

Does the term structure of corporate interest rates predict business cycle turning points?

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Abstract

The Treasury Yield Curve has been a very accurate leading economic indicator for the past 60 years—though normally sloping upward, it has inverted prior to every recession in that time period with only two false alarms. Even in those two cases, marked slowdowns in economic activity followed the inversions within the standard time period of four to six quarters. Despite the consistency, economists have not developed a widely accepted theory as to how this term structure of interest rates is able to predict business cycle turning points. This paper looks at term structures derived from corporate interest rates in an effort to compare them to that of the Treasury, with the hopes of shedding some light on their predictive ability. Through the use of various regressions, the paper finds that corporate interest rates are not as successful at predicting recession as Treasury interest rates. The paper then hypothesizes that the reasoning for this difference has to do with the government’s role in the Treasury security market and/or Treasury securities’ “risk-free” designation.

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“Predicting the future has always fascinated humans, and economic forecasting doubles the interest by adding a chance to turn profit.”

- Joseph Haubrich, Federal Reserve Bank of Cleveland¹

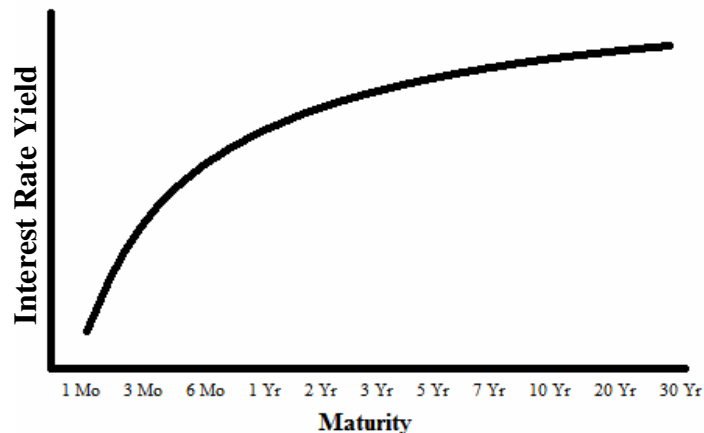
¹ Haubrich, Joseph. “Does the Yield Curve Signal Recession?” Federal Reserve Bank of Cleveland. Pg. 1.

1 Introduction

1.1 The Yield Curve

The goal of this thesis is to determine if the slope of the term structure of corporate interest rates helps to predict the turning point of the business cycle from boom into recession. The term structure of interest rates, or yield curve, is a relationship between interest rate yields and their maturity, and the most commonly referenced curve is the Treasury Yield Curve. Treasury securities are grouped into three categories: Treasury bills mature in one year or less, Treasury notes mature in two to ten years, and Treasury bonds mature in twenty to thirty years. Therefore, a Treasury Yield Curve is composed of the yields of each of these securities, whose maturities span from one month to thirty years, at any given moment. A typical curve might look like the one depicted in Figure 1, which noticeably slopes upward.

Figure 1

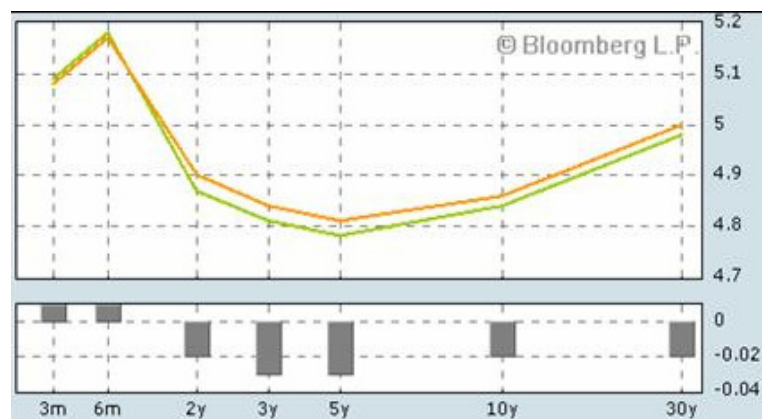


The Treasury Yield Curve is important because it acts as a leading economic indicator: the conventional wisdom is that the yield curve inverts in advance of the business cycle turning point (peak) with short-term interest rates rising above long-term interest rates. In other words, while the curve usually slopes upward, when it is

downward sloping, or “inverted,” a recession generally begins sometime in the following four to six quarters.² For example, Figure 2 is a snapshot of the inverted Treasury Yield Curve as of August 19, 2006, which preceded by five quarters the recession beginning in December 2007 (as defined by the National Bureau of Economic Research³). Figure 3 bears out the historical relationship between yield curve inversions, as measured by the spread between the ten year Treasury bill and three month Treasury note rates, and the quarterly percent change in Gross Domestic Product, as measured by the Bureau of Economic Analysis. This spread, and the ten year to two year spread, are the most common measures of the shape of the yield curve, and an inversion is defined as a spread less than or equal to zero. Figure 3 shows that since 1960, the Treasury Yield Curve has inverted eight times, and seven of those times a recession followed. The exception, an inversion in 1966, was still followed by a “credit crunch” and decline in production later that year.

