TERM STRUCTURE OF INTEREST RATES IN NEW ZEALAND

This article briefly considers the major term structure of interest rate theories and provides a graphical examination of the New Zealand yield curve over the last eight years.

Introduction

The relative positioning of interest rates offered on different securities through time is known variously as the 'term structure of interest rates', the 'yield curve', and the 'maturity structure'. This article briefly examines the alternative theoretical models of the term structure of interest rates and then examines the New Zealand historical evidence from a graphical perspective. The sample commences in July 1977 and extends through the 'freeze' period up to January 1986.

The Yield Curve

The yield curve refers to a graph depicting the relationship between interest rates and the term to maturity of a loan. It depicts the theoretical relationship between hypothetical securities that are identical in all respects except the length to maturity. Interest rates are measured on the vertical axis and the term to maturity of the security is measured on the horizontal axis. In reality, this theoretical yield curve has no measurable form as it is impossible to find securities across the maturity spectrum that all possess the same risk characteristics.

The chief determinant of differences in market rates between securities of the same maturity is the credit or default risk associated with the ability to honour interest payments and principal repayments. Other factors include the marketability of the security, tax status, the coupon rate, the convertibility characteristics of the security, and so on. Thus, some of the most important variables explaining the structural relationship among market rates may be unrelated to the maturity. A significant diversity of characteristics is found even in the range of government securities available. For example, short dated government securities with less than one month to maturity comprise part of primary liquidity and are therefore very liquid, while longer dated securities are excluded from the discount window and are therefore relatively illiquid. As securities across the maturity spectrum are far from identical in all respects, empirically constructed curves are very much an approximation of the theoretical yield curve.

While interest rate observations drawn from the market reflect a number of factors, it is assumed throughout the term structure literature, for simplicity, that there is no default risk. Risk is however attributed to:

1. Differences in liquidity or money substitutability among various maturities.
2. Inflation rate uncertainty.
3. Differences in lenders' and borrowers' time horizons.
4. Portfolio interaction and requirements.

Various aspects of these risks are considered in alternative term structure theories.

Term Structure Theories

Two main streams of thought have developed in the economic literature explaining the spread between rates offered on short and long securities. Between these two pure models, a number of variants have attempted to better approximate reality or synthesize the two extremes. At one extreme, the 'pure expectations model' relates the rate of interest on long securities to expected future rates on securities of shorter maturity. The basic postulate of the theory is that long run rates are averages of expected future short run rates. Alternative yield curve shapes can therefore be explained by varying expectations of future short rates. For example, if future short rates are expected to remain the same for some time into the future, then both current short and long rates would be equal and the yield curve would be relatively flat. Alternatively, expectations of higher short rates in the future would be built into rates on longer securities making the yield curve upward sloping. Likewise, expectations of a fall in short rates produce a downward sloping yield curve. A humped yield curve reflects expectations of a rise in short rates over a period (say the next i years) to be followed by a fall thereafter. The yield curve would then rise for maturities up to i years and fall for maturities greater than i years. The

theory therefore can account for any shape of the yield curve by assuming any expected movement in future short-term rates.

The theory has important implications for government policy as it implies the monetary authorities cannot alter the term structure unless they affect expectations. The immediate return to equilibrium, equalising returns across all maturity regions means only the average level of rates can be influenced but not the relative positioning of rates within the term structure. The selling of long stock, for example, will not push up the long rates relative to the short rates. According to the theory, the resulting excess supply of long bonds would reduce the price and push up the long interest rate. A fall in price induces investors to switch from the short end to the long end, creating an excess supply of short securities. This results in a decrease of price and an increase in interest rates on short maturities. Equilibrium is restored again when the term structure returns to its original form based on market expectations. While the shape of the yield curve has not changed, its overall position will have altered, *ceteris paribus*; in this case it would have shifted upwards. Therefore, according to the expectations theory, any attempts aimed at altering the term structure will be unsuccessful unless policy is targeted at changing expectations about future interest rates.

