The Maximum Maturity Difference

Huang et al's (2006) study examined how information from the entire yield curve can be used to improve forecasts of output growth and inflation. The study confirms previous empirical evidence suggesting that the yield curve can be used to forecast output growth. In addition, the authors introduce a new way of combining forecasts, in order to improve the accuracy. This new approach uses a Nelson-Siegel exponential components modeling of the yield curve with two or three factors, capturing the level, slope and curvature of the yield curve. The new approach is found to be most accurate in forecast both output growth and inflation.

Rudebusch and Wu (2008) developed a no arbitrage macro-structural model with macro variables and latent monetary factors that jointly drive yields. They report that output shocks have a significant impact on intermediate yields and curvature and that inflation surprises have large effects on the level of the yield curve. They also find that including macro factors improve the forecasts of the usual latent factor models

Chinn and Kucko (2009) analyzed the predictive power of the yield curve across various countries, including France, Canada, Italy, Germany, Japan, Sweden, Netherlands, UK and the US, from 1970 to 2008. They found that yield spreads contain significant predictive power when forecasting industrial production growth over a one-year time horizon. However, they also found evidences on the declining of the predictive power of the yield curve over time, although there are some exceptions.

A more recent study with a similar approach is the Abdymomunov (2011) study. In his study, Abdymomunov uses monthly U.S. government bonds interest rates data with eight different maturities, ranging from 3 to 120 months. From this data, a dynamic yield curve model is produced. Using basic OLS regressions, the study finds that the dynamic yield curve model produces better forecasts of real GDP than the traditional yield spread model, where the yield spread is defined as the difference between two yields of different maturities

Pierre Rostan& Alexandra Rostan (2012) presents an innovative "stock dog" technique coupled with Monte Carlo (MC) simulation that accurately forecasts the yield curve. Similar to a pastoral dog who acts as a living fence to make sure that the herd follows the general direction, this "stock dog" technique forces the simulated interest rate inside bands that are drawn using the information embedded in the shapes of the most recent yield curves. These bands are built to reflect the intrinsic dynamic forces of the current interest rate market environment responsible of the future shape of the yield curve.

Mishkin (2007) came to a conclusion that short-term interest rates would be expected to go up in the future in the case of a sharply rise in the yield curve. A moderately sharp yield curve on the other hand shows that the short-term interest rates are not likely to increase or drop much in the future. He also concludes that short-term interest rates are expected to fall moderately in the future for a flat yield curve. Finally, for an inverted yield curve he shows that short-term interest rates are expected to plunge scrupulously in the future.

1.3 Theoretical Framework

1.3.1 Introduction to Yield Curve Theories

While there is plenty of empirical literature on the predictive power of the yield curve, economic pundits lack a well-defined and accepted theory on why the yield curve predicts future economic growth. The focal point of yield curve research has been greatly inclined towards formulating empirical models rather than developing theoretical foundations of the underlying relationship between yield spread and future economic activity. Nonetheless, the literature does not hesitate to characterize the spread's predictive ability as 'impressive', 'robust' and 'particularly well established'.

However, there have been attempts to theoretically model this relationship. Estrella and Hardouvelis (1991) and Berk (1998) refer to simple dynamic IS-LM Harvey (1988) uses models. a consumption capital asset pricing model (CCAPM). Chen (1991) refers to real business cycle (RBC) models. Hejazi (2000), on the other hand, examines whether information in the US yield curve can be useful for predicting monthly industrial output by using a Generalized Autoregressive Conditional Heteroskedasticity-in-Mean (GARCH-M) model. Rendu and Stolin (2003) make use of a dynamic equilibrium asset-pricing model. Dai and Philippon (2004) estimate a no arbitrage VAR model. Rudebusch and Wu (2008) develop a no arbitrage macro-structural model. Recently Pierre Rostan& Alexandra Rostan (2012) presents an innovative "stock dog" technique coupled with Monte Carlo (MC) that accurately forecasts the yield curve.

We begin our theoretical study by first scrutinizing the various shapes of the treasury yield curve observed in real world and relate them to a set of economic theories. Finally, we look into some of the most important factors such as monetary policy and fiscal policy that give rise to the predictive ability of the yield curve.