Figure 2

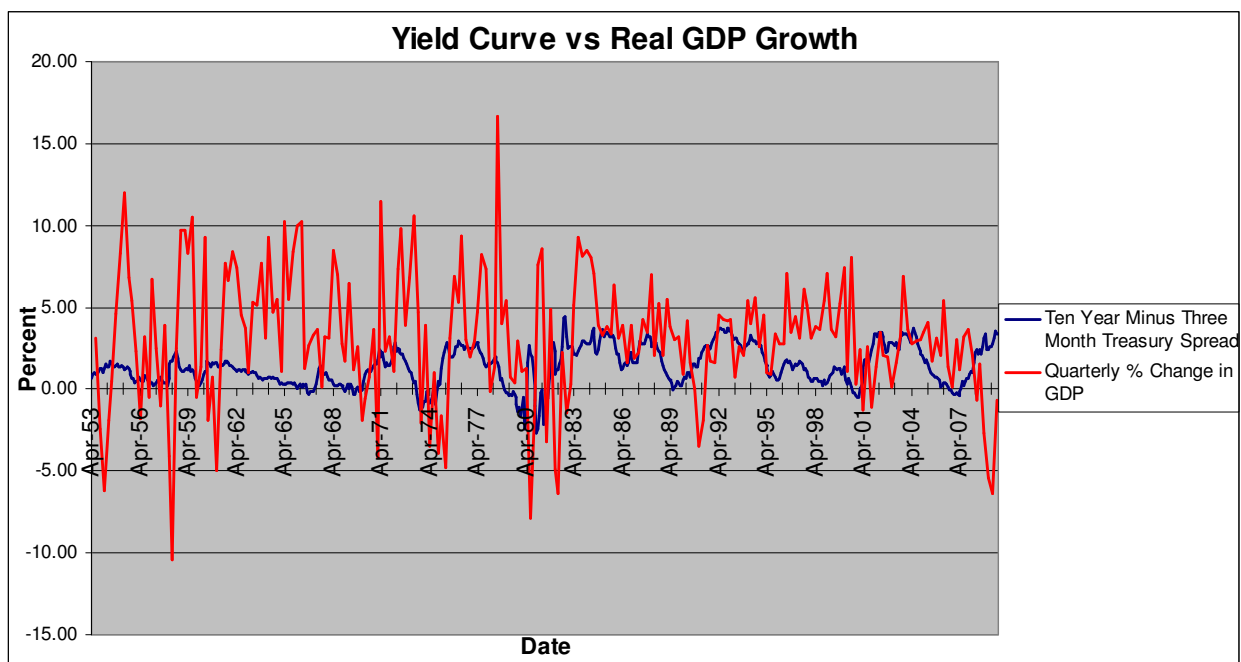
Yield curve. Source: Bloomberg. Accessed 11/9/09 at http://www.econbrowser.com/archives/2006/08/the_yield_curve_1.html



² Estrella, Arturo. “The Yield Curve as a Leading Indicator: Frequently Asked Questions.” October 2005. Pg. 2.

³ National Bureau of Economic Research. *Determination of the December 2007 Peak in Economic Activity*. <http://www.nber.org/cycles/dec2008.pdf>

Figure 3



Two questions arise upon reviewing this data: what is the significance of an economic leading indicator, and why is the curve proved to be such an accurate one? To the first question, the forecasting power of the yield curve is of interest to those in the fields of economics, finance, and perhaps even psychology. The ability to predict oncoming recessions would be beneficial to the field of economics in that fiscal and monetary policy are more effective the sooner they are implemented, and conceivably could be used to avoid recessions or lower their negative impact. Those in finance would welcome an accurate, well understood predictor for business cycles so that they could better time their investments and earn higher profits. Psychologists would be interested in the aspect of market expectations, which is the basis for the most widely accepted theory that explains the Treasury Yield Curve's behavior. The second question remains to be unanswered, and while this paper does not seek to answer it outright, it does seek to

add research to the debate. This paper will explore what is known about the Treasury Yield Curve, and will try to determine if a yield curve derived from corporate interest rates share the same power of prediction.

1.2 Corporate Debt

Corporate bonds differ from the standardized securities issued by the Treasury Department in that they are issued by thousands of businesses with varying levels of financial health. Therefore, corporate bonds are categorized not just by maturity (corporate paper refers to issued debt with a maturity of 270 days or less), but also by grades issued by ratings agencies such as Moody's and Fitch, who analyze each company's health. Grades of Aaa and AAA, respectively, are the highest and mean the associated bonds are considered the least risky, and thus generally have the lowest interest rate.

