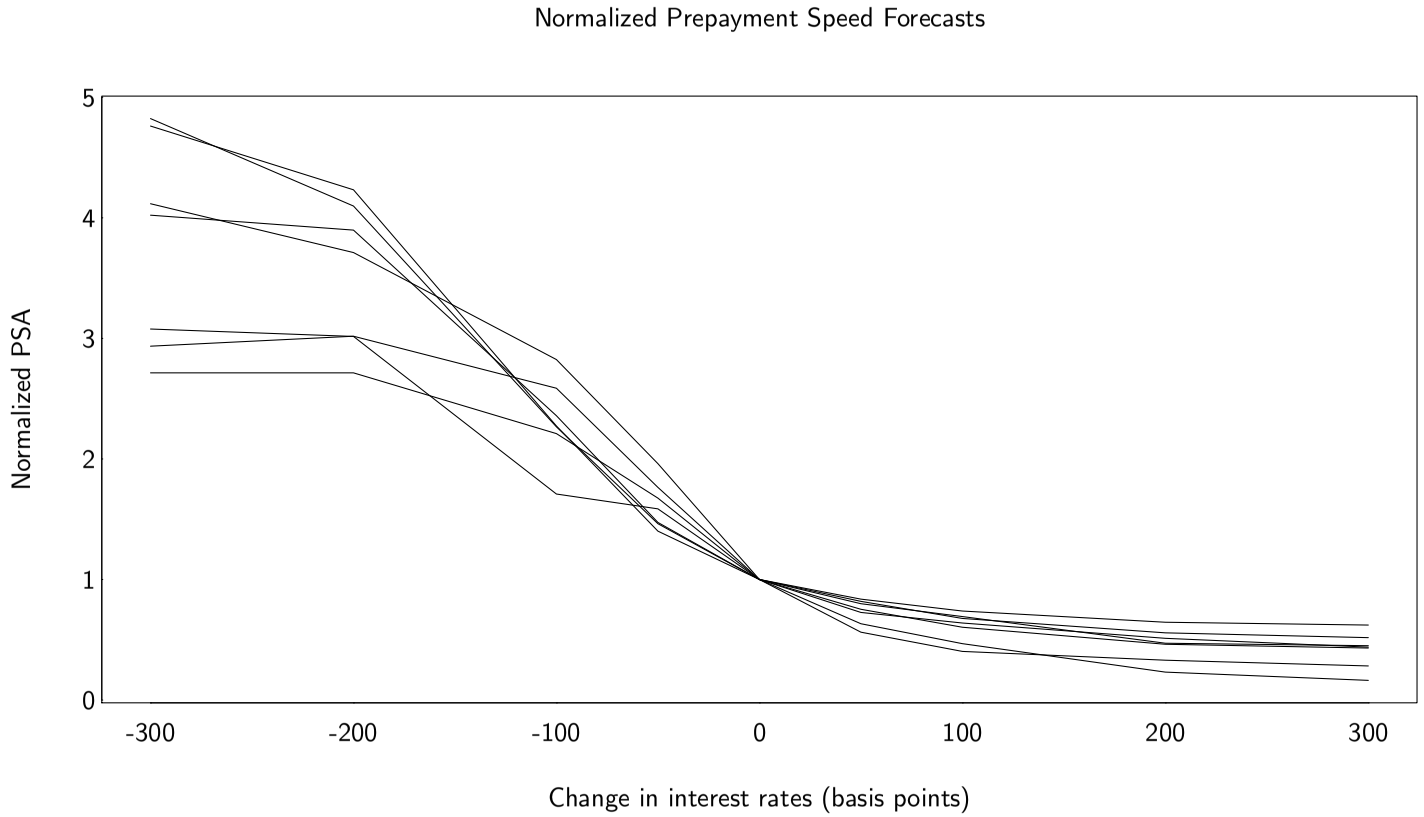


Figure 2. Normalized prepayment speed forecasts. This figure plots the prepayment forecasts described in Figure 1, scaling each dealer's forecast by their forecast for no change in interest rates.

