The Predictive Power of Forward Rates

João Frois Caldeira¹
Emanuelle Nava Smaniaotto²

Abstract
In this paper, we study time variation in expected excess returns, into regressions with one-year excess returns on initial forward rates, adopting the methodology in Fama and Bliss (1987) and Cochrane and Piazzesi (2005). Through a single factor model, we found a linear combination of forward rates, predicts excess returns on one-to-five-year maturity bonds with R² up to 0.50. Thus, a similar procedure as Cochrane & Piazzesi (2005) was adopted, using Generalized Moment Method (GMM) with a Hensen-Hodrick and Newey-West corrections, presenting statistical significant results.

Keywords: Forward Rates. Excess Returns. Maturities.

1. Introduction
Recent empirical researches have focused on bonds excess returns, which can be predictable. Several studies have described evidence that empirical models based on forward rates or forward spreads are able to generate accurate forecasts of bond excess returns. An investor who understood the patterns that: i. the high excess returns on long-term bonds were typically preceded by a high spread between the long and short Treasury; and ii. a higher overall level of the yield curve, have predicted high excess returns on long bonds in times of high slope and high level.

In support of this conjecture, Fama and Bliss (1987) described the forward-spot spread has predictive power for the change in the spot rate and excess returns, that the forecasting power increases as the forecast horizon lengthens; attributing this forecast power to a mean-reverting tendency in the 1-year interest rate. Thus, Cochrane and Piazzesi (2005) studied time variation in expected excess bond returns, through a regressions of one-year excess returns - borrow at the one-year rate, buy a long-term bond, and sell it in one year – on five forward rates available at the beginning of the period; the authors conclude that the specification was able to capture more than 30 percent of the variation of bond excess returns over the period used³.

Furthermore, many studies deal about the subject. For example, Thorn and Valente (2012) that investigate the economic gains accruing to an investor that exploits the predictability of bond excess returns relative to the no-predictability alternative consistent with the expectations hypothesis, showing that the information content of forward rates does not generate systematic economic value to investors. Piazzesi and Schneider (2009) uses a survey data on interest rate forecasts objecting to construct subjective bond risk premia; the authors found that constructed model can be used to understand the movements in both components of statistical risk premia: i. adaptive learning provides a reason for systematic differences between statistical forecasts and survey forecasts; and ii. adaptive learning gives rise to changes in perceived risk that in turn generate low frequency movements in subjective risk premia on long bonds.

One of the main theories to explain the term structure of interest rates is the expectations theory. In this case, long-term interest rate are formed form an average on expected short-term interest rates, plus a time-invariant risk premium. Accordingly, Gurkaynak and Wright (2012) studies through an analysis of the term structure of interest rates, emphasizing on recent developments at the intersections of macroeconomics and finance. The authors show that many features of the configuration of interest rates are puzzling from the perspective of the expectations hypothesis. After they review models which explain anomalies using time-varying risk premia, conclude that inflation uncertainty seems to play a large role and market segmentation as important to understand the term structure of interest rates during the recent financial crisis.

¹ Professor of Post-Graduation Economics Program on Federal University of Rio Grande do Sul (UFRGS)
² Doctorate of Post-Graduation Economics Program on Federal University of Rio Grande do Sul (UFRGS)
³ In 2008, Cochrane and Piazzesi extend the results for a larger set of maturities.
This research is based on predictive power of forward rates, considering excess returns and forward rates, adopting the methodology in Fama and Bliss (1987) and Cochrane and Piazzesi (2005). The topic is important to investors and policymakers, that wish to extract the maximized on predictive power from interest rates, and take actions to optimize theirs portfolio.

The rest of the paper is structures as follows. Section 2 documents yield curve concepts, through three subsections. Subsection 2.1 compresses the knowledge about excess returns and forward rates. Subsections 2.2 and 2.3 introduces two important models that where applied on this research: 2.2 Fama & Bliss Regression and 2.3 Cochrane and Piazzesi Model. Section 3 introduces the empirical results, with the conclusion on the last Section.