The most important difference between Treasury and corporate debt, and the basis for this paper, is that the corporate debt market is free from direct government influence. Treasury security yields are affected in the primary market through the Treasury Department's decision of how much debt to issue at a given time, and what its maturity will be. As part of the United States government, these decisions are influenced by budgeting issues, but also perhaps by government initiatives to influence interest rates. Similarly, the Federal Reserve purchases and sells Treasury securities explicitly with the intent of influencing interest rates, so as to properly manage economic growth and stability. That the government does not buy or sell in the primary or secondary corporate bond market means that it ought to be a more pure form of market expectations, which as

previously mentioned, is the basis for the most widely accepted theory explaining the behavior of the Treasury Yield Curve, and will be explained in the next section.

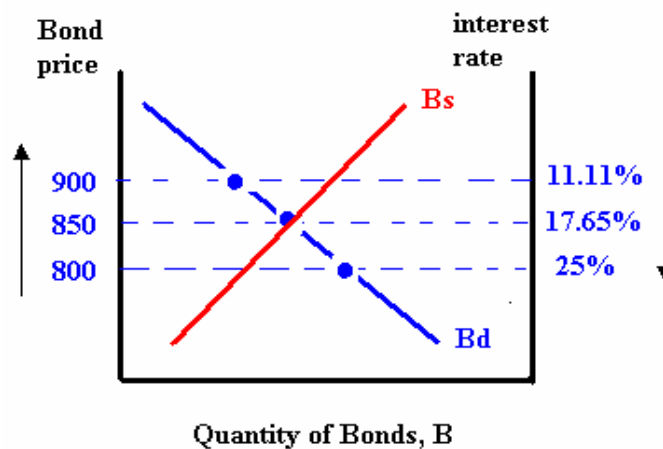
2 Characteristics of Bonds

2.1 Bond Pricing and Markets

Before moving forward, it will be useful to discuss different characteristics of bonds, beginning with how they are priced. Bond prices are determined in a similar fashion to most other assets—as a function of supply and demand. Suppliers issue bonds in order to borrow money from investors, who cumulatively make up demand in a given bond market. What is unique about the bond market is that the most relevant and often quoted characteristic of a bond is not the price, but the interest rate. Bond prices are a function of, and inversely related to, the interest rate, as seen in Figure 4.

Figure 4

<http://www.oswego.edu/~edunne/image45.gif>



Generally speaking, there are two types of bonds. Zero-coupon bonds, such as Treasury bills are purchased at a given value and the investor is repaid a redemption value at the end of the maturity period. The interest rate, or yield to maturity, is the rate

which equates the two values for the given time period. Coupon bonds, such as Treasury notes or bonds, are also purchased at a given value and pay a redemption value at the end of the maturity period, but also pay interest (coupon payments) in between, often two times a year. The yield to maturity is the interest rate (not the coupon rate) that equates all payments with the purchasing value. The differences in bond structure can be seen in the following equations:

$$\text{Zero-Coupon Price} = \frac{\text{Redemption Value}}{(1 + \text{interest rate})^{\text{length of investment}}}$$

Coupon

$$\text{Bond Price} = \left(\sum_0^{\text{length of investment}} \frac{\text{Coupon Payment}}{(1 + \text{interest rate})^{\text{time period}}} \right) + \frac{\text{Redemption Value}}{(1 + \text{interest rate})^{\text{length of investment}}}$$

There are several common factors that drive supply and demand in the bond market. Increases in investor wealth, the expected return on bonds, and the liquidity of bonds relative to other assets result in an increase in demand. The additional wealth means investors have more to invest, while the increased expected return and liquidity make bonds a more attractive investment. Increases in the expected interest rate, inflation rate, and riskiness of bonds relative to other assets decrease the demand for bonds. Higher interest and inflation rates lower the expected return for bonds, while added risk makes bonds a less attractive investment. On the supply side, expected increases in economic output and inflation increase the supply of bonds, as do higher government deficits. Economic growth yields profitable investment opportunities that businesses want to raise money for, while inflation lowers the real cost of raising that debt. Higher deficits lead to more bonds being issued in order to bridge budget gaps.

2.2 Bond Theories

Joseph Haubrich, a vice president at the Federal Reserve Bank of Cleveland, wrote that “economists do not currently have a well-accepted theory of why the yield curve predicts future economic growth⁴.” However, there are noticeable repeated behaviors by the curve and established theories that help to explain this behavior and the curve’s underlying components. One observation is that interest rates on bonds of different maturities tend to move together over time. For example, if the Federal Reserve raises the short-term interest rate target, the entire Treasury Yield Curve is likely to shift upward, not just the short-maturity end. This can be explained by the Expectations Theory of the term structure of interest rates, which states that the interest rate on a long-term bond will equal an average of short-term interest rates that the market expects to occur over the life of the long-term bond. The assumption that this theory relies on is that bonds of different maturities are perfect substitutes in the eyes of investors, and thus the expected returns on those bonds must be equal. Historically, if short-term rates rise, future rates are more likely to be higher, and thus the Expectations Theory explains why rates move together.