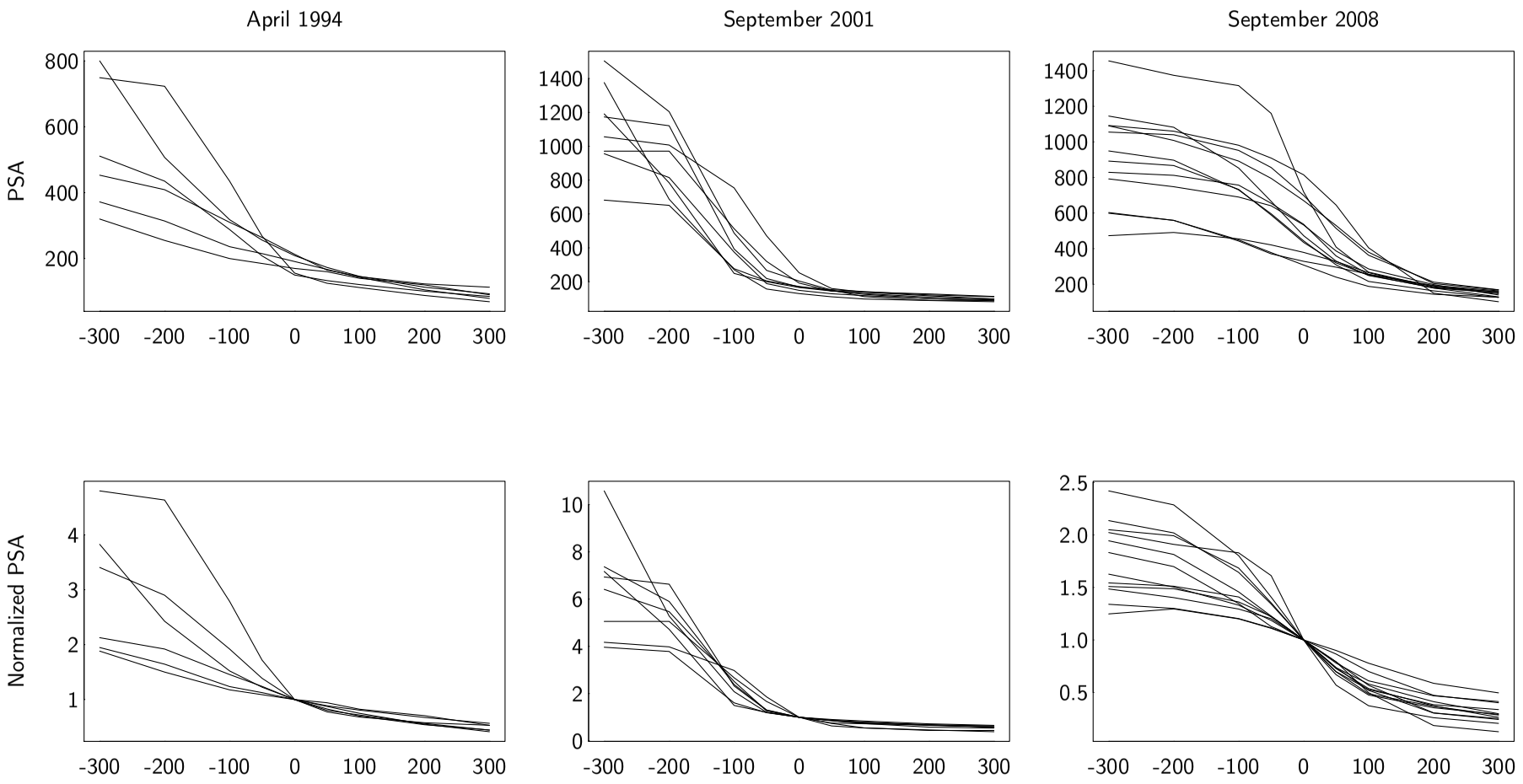


Figure 3. Prepayment speed forecasts. This figure plots prepayment forecasts and normalized forecasts for three distinct time periods: the failure of Askin Capital Management in 1994, the attacks of September 11, 2001, and the failure of Lehman Brothers in 2008. As in Figure 1, the top three plots show the cross-section of dealer prepayment forecasts for nine interest rate scenarios ranging from 300 basis above the current rate to 300 basis points below. As in Figure 2, the bottom row shows normalized prepayment forecasts for the same nine interest rate scenarios.