2. Yield Curve Concepts

According to existing literature, this paper considers zero-coupon bonds that make only one payment on a specific date. The zero-coupon bond is the most basic building block of fixed income analysis. This security provides the holder the right to $1, in nominal terms, at maturity. Considering \( P_t(r) \) the price of a year zero-coupon bond time, with maturity \( (r) \) on time \( (t) \), where \( y_t(r) \) is the annualized continuously compounded yield on this bond:

\[
P_t(r) = \exp \left( -r \cdot y_t(r) \right)
\]

(1)

This bond pays the holder $1 for date \( t+r \); thus, is possible to define (log) yield from time \( t \) to time \( t+r \), as expressed below:

\[
y_t(r) \equiv \left( -r \cdot y_t(r) \right)
\]

(2)

where \( p_t(r) \) is the log-price on a zero-coupon bond with \( r \) maturity for date \( t \), i.e. \( p_t(r) = \ln P_t(r) \). Anytime, zero-coupon bonds with different maturities will have different yields. An interest rate curve is a function with relates maturities and yields on determinate time.

Usually, is better to analyze the long-term bonds in relation of forward rates. A forward rate is an interest rate which an investor demands today, for date \( t \), to buy a zero-coupon bond with maturity \( r \) on a specific future moment; for example, the investor can by a zero-coupon on \( t+h \) and keep it for a \( r \) year period. Let \( F_t(r,h) \) denote the negotiate price at time \( t \) for a bond with maturity \( r \) to be purchase for time \( t+h \). In a frictionless market, secure the purchase for a maturity \( r \) bond for time \( t+h \) is equivalent as borrowing \( SP_t(r+h) \). In both cases, a certain amount is paid at time \( t+h \) for a maturity \( r \) bond. The absence of arbitrage thus requires that the payments are the same under the two strategies; that is, the forward price to be paid at time \( t+h \) is the same as repayment for \( h \)-periods at time \( t+h \):

\[
F_t(r,h) = P_t(r+h) \cdot \exp \left( h \cdot y_t(h) \right)
\]

(3)

The continuously compounded return on that investment strategy is the maturity \( r \) forward rate, since \( t+h \), is given by:

\[
f_t(r,h) = -\frac{1}{r} \cdot \log F_t(r+h)
\]

(4)

Taking the limit of (4) when \( r \) goes to zero gives the instantaneous forward rate \( h \) periods ahead, which represents the instantaneous return for a future date that an investor could demand:
\[
\lim_{r \to 0} \left( f_t^{(r,h)} \right) = f_t^{(0,h)} \\
= y_t^{(h)} + h \frac{\partial y_t^{(h)}}{\partial h} \\
= \frac{\partial}{\partial h} y_t^{(h)}(h) \\
= - \frac{\partial}{\partial h} \log P_t^{(h)}
\]  

(5)

One can think of a zero-coupon bond as a string of forward rate agreements into the investment horizon, and the yield thus has to equal the average of those forward rates. Specifically, from (5), can be write as:

\[
y_t^{(r)} = \frac{1}{r} \int_0^r f_t^{(0,s)} \, ds
\]

(6)

The attractive for forward rates is the possibility to isolate long-term determinants of bond yields that are separate from the mechanical effects of short-term interest rates.

Condition expressed on (3) implies a forward rate that can be express as a linear function of interest rates by \( r+h \) and \( h \) maturities:

\[
f_t^{(r,h)} = \frac{r+h}{r} \cdot y_t^{(r+h)} - \frac{h}{r} \cdot y_t^{(h)} \\
= y_t^{(h)} + \frac{r+h}{r} \cdot \left( y_t^{(r+h)} - y_t^{(h)} \right)
\]

(7)

For a long-term, with \( r+h \) maturity and a short-term forward, with \( r \) maturity, the forward rate is essentially the same as the interest rate for a long-term contract. On the another hand, if \( r+h \) is higher, but \( r \) is lower, such \( r+h \) be near to \( r \), the forward rate bear as a reduced version to spread between two rates.

Another essential tool of term structure analysis is the holding period return. The hpr, or simply \( r \), is the return on buying a zero-coupon bond with \( r \) maturity, at time \( t \), and the selling it as a zero-coupon bond with \( r-h \) maturity, at time \( t+h \). The return is define as:

\[
hpr_{t+h} = \frac{1}{h} \left[ \log \left( p_t^{(r-h)} \right) - \log \left( P_t^{(r)} \right) \right]
\]

(8)

The difference between \( hpr^{(h)} \) and the yield into a \( h \) maturity is the excess holding period return, defined for \( hprx \), or \( rx \):

\[
hprx_{t+h} = hpr_t^{(h)} - y_t^{(h)}
\]

(9)

The difference between the \( hprx \) of the long-year over short-year bonds over the sample periods is usually positive, reflecting the average upward slope of the yield curve.