The Expectations Theory also explains another observation that characterizes the Treasury Yield Curve: when short-term rates are low, the curve is more likely to slope upward, while when they are high, the curve is more likely to slope downward. These characteristics are a result of the market expecting low or high rates to move to a more moderate level in the future. Intuitively, low rates are probably the result of the Federal Reserve having a low Discount Rate and/or Federal Funds target, which often occur when

⁴ Haubrich, Joseph. “Does the Yield Curve Signal Recession?” Federal Reserve Bank of Cleveland. Pg. 3.

the economy needs stimulating through monetary policy. Interest rates that are left too low for too long can lead to asset bubbles or inflationary environments however, and therefore the market expects rates to be raised in the future. Conversely, high short-term rates are probably the result of the Federal Reserve targeting high inflation (and the market demanding high interest payments to account for rampant inflation), but these rates will slow down economic output and thus the market expects a return to lower rates in the future.

A third observation is that the Treasury Yield Curve nearly always slopes upward, except in the case of recession. Utilizing the Expectations Theory, this would mean that interest rates are more likely to rise in the future rather than fall, whereas in reality either is just as likely. The Segmented Markets Theory looks at the markets for bonds of different maturities as completely separate, and thus pricing of a long-term bond is independent of a short-term bond. The markets are segmented because investors are assumed to have a personal preferential holding period. For example, an investor who needs funding in three years would only be interested in the markets for bonds with maturities of three years or less. Due to this segmentation, bonds are priced based on the supply and demand for that specific maturity range, and generally the demand for short-term bonds is higher than for long-term bonds. As a result, prices for short-term bonds are higher and interest rates are lower.

All three observations are true, and yet only when the two defined theories are combined are they all explainable. The Segmented Markets Theory, which by definition separates the bond market by maturity, cannot explain why interest rates tend to move together, or why the curve tends to slope upward when short-term rates are high, and vice

versa. The Liquidity Premium Theory and Preferred Habitat Theory, however, do indeed explain all three observations, and draw from the two other theories. The Liquidity Premium Theory builds on the Expectations Theory, in that it considers bonds of different maturities as substitutes, but not perfect substitutes since long-term bonds carry a higher interest rate risk. Therefore, to account for that increase in risk, long-term rates are based not only on expectation of future rates, but also have an added “liquidity premium.” The Preferred Habitat Theory states a similar conclusion through slightly different reasoning, assuming investors prefer short-term bonds due to increased liquidity and decreased interest rate risk. Therefore, they are only willing to hold long-term bonds if the interest rate is higher in order to entice them to do so. Both of these theories explain why interest rates move together, why the shape of the curve is often dependent on the short-term interest rate, and also why long-term rates are almost always higher than short-term rates.

2.3 Theoretical Basis for Thesis

Considering the specific aspects of supply and demand and the behavioral theories, the aforementioned differences between the Treasury and corporate bond markets can now be expanded upon. In the Treasury market, demand consists of both private investors as well as the Federal Reserve. While private investors represent market expectations, the Federal Reserve acts with a separate agenda since it buys or sells the securities with the goal of manipulating the market to achieve a target rate. The Federal Reserve has its own expectations about the economy, but acts with enough buying power (and by making statements to the press) to perhaps change those expectations. On the supply side, the Treasury Department issues the securities in the primary market, and

both government agencies and private investors may be active in the secondary market. The Treasury Department's reasons for issuing varying levels of securities can be related to the budget, or might be coordinated with the Federal Reserve to achieve some target interest rate. These government interferences all complicate the idea of the role of expectations being the driving force behind the yield curve. However, in the corporate bond market, the demand side is composed of private investors (or perhaps government agencies, pensions, etc. who act independent of fiscal and monetary policy goals), while the supply side is composed of businesses raising capital. Thus, the entire market is made up of those who are interested in obtaining profit, and the effects of future interest rates, inflation rates, and market cycles.

If expectations play a role in every theory that explain the yield curve behavior, then it is logical to believe that the reason the Treasury Yield Curve predicts recession is that the market expects it. These expectations should then manifest themselves in the corporate yield curve, which should then also predict recession with the same consistency. If it does not, then this would support the notion that the government intervention in the Treasury security market plays a role in shaping the yield curve such that it inverts prior to a recession. For example, perhaps having a better understanding of the economy than the market and anticipating a recession, the Federal Reserve buys more Treasury securities to inject money into the economy, increasing demand and driving up prices for mid- or long-term bonds. Interest rates for these securities would as a result be lower, and the yield curve may then invert. Another example might be that, also in anticipation of a recession, the Treasury Department issues less mid- and long-term bonds in order to keep money in the economy, and this decline in supply raises prices and

lowers interest rates, causing the yield curve to invert. Of course there are many other ways the government might influence the Treasury Yield Curve, and if the corporate yield curve does not act in a similar fashion, the evidence will lend credence to that idea.