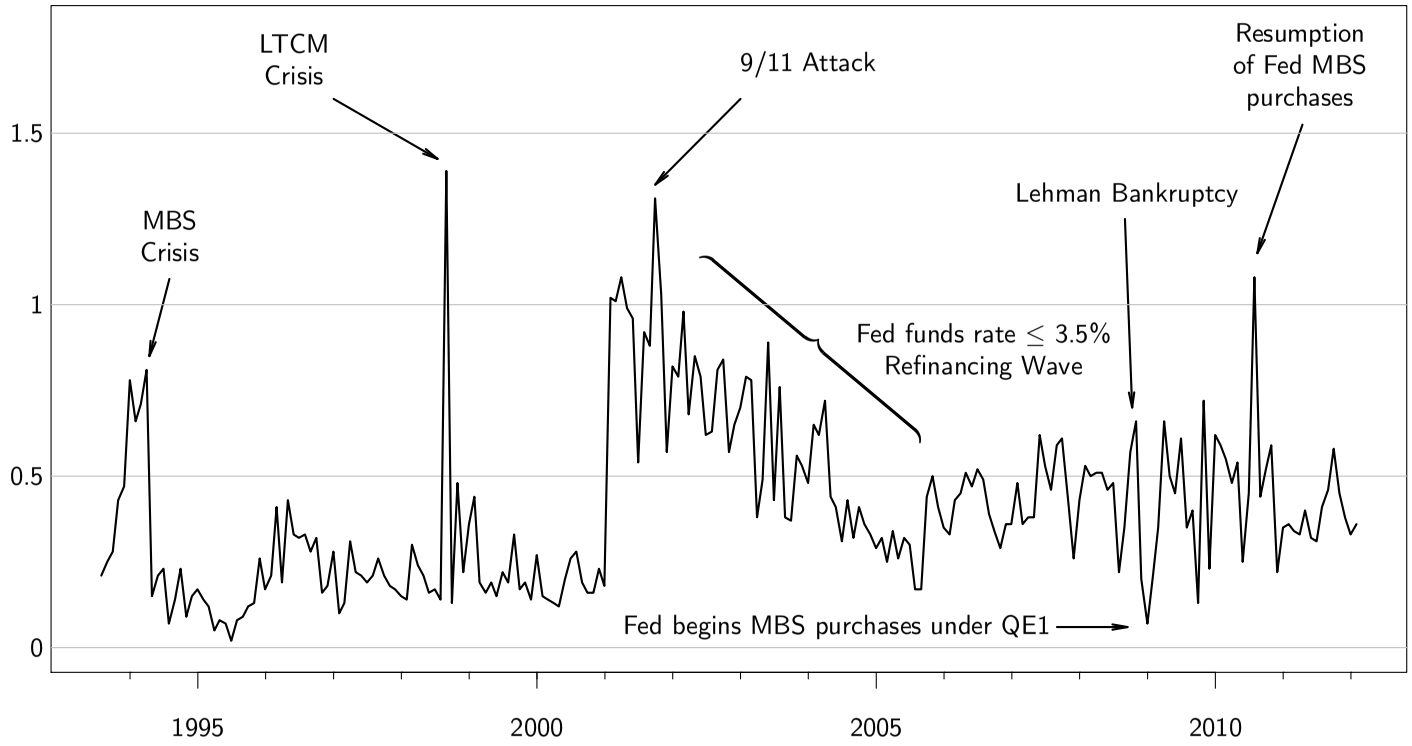


Figure 4. The time series of disagreement: July 1993 through January 2012. The disagreement measure is the cross-sectional standard deviation of a dealer's normalized prepayment duration forecast, which is the ratio between the normalized forecast prepayment forecasts conditional upon a -100 and a +100 basis point shift in the term structure. We use the forecast on the instrument having a coupon closest to the current par yield, which generally has the best coverage and most uniform terms.

Table 1

An Example of the PSA Forecasts Provided by Survey Participants. This table shows the PSA forecasts provided by the survey participants on January 31, 2012 for a four-percent GNMA mortgage backed security. The PSA forecasts are given for term structure scenarios ranging from a downward shift of 300 basis points to an upward shift of 300 basis points. The PSA forecasts for the current term structure are given in the column denoted by zero. Maturity denotes the weighted-average maturity of the mortgages underlying the GNMA mortgage backed security. Coupon denotes the weighted-average coupon or mortgage rate of the mortgages underlying the GNMA mortgage backed security.

			Term Structure Shift in Basis Points								
Dealer	Maturity	Coupon	−300	−200	−100	−50	0	50	100	200	300
Barclays	348	4.00	819	728	391	241	172	144	127	111	107
Bank of America	358	4.00	909	881	533	333	226	185	153	126	117
Credit Suisse	357	4.00	969	969	789	598	357	201	144	118	101
Deutsche Bank	359	4.00	1230	1045	578	373	255	192	154	118	110
JP Morgan Chase	354	4.00	844	761	579	402	205	149	131	105	90
Morgan Stanley	356	4.00	1456	1497	1283	875	496	314	232	115	81
UBS Warburg	355	4.00	751	736	417	387	244	195	169	115	110

Table 2

Summary Statistics for PSA Forecasts Provided by Survey Participants. This table provides reports summary statistics for the PSA forecasts provided by each of the participants in the survey. Number of Months denotes the number of months that the participant provided forecasts. Total Observations denotes the total number of forecasts provided by the participant. Average Number of Observations denotes the average number of forecasts provided by the participant during months in which the participant provided forecasts. Average Ratio denotes the average ratio of the PSA forecast provided by the participant to the average PSA forecast provided by the other participants for the same mortgage backed security that month. Standard Deviation of Ratio is the standard deviation of the average ratio.