At the other end of the theoretical spectrum, the segmentation hypothesis accredits the determination of interest rates to supply and demand pressures within distinct maturity bands. Risk aversion, or a desire to hedge, forces investors into certain maturity regions and this factor determines the shape of the yield curve. The dominance of risk averters divides the yield curve into separate or segmented markets reflecting investors' and borrowers' desired investment periods. Given a desire to avoid risk, an investor will match maturities to encashment periods. With varying encashment periods, capital markets will be comprised of a number of distinct compartments representing different maturities in which interest rates are determined by the forces of supply and demand. The term structure of interest rates is therefore determined by the desired maturity structure of investors and debtors, and may therefore be any shape or form.

Both sides of the market are governed by risk avoidance, thus maturity is matched with encashment period by investors while debtors match assets and liabilities. A wide range of factors may inhibit the perfect mobility of funds between maturity regions, confining investors to specific maturities. Impediments in debt markets include:

1. Legal restrictions on some types of borrowing and debt holdings of particular institutions.
2. The desire of investors to diversify their portfolio in a particular manner.
3. Customary investment procedures used by financial institutions.
4. Lags in establishment or revision of financial institutions.
5. Specialisation of investors on technical grounds.

The nature or structure of the flow of funds through financial intermediaries may be altered by a number of variables, such as legal, political or sociological factors. The most important shifts in the demand for funds may result from changes in the purpose of borrowing either to finance long-term productive capital projects or to finance short-term contingency needs. Open market operations and direct manipulation of the maturity structure of government debt will directly influence the term structure. Alteration of the supply of different maturities of government securities will influence the interest rate associated with those maturities. For example, increasing the supply of long-term government securities will reduce the price and push up the interest rate on long-term securities.

The two alternative theories, segmentation and expectation, imply different factors are responsible for the determination of the term structure of interest rates. More importantly, from a policy perspective they imply completely contrasting options. The expectations approach suggests that attempts to alter the term structure by government intervention in capital markets is fruitless unless policy alters underlying expectations of future interest rate levels. The segmentation hypothesis on the other hand asserts supply and demand for specific maturities determines the term structure; therefore changes in supply via open market operations, debt management, etc. may be expected to directly influence relative interest rates.

Between these two theoretical poles, two main variants have achieved prominence in the current literature. The first is the 'liquidity premium hypothesis' in which the long rate is not only a function of expected future short rates but also a liquidity or risk premium reflecting the relative riskiness of securities of different maturities. The second synthesis is the 'preferred habitat' model which blends together elements of all three theories above. The preferred habitat model asserts, as does the expectations hypothesis, that the term structure is basically determined by the principle of the equality of expected returns between different maturities. A market participant's desired maturity region or habitat is the main determinant of the liquidity premium in this model. A desire to avoid risk induces investors to hedge by staying in their preferred habitat as suggested by the segmentation theory. An imbalance of funds between maturity regions is only averted by offering a premium sufficient to compensate for the risk and cost associated with moving out of traditional habitats. The resulting positive or negative premium is in general expected to vary from one maturity to another, though smoothly, as nearby maturities would be expected to be close substitutes.

This article does not examine the empirical validity of these alternative theories, but instead concentrates on a graphical examination of the term structure in New Zealand.

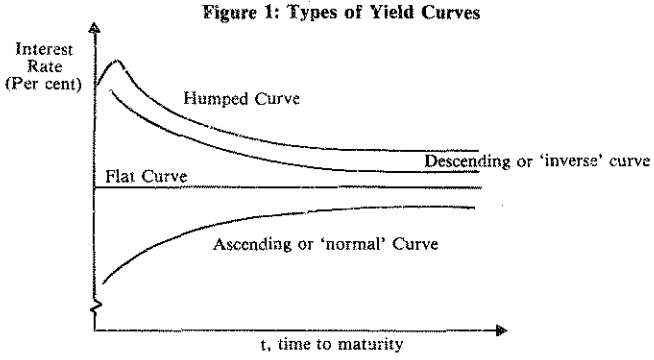
Empirical Yield Curves

Empirical yield curves are constructed by plotting market interest rate observations against their associated maturities. As a maturity continuum of like securities does not exist, gaps exist in the maturity structure between discrete observations. This problem is overcome by using interpolation techniques to estimate unobserved values between these discrete points. Straight line, regression and mathematical interpolation techniques have been among the most commonly used procedures. The straight line approach, adopted below, tends to suggest that market behaviour is abrupt or discontinuous but the underlying shape of the yield curve is nevertheless highlighted.