3 Data

This paper is not the first to look at other interest rates' relationship with business cycles, though Treasury securities are the most commonly observed due to their convenience. Treasury data is available for many maturities and in a consistent format dating back to at least 1950 through the Federal Reserve, and also lacks the credit risk premium that many other rates contain, since Treasuries are often considered "risk-free." Other risk-free rates, such as the short term lending Federal Funds rate, have been looked at, but while they act as an accurate predictor of recession during some time periods, they are much less so in others. Interest rates such as swap and corporate generally have limited availability and also lack much historical depth⁵.

3.1 Bond Data

Despite the scarcity of historical corporate rates, enough data was found in order to generate a basic comparison between the predictive ability of corporate and Treasury rates. The first data set, which contains the most historical depth, is from the Historical Statistics of the United States Millennial Edition Online, provided by Cambridge University. Compiling data from the National Bureau of Economic Research, unpublished data from the investment firm of Scudder, Stevens, and Clark, and the book *A History of Interest Rates*, this data set provides yearly high-grade corporate yields

⁵ Estrella, Arturo. "The Yield Curve as a Leading Indicator: Frequently Asked Questions." October 2005. Pg. 4.

dating back to 1900 (until 1975) for maturities of 1, 5, 10, 20, and 30 years. However, given that the Treasury relationship is only bared out in the post-war period, beginning after 1950, this range was applied to this data as well. Similarly, given the restrictions in the availability of maturities, the relevant spread was calculated as the 10 year to 1 year spread. It has been noted that most term spreads are highly correlated, and thus the actual maturities used are not that important as long as they are far apart from one another. The ten-year to three-month spread used for the Treasuries would tend to be larger than the ten-year to one-year spread used for these corporate rates, and thus would only invert a bit later⁶.

Unfortunately, given that data sets of corporate yields with such longevity are so hard to find, other data sets were needed to piece together in order to extend from 1975 to 2009. While unable to find data for the 1975-1995 period, Standard and Poor provides corporate interest rate data beginning in 1996. This data is organized into 1, 3, 5, 10, 15, and 20 years to maturity, and extends through 2002. However, given the date range for the following data set, only data for the years 1996-1999 were used. Also, to maintain consistency with the Historical Statistics data, a ten-year to one-year spread calculated using AAA (high grade) bonds was utilized for the analysis.

The final data set used was provided by Bank of America Merrill Lynch, and spans from 2000-2009. The data is provided in ranges of maturities, the useful ones being those with 1-3 years until maturity, 7-10 years to maturity, and 10-15 years to maturity. To calculate the relevant spread, an average of the rates from the 7-10 and 10-

⁶ Estrella, Arturo. "The Yield Curve as a Leading Indicator: Frequently Asked Questions." October 2005. Pg. 5.

15 year maturity ranges was used, and the 1-3 maturity range spread was subtracted from it.

Though the data sets' time periods fit nicely in order to piece together one large data set, inconsistencies between those which overlapped demonstrated the need to normalize each one. For example, a fourth data set provided by Bloomberg, spanning from 2002-2009, was compared to that provided by Standard and Poor and Bank of America Merrill Lynch. In October 2002, the Bloomberg average 1 year yield was .4% lower than that of Standard and Poor, and .3% lower for the 10 year maturity. Similarly, the average 1-3 year yield provided by Bank of America Merrill Lynch was 2.12% greater than the 1 year provided by Bloomberg (in part due to the inclusion of 2 and 3 year yields), while the average 10 year maturity was 1.5% larger. Though the Bloomberg data set was not included since the time period of its data was contained within the Bank of America Merrill Lynch set (which had more longevity), it was useful as a consistency check.

The result of these inconsistencies was to normalize every data set by dividing each value by its average, before running the regressions. Analysis was conducted on the normalized data, but also on a discrete variable constructed based on this data. In the latter case, the normalized data was converted such that if the value was less than 100%, it was valued as a 1, whereas if the data was greater than or equal to 100%, it was valued as a zero. This created an additional way to analyze the data, where the spread is determined to be above or below its average, correlating to how the yield curve is shaped compared to its average shape.

3.2 Recession Data

Regarding the occurrence of recession, various methods were attempted before settling on the creation of a discreet dummy variable, valued at 1 in the incidence of recession, and 0 otherwise. The time periods for a given recession were defined by the National Bureau of Economic Research, which designate business cycle expansions and contractions. Though the start and end points are defined as a specific month, the analysis was done on a yearly basis, and thus a year was defined as a recession for only those years in which the recession was most present. For example, the most recent recession began in December 2007 and is expected to have ended in July 2009 (recession dates are generally determined with a substantial lag), and thus would generate the value of 1 for both the years 2008 and 2009. The recession values were then lagged by one year before calculating regressions, so that the relationship defined by the regression would be properly measured as predictive.