2.1 Excess Returns and Forward Rates

Based on existing literature, the log-yield and \( t \)-year bond can be defined as \( y_t^{(h)} = -\frac{1}{h} \log p_t^{(r)} \) where \( p_t^{(r)} \) is the log price of an \( n \)-year zero-coupon bond at time \( t \). The excess returns of a long-term bond can be describe in terms of forward rates. The excess log-return, composed continually, \( rx_{t+1}^{(r)} \), of a bond with \( r \) maturity (expressed on years) at time \( t+1 \), for \( t = 1, ..., T \), is defined as:

\[
rx_{t+1}^{(r)} = p_{t+1}^{(r-1)} - p_t^{(r)} - y_t^{(1)} = r_{t+1}^{(r)} - y_t^{(1)}
\]

(10)
where \( r_{t+1}^{(r)} \) is the log price of an period zero-coupon bond at time \( t \) and purchased as a bond with \( r \)-1 maturity in \( t+1 \) and \( y_t^{(1)} \) is the log yield for a bond with maturity for one year. The excess return for longest periods is defined of an analog form. The bond excess return with \( r \) maturity between \( t \) until \( t+h \) is given by:

\[
x_t^{(r)} = p_{t+h}^{(r-h)} - p_t^{(r)} - h.y_t^{(h)}
\]

where \( y_t^{(h)} \) means a yield at time \( t \) by a bond with maturity \( h \)-periods. Is possible have the excess returns for a long-term bond if the capital gain exceeds de short-term yield. The excess return, as (12) is given as the difference between forward rate and future spot rate:

\[
x_t^{(r)} = f_t^{(r,h)} - y_t^{(r)}
\]

thus, the excess returns will be high if the forward rate is higher than the future spot rate.

Recent empirical researches has found evidence of predictability of variations in bond excess returns. More specifically, several studies pointed out that bond excess returns vary throughout the time, and are a quantitatively important source about fluctuations in the bond market (Ludvigson & Ng, 2009; Thornton & Valente, 2012; Piazzesi et al, 2013). In this study, we selected two models widely used to explain and predict bonds excess returns through forwards rates and forward differences.

### 2.2. Fama & Bliss (FB) Regression

Fama and Bliss (1987) regressed each excess returns against the same maturity forward spread and provided classic evidence against the expectations hypothesis in long-term bonds:

\[
x_t^{(r)} = \beta_0 + \beta_1 f_t^{(r)} + \beta_2 f_t^{(2)} + \cdots + \beta_5 f_t^{(5)} + \epsilon_t^{(r)}
\]

where \( r = 2, \ldots, 5 \) denotes forward rates maturities, expressed in years. FB used equation (13) and found evidence that the forward rate spread and the spot rate have predictive power for the bond excess returns, and that the predictive power increases when the forecast horizon increases.

Furthermore, the variation of expected term premiums seems to be related to the business cycle. The authors evidence, like that for shorter maturities in Fama (1986), suggests that the ordering of risks and rewards changes with the business cycle. Thus, Fama and Bliss (1987) found an evidence that forward rates can forecast near-term changes in interest rates; thus, when the forecast horizon is extended, however, forecast power improves, and 1—year forward rates forecast changes in the 1-year spot rate 2 to 4 years ahead. The authors conclude that this forecast power reflects a slow mean-reverting tendency of interest rates.

### 2.3 Cochrane & Piazzesi (CP) Model

Cochrane & Piazzesi (2005) studied time variation in expected bond excess returns, as an extension Fama and Bliss (1987) and Campbell and Shiller (1991) classic regressions. Through regressions of one-year excess returns on initial forward rates, the authors found that the term structure for forward rates explain between 30% and 35% the excess variations returns for the same maturities group analyzed for FB.

\[
x_t^{(r)} = \beta_0 + \beta_1 y_t^{(1)} + \beta_2 f_t^{(2)} + \cdots + \beta_5 f_t^{(5)} + \epsilon_t^{(r)}
\]

For evaluate if the bond excess returns are predictable, equations (13) and (14) can be written on a general format:

\[
x_t^{(r)} = \alpha + \beta' Z_t + \epsilon_t^{(r)}
\]
where \( Z_t \) can include forward individual rates studied in FB, \( Z_t = (f_t^{(1)} - y_t^{(1)}) \), a combination for \( y_t^{(1)} \) and four forward rates as CP, \( Z_t = [y_t^{(1)}, f_t^{(2)}, .., f_t^{(5)}]' \), or another predictable variables based on macroeconomic series.