While a yield curve may take any shape or form, four

general shapes have been widely recognised throughout the literature. These are illustrated in figure 1. An 'ascending' or normal curve tracks upwards at a diminishing rate from a low in short maturities to a high in long maturities. A 'descending' or 'inverse' curve in contrast is negatively sloped with short dated securities exhibiting higher yields than longer paper. An intermediate 'flat' curve exists between these two when yields across the maturity spectrum are approximately equal. Finally, a hump shaped yield curve rises at the short end to a peak and then declines as interest rates level out in longer maturities.

Figure 1: Types of Yield Curves



Inflation has been one of the major determinants of the level of nominal interest rates and as such has been a primary determinant in the slope of the yield curve over recent years. Generally high interest rates have been associated with high inflation, and coupled with the expectation that rates will come down at some date in the future this has generated a descending yield curve. The decline in nominal interest rates overseas has been associated with declining inflation. However, long rates have been slower to come down than short rates because of uncertainty about the permanence of the reductions in inflation and, combined with the usual liquidity premium, this has typically given upward sloping curves.

The New Zealand Financial Sector

The New Zealand financial sector has been subject to a number of interest rate regulations over the past decade and a half. Among the most notable were the Interest on Deposit Regulations between 1972–77, applying interest rate ceilings to various deposits across most financial institutions. These regulations were amended throughout their existence, essentially altering the interest rate payable. Apparent freedom was extended to the financial sector with their complete removal in July 1977; however, indirect influence was still exerted on rates through reserve asset ratio requirements and a host of other binding monetary regulations.

The early 1980s once again saw growing concern over the level of interest rates as strong political and social pressures built up to hold rates at low levels. Increasing pressure was gradually applied to interest rates through a number of directives, interest ceilings, regulations and reserve asset ratio changes. The re-imposition of direct legislative pressure commenced with the 'freeze' on wages, prices and interest rates on 22 June 1982. This move was followed up with arbitrary reductions in government security interest rates, July 1983; maximum limits on mortgage interest rates, November 1983; interest rate ceilings, May 1984; and culminated with the Interest on Deposit Regulations, June 1984. Administrative change after the general election in July 1984 saw a dismantling of the web of controls and regulations. Early moves in late July were followed by a general deregulatory package involving the abolition of the ratio system, establishment of a comprehensive liquidity management scheme and floating of the currency.

Given this degree of intervention and distortion of New Zealand's capital markets, regular or stable yield curves may not be found throughout this period. The initial 'freeing-up' of the financial sector in July 1977 appears to provide a good starting point for this study. In addition, the commercial bill market had attained a reasonable level of activity and depth by this stage, after a slow early development. The sample period extends through the heavy 'interest rate regulation' period of 1983/84 and up to January 1986.

Choice of Interest Rates

The unavailability of government securities across the broad maturity spectrum means rates are drawn from a number of diverse institutions. Large differences in risk therefore exist among maturities across the sample term structure. In choosing appropriate instruments an attempt was made to concentrate on the wholesale end of the market. While yield curves constructed with these rates represent a poor approximation of theoretical zero default risk curves, they do reflect the markets' perception of what 'investment' or large funds can earn. The long end of the market was captured with the use of government security yields on long (over 5 years) and medium (2–5 year) term instruments. The short end of the maturity structure was divided into four: call, 30 day, 90 day and one year deposits. The absence of a lengthy 'overnight' rate series meant rates offered on call secured deposits by finance companies were utilised as the shortest maturity. In addition, while the overnight rate may be a better indicator of very short-term liquidity, its extreme volatility in response to expectations, rumours, cash injections and withdrawals, etc. make it undesirable in this context. Rates offered on commercial bills, traded by dealers represent short-term 30 day and 90 day wholesale instruments. One year rates offered on large deposits (i.e. over $20,000) by trading banks completed the set of six maturities examined. In each instance, maximum rates from reported monthly spreads were used as presumably these best reflected the current economic conditions.