The original analysis was done on a monthly basis, and recession values were lagged four, five, and six quarters (12, 15, and 18 months) in order to observe similar relationships to those previously identified with the Treasury securities. However, the regression framework was flawed in that it was mistakenly identifying the relationship between how *long* the yield curve was inverted and how *long* the following recession lasted. The targeted relationship considered whether or not a recession occurred, given a yield curve inversion. For example, when the corporate yield curve became flat/inverted in September 2000, the following 2001 recession can be considered predicted. It does not matter that the curve maintained a similar shape for the next four months before steepening, through the monthly regression takes this into account. Similarly, the 2001 recession began in March, but regarding whether or not it was predicted, it is irrelevant

that the recession lasted until November—this too, however, was accounted for in the regression. As a result, the spread data was annualized in addition to being normalized, so that it properly aligned with the recession data and did not take into account the length of the yield curve inversion.

4 Empirical Implementation

For this paper, interest rates of various maturities were collected and a yield spread (long-term rates minus short-term rates) was computed. This spread was then used as an independent variable in an attempt to account for the dependent variable, the business cycle turning point. In order to test this relationship, three different types of regressions were run on the data. The first was an ordinary least squares regression, which was run twice—once using the continuous, normalized spread and recession dummy variable described in the previous section, and the other using the discrete spread variable and the spread and the dummy recession variable. The second was a multiple regression, which looked at the relationship from a slightly different standpoint by determining if using both the corporate and Treasury spread as independent variables improved the model's ability to account for recession. Lastly, a Probit regression, a type of binary response model, was calculated to better deal with the recession variable, since it is a binary dependent variable.

4.1 Ordinary Least Squares Regression

The model that was tested appears as follows:

$$Recession_t = B_0 + B_1 Spread_{(t-1)} + \varepsilon$$

The relationship between the Treasury spread and occurrence of recession is an established one, and was demonstrated visually in Figure 3. In order to test for a

relationship between the corporate spread and recession, the Treasury relationship first has to be quantified. In the first iteration, the Spread variable consisted of normalized, annual, ten year to 3 month Treasury spreads, and Recession as the dummy variable. Then, to compare the Treasury data to the corporate data, the Recession variable remained the same, while the Spread variable consisted of normalized, annual, ten year to one year corporate spreads. The results are summarized in Table 1, and show that, as expected both B_1 coefficients are negative, but that the Treasury model is a much better fit to the data. A negative B_1 coefficient means that a decrease in the spread (when the yield curve is flatter or perhaps inverted) correlates to an increase in the occurrence of recession. However, using the R-squared variable as a measure of fit, the Treasury model explains 21.5% of the variance in the data, whereas the corporate model only explains 3.5% of the variance in the data. Additionally, only the B_1 coefficient for the Treasury model is statistically significant.

Table 1

Continuous Treasury Data		R-Squared = 21.5%		
<i>Variable</i>	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	0.461574817	0.081072128	5.693384732	5.26413E-07
Spread	-0.252619693	0.065620279	-3.849719869	0.000315242
Continuous Corporate Data		R-Squared = 3.5%		
<i>Variable</i>	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	0.319274373	0.093886238	3.400651473	0.00177495
Spread	-0.061894798	0.056603672	-1.093476736	0.282102613

In the second iteration, the Spread variable consists of a binary independent variable—0 if the spread was above it's average (implying an upward sloping yield curve) and 1 if the spread was below it's average. This time, the B_1 coefficients were positive, because of the way the dummy variables were assigned. In other words, a negative slope (where the variable equals 1) correlates to the occurrence of recessions, as would be expected. Similar to the first iteration, the Treasury model was a much better fit to the data, explaining 14.5% of the variance, whereas the corporate model explained only 10%. The corporate B_1 coefficient is also once again less consistent than that of the Treasury, only statistically significant at the 10% level. The rest of the results are displayed in Table 2.

Table 2

Discreet Treasury Data		R-Squared = 14.5%		
<i>Variable</i>	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	0.04	0.077252708	0.517781202	0.606725805
Spread	0.31483871	0.103830962	3.032223754	0.003724913
Discreet Corporate Data		R-Squared = 10%		
<i>Variable</i>	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	0.076923077	0.118400234	0.649686866	0.520391572
Spread	0.286713287	0.149339689	1.919873335	0.063553093

4.2 Multiple Regression

The multiple regression model used was as follows:

$$\text{Recession}_t = B_0 + B_1 \text{corpspread}_{(t-1)} + B_2 (\text{corpspread}_{(t-1)} - \text{govspread}_{(t-1)})$$

This model sought to test whether the corporate spread was a sufficient independent variable in predicting the occurrence of recession, or whether the addition of the Treasury spread would increase the model's accuracy. The expectation is that B_1 will be positive, as it was in the ordinary least squares regressions, and thus the variable of interest becomes B_2 . If it is 0, then this implies that the corporate spread is indeed sufficient for predicting recession. However, given that it was positive (and statistically significant) as seen in Table 3, this means that preferred prediction model utilizes Treasury spreads.