When \( \beta = 0 \), the excess returns are not predictable and are equal to a constant \( \alpha \). This case is consistent with the expectations hypothesis of the forward interest rate structure, which is often used as a benchmark against which other empirical models for excess returns are compared.

Based on the fact that the same function of forward rates is used to predict excess returns for all maturities, Cochrane & Piazzesi (2005) constructed a linear combination of forwards rates, that is, a CP factor, which allows to describe the excesses of expected returns of all maturities in terms of just on more parsimonious form factor. Specifically, the CP factor is constructed through a regression on the mean excess returns for all maturities at each time point over the one-year maturity interest rate and the four forward rates \( f_t = [y_t^{(1)}, y_t^{(2)}, y_t^{(3)}, y_t^{(4)}, y_t^{(5)}]' \):

\[
rx_{t+1} = b_n (y_0 + y'f_t) + \epsilon_{t+1}^{(r)}
\]  

(16)

Cochrane & Piazzesi (2005) normalize the coefficients such that the mean of \( b_n \) be equal as one:

\[
\frac{1}{4} \sum_{n=2}^{5} b_n = 1
\]

(17)

with this normalization, the equation (17) is estimated in two steps. At first step, are estimated the \( \gamma \)'s through the regression:

\[
rx_{t+1} = y_0 + y'f_t + \epsilon_{t+1}^{(r)}
\]

(18)

where \( rx_{t+1} \) is excess mean returns between all maturities in each point at time. At second step, getting the coefficients \( \gamma \)'s is constructed the CP factor \( (y_0 + y'f_t) \), estimating equation (17) for each maturity.

3. Empirical Results

The data base used in this study comprises monthly data (closing prices) of DI futures contracts with maturities of 1-, 2-, 3-, 4-, 5-years for the period from January.1998 to March.2015, marking a total of 209 observations of each series. The log-excess returns are calculated as described above. The descriptive statics for the resulting series for returns are presented in Panels A and B on Table 1. Note that the average excess returns vary between 1.54\% and 3.49\%, and are statically significant at level of 5\% of all analyzed maturities. The autocorrelation coefficients of orders 1 and 6 for each series are also presented. Return excesses are serially correlated, exhibiting high persistence. Panel B presents descriptive statistics of the absolute values of excess returns, which are used as proxy for volatilities in Thornton & Valente (2012). The mean absolute values of excess returns are considerably larger for longer maturities. In addition, they are also serially correlated and exhibit high persistence.

Table 1: Descriptive Statistics

Note: The Table presents descriptive statistics for returns excess (Panel A) and absolute returns excess (Panel B) calculated for the different maturities, \( r \). The asterisks to the right, *, **, *** denote statistical significance to levels 10\%, 5\% and 1\% respectively. The statistical significance is analyzed using robust standard errors to presence of autocorrelation and heteroscedasticity (Newey and West, 1987). The mean and the standard are presented in decimals (i.e., 0.01 = 1 percentage point per year).
Table 2: Cochrane-Piazzesi Regressions, 1998:01-2015:03
Note: This Table shows results of excess return regressions for 1 year over all forwards rates. The estimated regression equation is:

\[ hprx_{t+1}^{(r)} = \beta_0^{(r)} + \beta_1^{(r)} y_t^{(1)} + \beta_2^{(r)} y_t^{(2)} + \beta_3^{(r)} y_t^{(3)} + \beta_4^{(r)} y_t^{(4)} + \epsilon_{t+1}^{(r)} \]