1.3.2 Types of the yield curve

The treasury yield curve is simply a diagrammatic illustration depicting the yield to maturity, on the y-axis, against time to maturity, on the x-axis. It enables investors, consumers and government at a quick glance to compare the yield offered short-term, medium-term and long-term bonds. The Yield Curves can be classified into four main types :

The Normal Yield curve

A normal yield curve slopes gently upwards as the maturity increases. The positive slope of the yield curve indicates that as time to maturity lengthens, the yield increases. Generally the gentle slope of the yield curve reflects the market's expectations for the economy to grow. On the other hand, a sharply upward sloping curve is usually a sign of accelerating economy and higher future inflation. Moreover when the yield curve is positive, a higher rate of return on the added risk of lending money for a longer period of time is required to investors. An illustrative example of this is shown in Figure1 below:

Yield

Maturity

Figure 1 – Normal Yield Curve

The Inverted Yield Curve

Inverted yield curve also known as negative yield curve as shown in Figure 2 below. An inverted yield curve is measured as a predictor of economic recession. Traditionally, many of the U.S recessions were preceded by the inversions of the yield curve. Hence, the yield curve is frequently distinguished as an accurate forecast of the turning points of the business cycles. Recently in 2000, the U.S treasury yield curve inverted prior to the collapsed of the U.S equity markets .An inverse yield curve predicts lower interest rates in the future as longer term bonds are being demanded, sending the yield curve down.

Another effect, which could also be contributing the cause of the inverted yield curve, is decreasing inflation expectations. The lower expected inflation would lead investors to expect the long term yield to decrease. Investors will then lock in a greater portion of their capital in long term bonds. This will in turn lead to an increased demand for long term bonds which will drive the prices of these bonds up and yields down.

Yield

Maturity

Figure 2 – Inverted Yield Curve

The Flat Yield Curve

When there is almost no difference between short and long-term yields, the yield curve is flat. A flat yield curve is usually a sign of a changing economy and frequently signals an economic slowdown. A flat yield curve is unusual and typically indicates a transition to either an upward or downward slope. They occur in response to abnormal circumstances.

Yield

Maturity

Figure 3 – Flat Yield Curve

The Humped Yield Curve

Humped Yield Curve also known as bell-shaped curves is relatively rare and is affected when the rates of both long and short-term instruments are lower that the interest rates on medium-term fixed income securities. This formation is commonly thought of as a precursor to recession as the hump occurs during the transition from a normal to an inverted yield curve. Hence, though a humped yield curve is often display of sluggish economic growth it should not be compared with an inverted yield curve.

Yield

Maturity

Figure 4 – Humped Yield Curve

1.3.3 Theories explaining the yield curve

The Term Structure of interest rates

According to Mishkin (2007) a hypothesis of the term structure of interest rates should explain three features of the yield curve. These are: how interest rates on bonds with different terms to maturity move together over time; how and why the yield curve is normally upward sloping; and how during periods of low short-term interest rates the yield curve is upward sloping, but when short-term interest rates are high the yield curve is likely to become downward sloping or inverted. There are three accepted theories which attempt to explain the idiom structure of interest rates and the variations in the shape of the treasury yield curve:

The Pure Expectations Theory

The Pure Expectations Theory states that the gradient of the yield curve is a mirror of the expectations of investors for short-term interest rates in the future. Habitually, investors expect interest rates to go up in the future, making the yield curve to slope upward. Similarly based on this theory, an inverted yield curve would indicate that the market expects short rates to fall in the future.

According to Mishkin (2007) the expectations hypothesis states that the interest rate on a long-term bond will equal an average of the short-term interest rates that people expect to occur over the life of the long-term bond. The idea is that an investor can choose between holding a long-term bond with a set term-to-maturity and long-term interest rate or hold a succession of short-term bonds. However, interest rates on short-term bonds are known only for the first period. Interest rates for the subsequent years can only be speculated upon. Long-term rates therefore reflect investors' expectations about what future rates will be.

The Liquidity Preference Theory

The Liquidity Preference Theory is an outcome of the Pure Expectations Theory, which affirm that a premium is included for holding long term bonds, called the term premium or liquidity premium along with long-term interest rates. Since investors have an added risk of having their money tied up for a longer period, including the greater price uncertainty, the premium would compensate for that risk. Due to the term premium long-term bond yields tend to be higher than short-term yields hence leading to an upward movement in the slope of the yield curve slopes.

The Preferred Habitat Theory

This theory lightens up the assumption of perfect markets and recognises that markets for different maturities might be separated. Along with expectations of the interest rate, investors have different investment horizons and need a significant premium to acquire bonds with maturities outside their preferred maturity. Those who advocate this theory believe that the fixed-interest market is more common for short-term and therefore, longer-term rates tend to be superior than short-term rates.

1.3.4 Estrella &Hardouvelis (1991) OLS regressions framework

Estrella &Hardouvelis (1991) devised a framework of the predictive power of the yield curve. They showed the empirical relation between future rates of growth in real GNP and its components with the current slope of the yield curve.