The same conclusion can be obtained by looking at a similar regression model:

$$\text{Recession}_t = B_0 + B_1 \text{govspread}_{(t-1)} + B_2 (\text{govspread}_{(t-1)} - \text{corpspread}_{(t-1)})$$

Here the question is posed in an opposite fashion: is the Treasury spread sufficient information to predict recession, or does the addition of corporate spreads increase the predictive ability. Though B_2 is positive, implying that corporate spreads are helpful, the value is statistically significant, leading to the same conclusion: Treasury spreads are good at predicting recession, while corporate spreads add no value.

Table 3

Treasury		R-Squared = 11.5%		
<i>Variable</i>	<i>Estimate</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
(Intercept)	0.43674	0.11509	3.79500	0.00060
Treasury Spread	-0.22257	0.10789	-2.06300	0.04710
Treasury-Corporate	0.02003	0.05946	0.337	0.7383

Corporate		R-Squared = 11.5%		
<i>Variable</i>	<i>Estimate</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
(Intercept)	0.43670	0.11510	3.79500	0.00060
Corporate Spread	-0.22260	0.10790	-2.06300	0.04710
Corporate-Treasury	0.2025	0.117	1.732	0.0927

4.3 Probit Regression

The probit regression model used for analysis looks like this:

$$P(\text{recession}_t = \text{occurred} \mid \text{spread}_{(t-1)}) = G(B_0 + B_1 \text{spread}_{(t-1)})$$

where G is the standard normal cumulative distribution function, with normal density.

This equation considers the probability that a recession has occurred, given the spread, using the normal CDF to derive that probability. This model was run with both the

Treasury data and the corporate data, and the results are displayed in Table 4,

respectively. However, the coefficients are interpreted differently than in the linear

regressions: for example, for the Treasury data, the Z -score for a spread of 0 is about .09, meaning that for each point of increase in the spread, the Z -score is decreased by -

1.20758. For the corporate data, the Z -score for a spread of 0 is about -.41, meaning that for each point of increase in the spread, the Z -score is decreased by -.32230. Perhaps the

most important statistic is the measure of fit—the chi-square value. For the Treasury

data, this value is 14.81263, corresponding to a p -value of .000063, which means that the

model as a whole fits significantly better than the null model with just an intercept. By

contrast, for the corporate data, the chi-square of 1.719115 with a p-value of .1288121 means that the model as a whole does not fit significantly better than the null model with just an intercept. Essentially, the model adequately fits the Treasury data, but the same cannot be said for the corporate data.

Table 4

Treasury				
<i>Variable</i>	<i>Estimate</i>	<i>Standard Error</i>	<i>z value</i>	<i>Pr(> z)</i>
(Intercept)	0.08566	0.30863	0.27800	0.78136
Spread	-1.20758	0.38921	-3.10300	0.00192
Corporate				
<i>Variable</i>	<i>Estimate</i>	<i>Standard Error</i>	<i>z value</i>	<i>Pr(> z)</i>
(Intercept)	-0.41360	0.30880	-1.34000	0.18000
Spread	-0.32230	0.28770	-1.12000	0.26300