Standard errors are shown in parenthesis. \( X^2 (5) \) is the Wald Statistics which tests if the coefficients are together equal to zero. All equations are estimated assuming constant conditional variance to innovation of return excess. \( r \) denotes de forward rates and returns excess maturity and is expressed in years. The Panel A equations are estimated for entire period: January-1998 to March-2015. \( \bar{R}^2 \) denotes the adjusted determination coefficient. \( \bar{R}^2 - level \) refers to \( \bar{R}^2 \) for regression using the return excess in level, not log. \( \exp(hprx_{t+1}^{(r)}) - \exp(y_t^{(r)}) \).
<table>
<thead>
<tr>
<th>Maturity (r)</th>
<th>Const.</th>
<th>$y^{(1)}$</th>
<th>$f^{(2)}$</th>
<th>$f^{(3)}$</th>
<th>$f^{(4)}$</th>
<th>$f^{(5)}$</th>
<th>$\bar{R}^2$</th>
<th>$\bar{R}^2$ level</th>
<th>$X^2(5)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>-4.034</td>
<td>-0.456</td>
<td>1.998</td>
<td>-0.877</td>
<td>2.134</td>
<td>-2.437</td>
<td>0.502</td>
<td>0.634</td>
<td>158.31</td>
</tr>
<tr>
<td></td>
<td>(1.218)</td>
<td>(0.230)</td>
<td>(0.355)</td>
<td>(0.290)</td>
<td>(1.213)</td>
<td>(1.207)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>-7.900</td>
<td>-0.726</td>
<td>3.158</td>
<td>-1.408</td>
<td>4.601</td>
<td>-4.962</td>
<td>0.451</td>
<td>0.572</td>
<td>156.42</td>
</tr>
<tr>
<td></td>
<td>(2.540)</td>
<td>(0.408)</td>
<td>(0.598)</td>
<td>(0.693)</td>
<td>(2.488)</td>
<td>(2.427)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>-10.830</td>
<td>-0.985</td>
<td>4.465</td>
<td>-3.241</td>
<td>8.107</td>
<td>-7.467</td>
<td>0.418</td>
<td>0.563</td>
<td>140.85</td>
</tr>
<tr>
<td></td>
<td>(3.940)</td>
<td>(0.617)</td>
<td>(0.890)</td>
<td>(1.294)</td>
<td>(3.749)</td>
<td>(3.604)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>-12.669</td>
<td>-1.014</td>
<td>5.571</td>
<td>-5.126</td>
<td>10.744</td>
<td>-9.152</td>
<td>0.370</td>
<td>0.551</td>
<td>105.66</td>
</tr>
<tr>
<td></td>
<td>(5.547)</td>
<td>(0.910)</td>
<td>(1.326)</td>
<td>(1.902)</td>
<td>(4.873)</td>
<td>(4.639)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The $R^2$ rise from 37 to 50 percent, a similar result as founded on Cochrane and Piazzesi (2005), which found 35 to 44 percent. Different as found by the cited authors, the constant estimates has significant changes as we add lags.

**Figure 1:** Return Excess Coefficients on Forward Rates

Note: This Figure express the returns excess regression coefficients ($hprx$) to interest rates for one year maturity and the four forward rates.

The top panel presents estimates $\beta$ from the unrestricted regressions of bond excess returns on all forward rates. The bottom panel presents restricted estimates from the single-factor-model. The legend gives the maturity of the bond whose excess returns is forecast. The performance found in the estimates differs from the results found in the Cochrane and Piazzesi (2005), demonstrating differences between the studied markets.

**Figure 2:** Return Excess Coefficients on Forward Rates

Note: This Figure shows the returns excess regression coefficients ($phrx$) to interest rates for one year maturity and the four forward rates.
Table 3: Cochrane-Piazzesi Regression, Restrict Model
Note: The Table presents the regression results about one factor model (restrict model). The estimated regression is:

\[ r_{x_{t+1}} = \gamma_0 + \gamma' f_t + \epsilon^{(r)}_{t+1} \]

The standard errors are presented on parenthesis. \( X^2(5) \) is the Wald statistic which tests if coefficients are together equal to zero. The equation is estimated for all sample period: January-1998 to March-2015. \( \bar{R}^2 \) denotes the adjusted determination coefficient.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>( \gamma_0 )</th>
<th>( \gamma_1 )</th>
<th>( \gamma_2 )</th>
<th>( \gamma_3 )</th>
<th>( \gamma_4 )</th>
<th>( \gamma_5 )</th>
<th>( R^2 )</th>
<th>( X^2(5) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter</td>
<td>-8.858</td>
<td>-0.979</td>
<td>3.798</td>
<td>-2.663</td>
<td>6.396</td>
<td>-6.004</td>
<td>0.428</td>
<td>65.853</td>
</tr>
<tr>
<td>Std Error</td>
<td>(1.218)</td>
<td>(0.230)</td>
<td>(0.355)</td>
<td>(0.290)</td>
<td>(1.213)</td>
<td>(1.207)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4: Cochrane-Piazzesi Regression, Restrict Model
Note: This Table shows the parameters about the second step by restrict model estimation. The regression equations is estimated by:

\[ r_{x_{t+1}} = b_n (\gamma_0 + \gamma' f_t) + \epsilon^{(r)}_{t+1} \]

Where \( \gamma \) is the parameters vector, estimated on Table 3, and \( f_t \) denotes the vector which contain all forward rates. The standard errors are represented on parenthesis. \( X^2(5) \) is the Wald statistic which tests if coefficients are together equal to zero. The equations are estimated for sample period: January-1998 to March-2015. \( \bar{R}^2 \) denotes the adjusted determinations coefficient.