Dealer	Number of Months	Total Observations	Average Number of Observations	Average Ratio	Standard Deviation of Ratio
Barclays	66	679	10.29	0.967	0.262
Bank of America	129	1157	8.97	1.091	0.269
Bear Stearns	181	1228	6.78	0.993	0.161
Credit Suisse	223	2145	9.62	0.985	0.227
Deutsche Bank	95	801	8.43	0.903	0.271
Donaldson, Lufkin, and Jenrette	56	504	9.00	1.011	0.212
Goldman Sachs	116	1009	8.70	1.025	0.295
Greenwich Capital	84	762	9.07	1.059	0.271
HSBC	14	70	5.00	1.072	0.119
JP Morgan Chase	107	1022	9.55	1.069	0.258
Lehman Brothers	144	826	5.74	0.919	0.167
Merrill Lynch	188	2009	10.69	0.999	0.174
Morgan Stanley	133	1212	9.11	1.089	0.322
Nations Bank	20	140	7.00	0.901	0.223
Prudential	92	671	7.29	0.948	0.130
Salomon Brothers	182	1524	8.37	0.978	0.245
Smith Barney	44	286	6.50	1.026	0.186
UBS Warburg	223	1617	7.25	0.977	0.232
Total	223	17662	8.42	1.002	0.242

Table 3

Descriptive Statistics for the Disagreement Index, Mortgage Returns, Mortgage Return Volatility, and Mortgage Trading Volume. This table reports the indicated summary statistics for the disagreement index (top panel), and for monthly FNMA mortgage backed security returns, monthly mortgage return volatility (calculated as the standard deviation of daily mortgage returns for each month in the study period), and total monthly mortgage trading volume (in $billions) by U.S. primary government bond dealers as reported by the New York Federal Reserve Bank. Mortgage returns and volatility are expressed as percentages.

Variable	Mean	Standard Deviation	Minimum	Median	Maximum	Serial Correlation	N
Disagreement Index	0.4029	0.2480	0.0196	0.3543	1.3860	0.6198	223
Mortgage Returns	0.2069	0.8715	−4.2850	0.2222	1.9926	0.1077	165
Mortgage Return Volatility	0.1781	0.0922	0.0441	0.1609	0.5331	0.6715	165
Mortgage Trading Volume	938.65	444.94	212.56	992.31	1917.80	0.8959	165

Table 4

Results from the Regression of the Disagreement Index on Contemporaneous Variables. This table reports the results from the regression of the disagreement index on its first two lags and on the indicated contemporaneous financial and economic variables. Refinancing denotes the refinancing index reported by the Mortgage Bankers Association. Mortgage Rate denotes the current coupon rate for GNMA I mortgages as reported by Bloomberg. VIX denotes the S&P 500 volatility index as reported by Bloomberg. Treasury Volatility denotes the Merrill Lynch MOVE index of Treasury Volatility as reported by Bloomberg. Slope is the difference between the constant maturity ten-year and two-year Treasury rates as reported by the Federal Reserve Board. Stock Return denotes the monthly excess return on the CRSP Value Weighted Index. Inflation is computed from the CPI-U index (nonseasonally adjusted) reported by the Bureau of Labor Statistics. Unemployment is the unemployment rate reported by the Bureau of Labor Statistics. The monthly sample period is from July 1993 to January 2012. The reported t-statistics are based on the Newey-West estimate of the covariance matrix (with four lags). The superscript ** denotes significance at the five-percent level; the superscript * denotes significance at the ten-percent level.

Variable	Coefficient	t-Statistic
Intercept	0.26806	1.94^{*}
Index_{t-1}	0.28294	2.71^{**}
Index_{t-2}	0.29352	4.27^{**}
Refinancing	0.02140	2.13^{**}
Mortgage Rate	0.01088	0.88
VIX	0.00446	2.01^{**}
Treasury Volatility	−0.00210	-2.81^{**}
Slope	0.08068	3.04^{**}
Stock Return	−0.00979	-2.03^{**}
Inflation	2.93231	1.51
Unemployment	−0.02856	-2.25^{**}
Adjusted R^2		0.5188
N		223