5 Conclusion

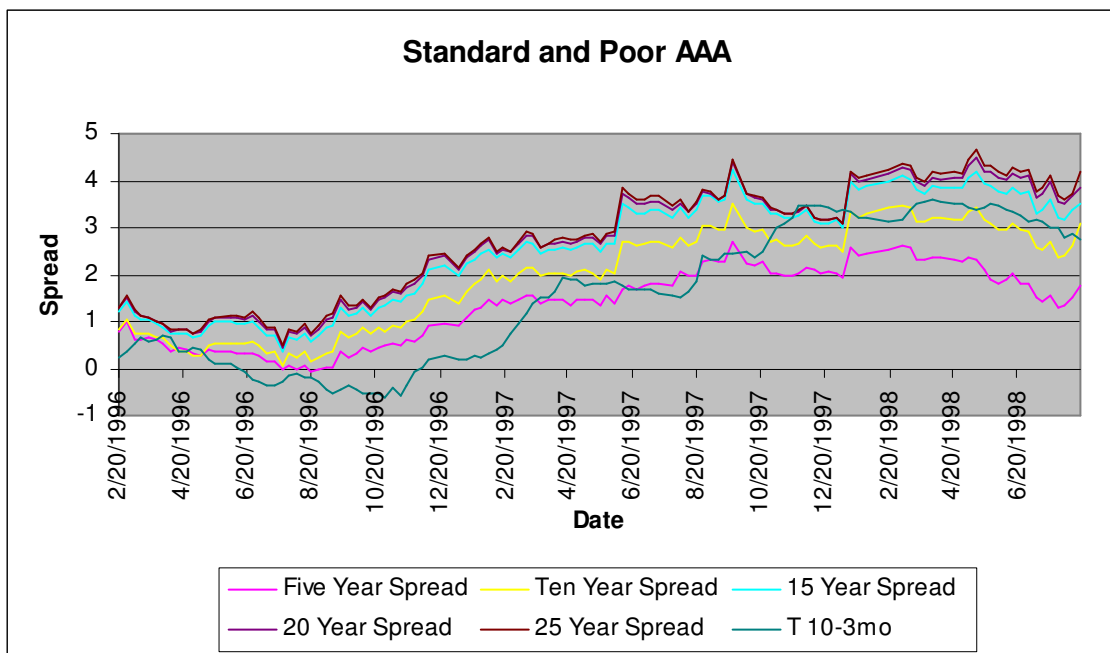
5.1 Discussion of Results

In each of the regression models, the results demonstrate that the ability of debt yields to predict recession applies only to Treasury securities and not corporate securities. This implies that government intervention in the Treasury market is a significant factor in why the relationship exists at all. Perhaps it is true that the Federal Reserve buys more Treasury securities, or that the Treasury Department issues less when anticipating a recession. In turn, this implies that though a government agency sees an oncoming

recession, it fails to prevent it—yet it could also be that the intensity of these recessions is mitigated, and that without such anticipation, they would be much worse. Proving such theories would be quite difficult.

Another explanation though remains, and is the result of the following observation: sometimes corporate spreads have appeared to move opposite the Treasury spread when it was approaching zero, or when it was rebounding from it. Figure 5 depicts this relationship: when the Treasury spread begins its descent in late April and early May 1996, the corporate spreads, especially those ten years or greater, noticeably move in the opposite direction. Similarly, in late 1997 when the economy was booming, the Treasury spread jumps upwards while the corporate spreads shift in an opposite fashion.

Figure 5



The explanation from this observation focuses on the “risk-free” characteristic of the Treasury securities, and not the involvement of government in the markets. If both

the Treasury and corporate debt yields are considered the results of market expectations about future interest rates, this observation makes perfect sense. In expecting a recession in the near future, investors partake in the “flight to safety,” changing their holdings from all types of asset classes to the riskless Treasury market, something that occurred so much so in the latest recession that some talked of a “Treasury bubble.” This explains, at least in part, why the Treasury spread declines. In the corporate debt markets, some of those same investors have sold their holdings in order to purchase the Treasury securities, while businesses issue less in order to stabilize their balance sheets while anticipating less opportunity for growth during the expected recession. Also, investors that do partake in the corporate debt market demand higher interest rates on their securities, because of the increased default risk that will occur during the recession (businesses are more likely to default in times of economic hardship). This explains why the corporate spread would initially jump when the Treasury spread declines, and helps explain the discrepancy between the spreads’ respective abilities to predict recession. A similar explanation holds for when the Treasury spread jumps while corporate spreads fall: with robust economic growth, there is less of a demand for Treasury securities because widespread risk-aversion does not characterize the market atmosphere. The Treasury Department must offer higher interest rates to entice investors, whereas businesses may offer relatively lower rates to investors who no longer fear default.

Another observation from Figure 5 is that, despite the different directions taken by the AAA and Treasury debt noted above, for the most part the two move together. In fact, the Pearson correlation coefficient between the corporate ten year spread and the Treasury spread is .827, indicating a strong positive correlation. One way to interpret this

is to view AAA corporate interest rates as the sum of Treasury interest rates and some additional noise—which is composed of default risk and perhaps tracking delay, among other factors. After all, Treasury rates are carefully watched and are also considered the base point for risk-free interest rates for any given time period. Therefore it is easy to understand that, in terms of the multiple regression, corporate spreads are likely to add only a little, if any, predictive ability to the Treasury spread. In terms of the other regressions, the Treasury spread is a better predictor of recession than the corporate spreads.

5.2 Direction for Further Research

The Treasury Yield Curve is one of the most prominent leading economic indicators used today, and while its ability to predict recession has been repeatedly observed, no clear, widely accepted rationale exists for why this is so. According to the analysis conducted for this paper, the relationship between corporate yield curves and recession does not appear as convincingly, thus implying that the reason the Treasury curve is such an accurate predictor has something to do with either the existence of government intervention in the Treasury security market, or the securities' status as risk-free. Despite this conclusion, clearly much remains to be done in the way of researching this topic, especially by using more sophisticated econometric methods. Specifically, one important improvement would be the construction of a regression model that adequately handles the four to six quarter lag period, so that one specific lag period (in this case, four quarters) need not be settled upon.

Of course one of the main flaws of the analysis conducted in this paper was a lack of corporate debt yield data. It appears that data with a much greater frequency, and with

more historical depth, is available despite being quite costly to the purchaser. Future analysis should definitely include this data, should the funding be obtainable.

Lastly, given the discussion about different risk factors between the Treasury and corporate securities, future research should also analyze the variation of risk premiums in relation to recessions, as this might provide insight as to whether the theory explained earlier had any validity.

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