<table>
<thead>
<tr>
<th>Maturity (( r ))</th>
<th>( b_n )</th>
<th>( SE-\text{OLS} )</th>
<th>( SE-\text{GMM} )</th>
<th>( \bar{R}^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0.387</td>
<td>0.058</td>
<td>0.041</td>
<td>0.483</td>
</tr>
<tr>
<td>3</td>
<td>0.796</td>
<td>0.166</td>
<td>0.034</td>
<td>0.459</td>
</tr>
<tr>
<td>4</td>
<td>1.236</td>
<td>0.320</td>
<td>0.008</td>
<td>0.438</td>
</tr>
<tr>
<td>5</td>
<td>1.581</td>
<td>0.486</td>
<td>0.070</td>
<td>0.384</td>
</tr>
</tbody>
</table>
Table 5: Fama-Bliss Regressions, 1998:01-2015:03
Note: This Table presents the Fama-Bliss regression results, where the returns excess for each maturity are regressed on the spread on the forward rate of same maturity. The regression equation is:

\[ r_{t+h} = \zeta_0 + \zeta_1 \left(f_t - y_t^{(1)}\right) + \nu_{t+h} \]

The standard errors are represented on parenthesis. \( X^2 (5) \) is the Wald statistic which tests if coefficients are together equal to zero. The equations are estimated for sample period: January-1998 to March-2015. \( \bar{R}^2 \) denotes the adjusted determinations coefficient.

<table>
<thead>
<tr>
<th>Maturity (r)</th>
<th>Const. (( \zeta_0 ))</th>
<th>( \sigma(\zeta_0) )</th>
<th>( \left(f_t^{(r)} - y_t^{(1)}\right) )</th>
<th>( \sigma(\zeta_1) )</th>
<th>( \bar{R}^2 )</th>
<th>( X^2(5) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0.775</td>
<td>0.886</td>
<td>1.317</td>
<td>0.560</td>
<td>0.254</td>
<td>23.575</td>
</tr>
<tr>
<td>3</td>
<td>1.819</td>
<td>1.764</td>
<td>1.462</td>
<td>0.688</td>
<td>0.137</td>
<td>29.038</td>
</tr>
<tr>
<td>4</td>
<td>3.545</td>
<td>2.650</td>
<td>1.111</td>
<td>0.577</td>
<td>0.058</td>
<td>35.295</td>
</tr>
<tr>
<td>5</td>
<td>3.879</td>
<td>3.349</td>
<td>1.620</td>
<td>0.715</td>
<td>0.074</td>
<td>64.091</td>
</tr>
</tbody>
</table>

Fama and Bliss (1987) regressed each excess returns against the same maturity forward spread and provided classic evidence against the expectations hypothesis in long-term bonds. Comparing the results as the Cochrane and Piazzesi (2005) estimation, we found better results on \( R^2 \) to 2 year maturity only, and a coefficient with higher variances between the tested maturities.

4. Concluding Remarks
This research, based on predictive power of forward rates, considered excess returns and forward rates, adopting the methodology in Fama and Bliss (1987) and Cochrane and Piazzesi (2005). The topic is important to an investor analyze the predictive power from interest rates and take actions to optimize theirs portfolio.

This analysis is still incomplete in many respects, being need to expand the analysis and comparison to other researches. Examining the one-to-five year maturity bonds at a one-year horizon, was possible to better understand how expected returns and interest rate forecasts vary across investment horizon, and extend the interpretation by their maturities. Some results, as was possible to see, are different then the obtain on Cochrane and Piazzesi (2005), demonstrating some market peculiarities.

Moreover, the expected returns variation seems to be related to the business cycle, as affirmative Fama and Bliss (1987), also requiring a greater analysis of the results found in relation to the analyzed market.

REFERENCES