They observed Real GNP from 1955 Q1 to 1988 Q4. The dependent variable in their basic regression is the annualized cumulative percentage change in the seasonally adjusted finally revised real GNP number based on 1982 dollars:

$Y_{t,\, t+k} = (400 / k) * (\log (Y_{t+k} / Y_t))$ (1)

where k denotes the forecasting horizon in quarters, and Y_{t+k} denotes the level of real GNP during quarter t + k, and Y_{tt+k} denotes the percentage change from current quarter t to future quarter t + k.

In order to attain a better estimation of how far into the future the predictability of the models holds, a second basic regression is estimated with marginal GDP growth as the dependent variable. The marginal GDP growth is defined as:

Yt+k-j, t+k = (400/j) [log (Yt+k /Yt+k-j)] (2)

Observe that the cumulative percentage change Ytt+k is the average of consecutive marginal percentage changes Yt+i-, t+i for i = 1,2,3, . . ., k. Hence, each Yt+ i- 1, t+ 1 provides more precise information on how far into the future the term structure can predict.

For simplicity, they only two interest rates to construct the slope of the yield curve, the 10-year government bond rate RL, and the 3-month T-bill rate Rs. Both RL and Rs are annualized bond equivalent yields. Hence they use the difference between the two rates to measure the slope of the yield curve.

SPREADt = - (3)

In computing the two rates, average quarterly data which are used provide an opportunity to check the robustness of previous results on the predictive power of the term structure that used only point-in-time data.

1.4 Linkage between the stock market and the economy

The stock market can be influenced by the implementation of policies. The policy encouraged may arise from the conduct of monetary policy or fiscal policy while policy not implemented maybe due to major developments such as the global financial crisis.

1.4.1 Monetary Policy and Yield Curve

A tightening of the monetary policy through raising the short term interest rate is typically done to reduce the inflation pressure. The long term rates will also increase but not as much because when the inflation pressure recede policy makers are expected to switch to an opposing policy. The monetary tightening will therefore both slow down the economy and cause a flattening or even inverting of the yield curve. Since the expectations of future short term rates are based on the future demand for credit and future inflation. A tightening of the monetary policy could be expected to lead to a future slowdown in the economy, thus putting downward pressure on future interest rates since the credit demand will be low. The slowing economy will most likely lead to an easing of the monetary policy and the expected low future short term rates will reduce the current long term rates and the yield curve will flatten.

The monetary policy stance is transmitted into the real economy through various channels: asset price channel, interest rate channel, exchange rate channel and credit channel. All of these channels affect stock prices directly or indirectly. The asset price channel draws its strength from the finding that the decline in asset prices owing to the stock market crash in the USA in 1929 and the same in Japan in the late 1980s and early 1990s, was followed by a slowdown in economic activity as well as increased financial and banking sector instability. Furthermore, several empirical studies indicate that the monetary policy stance adopted by the central bank impacts stock price movements. For example, Ehrmann and Fratzscher (2004), shows that monetary policy shocks have instantaneous and significant effects on stock prices in the US economy. A tightening of monetary policy by 50 basis points reduced US stock returns by about three percent on the announcement day. Any significant downturn in the stock market limits firms' ability to raise capital for further expansion, thus retards output growth, lowers consumer demand, and may cause financial instability.

1.4.2 Fiscal Policy and Yield Curve

Fiscal policy is the use of government spending and tax rates to influence the economy. The relevance of fiscal policy increases in an environment where monetary policy becomes powerless in stimulating the economy. An alternative view of assessing the impact of fiscal policy on the yield curve is to look at the prevailing federal budget deficits. Generally, countries with soaring budget deficits tend to exhibit higher overall interest rates. In the case where deficit is grossly high, to the point where there is an increasing sentiment in the market of a likely default, the short-term rates will tend to be much higher than long run rates. This is because investors demand a high compensation for assuming a default risk, but the longer horizon bond yields will not rise as much because investors would hope that over the long run, the government would eventually be able to impose austerity packages to bring its budget in control. This analysis confirms our hypothesis of an inverted yield curve's ability to predict exacerbating economic situation in times ahead. This can be supported by Dai and Phillippon (2006) who introduce deficit shocks as an observable factor in addition to other observable factors corresponding to the output gap, inflation and the federal funds rate, and a dormant factor. They find that in response to a positive deficit shock, the increase in the long interest rate for ten-years can be attributed to both a change in the risk premia and as well as the expected short rates.

In short, the longer the maturity horizon, the greater is the risk of things going wrong. This analysis suggests that a steep yield curve may be an indicator of expected increases in budget deficits, which could have different impacts on the overall economic growth.

1.5 Conclusion

Positive evidence about the historical relationship between the yield curve and economic activity globally, as well as the more recent evidence of its declining predictive value suggest that an updated study of the yield curve in Mauritius will be valuable. It will determine whether the yield curve retains its predictive value in the Mauritian context and, therefore, whether it continues to be a beneficial tool to policy makers and investors.