Table 5

Results from the Regression of Monthly Mortgage Returns on Ex Ante Mortgage Disagreement, Financial, and Economic Variables. This table reports the results from the regression of the monthly mortgage return on the indicated ex ante variables, all of which are observed as of the end of the prior month. Riskless Rate denotes the yield on one-month Treasury bills. Mortgage Rate denotes the current coupon rate for GNMA I mortgages as reported by Bloomberg. Refinancing denotes the refinancing index reported by the Mortgage Bankers Association. Slope is the difference between the constant maturity ten-year and two-year Treasury rates as reported by the Federal Reserve Board. Corporate Credit Spread is the difference in the yields of Baa and Aaa rated bonds as reported by the Federal Reserve Board. Ten-Year Swap spread is the difference between ten-year swap rates and the ten-year constant maturity Treasury rate as reported by Bloomberg. Stock Return denotes the monthly excess return of the CRSP Value Weighted Index. VIX denotes the S&P 500 volatility index as reported by Bloomberg. Treasury Volatility denotes the Merrill Lynch MOVE index of Treasury volatility as reported by Bloomberg. Inflation is computed from the CPI-U index (nonseasonally adjusted) reported by the Bureau of Labor Statistics. Unemployment is the unemployment rate reported by the Bureau of Labor Statistics. The monthly sample period is April 1998 to January 2012. The reported t-statistics are based on the Newey-West estimate of the covariance matrix (with four lags). The superscript ** denotes significance at the five-percent level; the superscript * denotes significance at the ten-percent level.

Variable	Coefficient	t-Statistic	Coefficient	t-Statistic
Intercept	0.00406	2.72**	0.00394	2.68**
Lagged Mortgage Return	0.57504	2.65**	0.64849	3.28**
Change in Riskless Rate	−0.00134	−0.47	−0.00047	−0.16
Change in Mortgage Rate	0.01712	2.79**	0.01939	3.18**
Refinancing	−0.00094	−1.58	−0.00091	−1.57
Change in Slope	−0.00103	−0.31	−0.00086	−0.26
Change in Corporate Credit Spread	0.00147	0.32	0.00306	0.68
Change in Ten-Year Swap Spread	0.00277	0.30	0.00595	0.65
Stock Return	−0.00053	−2.65**	−0.00049	−2.30**
Change in the VIX Index	−0.00030	−1.17	−0.00041	−1.57
Change in Treasury Volatility	−0.00001	−0.26	−0.00001	−0.09
Inflation	−0.17363	−1.89*	−0.20228	−2.22**
Change in Unemployment	−0.00385	−0.93	−0.00417	−1.09
Change in Disagreement Index			0.00928	2.88**
Adjusted R^2		0.0807		0.1383
N		165		165

Table 6

VAR Estimation of Monthly Changes in Disagreement, Mortgage Return Volatility, and Mortgage Trading Volume. This table reports the results from VAR estimation of the three indicated equations, where the dependent variable in each specification is shown in the column heading. Disagreement denotes the disagreement index. Volatility denotes the standard deviation of mortgage returns computed using daily returns each month. Trading Volume denotes the total trading volume of mortgage backed securities by primary government bond dealers as reported by the Federal Reserve Bank of New York. The VAR is estimated using monthly data for the April 1998 to January 2012 period. The reported t-statistics are based on the Newey-West estimate of the covariance matrix (with four lags). The superscript ** denotes significance at the five-percent level; the superscript * denotes significance at the ten-percent level.

		Change in Disagreement		Change in Volatility		Change in Trading Volume	
Variable	Lag	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic
Intercept		−0.00161	−0.12	−0.00009	−0.14	0.00971	0.77
Change in Disagreement	1	−0.59158	−4.58**	0.00052	0.16	0.13705	2.49**
Change in Disagreement	2	−0.27546	−2.24**	0.01746	3.38**	0.12737	2.58**
Change in Disagreement	3	−0.19971	−2.46**	0.00317	0.77	0.04341	0.69
Change in Volatility	1	1.21180	1.08	−0.29826	−4.27**	−0.04704	−0.03
Change in Volatility	2	−0.57288	−0.53	−0.27740	−3.71**	−1.74449	−1.65
Change in Volatility	3	−0.02100	−0.02	−0.19749	−2.82**	−1.01908	−0.95
Change in Trading Volume	1	−0.04493	−0.54	0.00837	1.67*	−0.63393	−5.79**
Change in Trading Volume	2	−0.21791	−2.03**	0.01619	2.17**	−0.22545	−2.20**
Change in Trading Volume	3	−0.17262	−1.86*	0.01690	2.49**	0.14746	1.65
Adj. R^2			0.3174		0.2380		0.3169
N			165		165		165