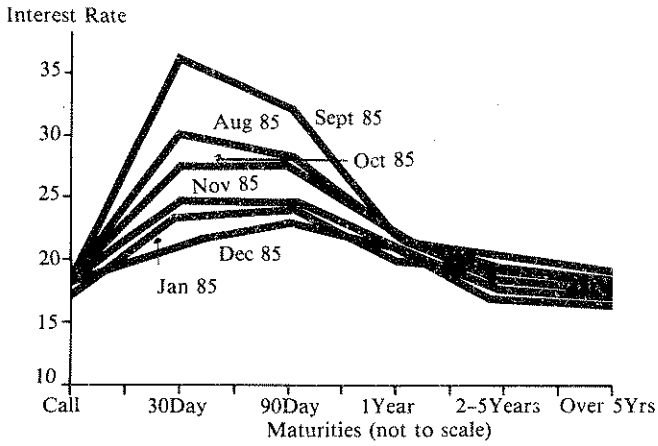
Examination of the New Zealand Yield Curve

Monthly yield curves were constructed for the period July 1977 to January 1986. One dominant shape prevailed throughout the whole period — a regular hump shaped yield curve. The relative positioning of interest rates on different maturities has remained fairly consistent over time. Generally the structure shifted as a unit rather than experiencing divergences within the maturities.

The curves plotted for August 1985 to January 1986

in figure 2 illustrate the general pattern found throughout the period. The finance company call rate aligned itself with or slightly below yields on medium and long-term government securities. Over the period this rate remained markedly below commercial bill rates, except for a brief three month period between August and October 1983. The yield curve typically tracked upwards from the call rate to the 30 day commercial bill rate. In only 17 months out of a total of 103 in the sample period did the excess of the 30 day rate over the call rate fall below 2 percentage points. The curve peaks at the 90 day commercial bill rate after a slight increase above the 30 day rate. Until October 1984, with the exception of two months, the maximum rate on 90 day bills equalled or exceeded the 30 day rate in every month. The 30 day rate however, displayed greater fluctuation than all other rates considered. Descending from the peak, the trading bank one year rate fits into a smooth downward trend to medium and long-term government securities.

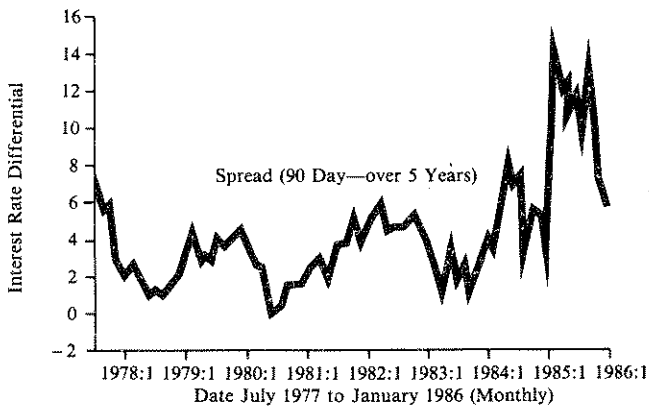
Figure 2: Monthly Yield Curves for N.Z. from August 1985 to January 1986



There is little to differentiate the two longer dated securities, which until August 1983 were always below the one year rate. During the period of heavy interest rate controls this trend reversed and in late 1984 and early 1985 the three rates fluctuated within a one percentage point band of each other. The rates diverged somewhat from April 1985 onwards with the trading bank one year rate exceeding the medium-term government stock by at least 1.5 percentage points in every month up until January, at which point the two rates closed to within 0.7 percentage points. The long-term government stock rate fluctuated within one percentage point of the medium-term rate throughout 1985 except in May (2 per cent) and October (1.5 per cent). The conversion of government stock issues to a tender from a tap system in September 1983, did not alter the relationship between short and long-term interest rates. The hump shaped yield curve persisted despite expectations that the linkage between issue and secondary markets for government stock may have been altered.

While the underlying relationship between maturities has been consistent, changes in the spread between short and long rates have flattened or accentuated the hump in the curve. Widening of the spread accentuates the hump while closing flattens the yield curve. To the extent that the spread is a function of relative highs and lows of interest rates, the shape of the curve is a function of relative interest rates. Generally, the peaking of short rates has been accompanied by peaking of the spread between short and long securities. Similarly short rate troughs have been accompanied by closing of the spread between long government securities and commercial bill rates. For example, (figure 3) troughs in the spread were accompanied by relative lows in the 90 day rate late in 1978, mid-1980, and in the third quarter of 1983. Maximums in the short rate have occurred in conjunction with peaks late in 1979, early 1982, and early to mid-1985.

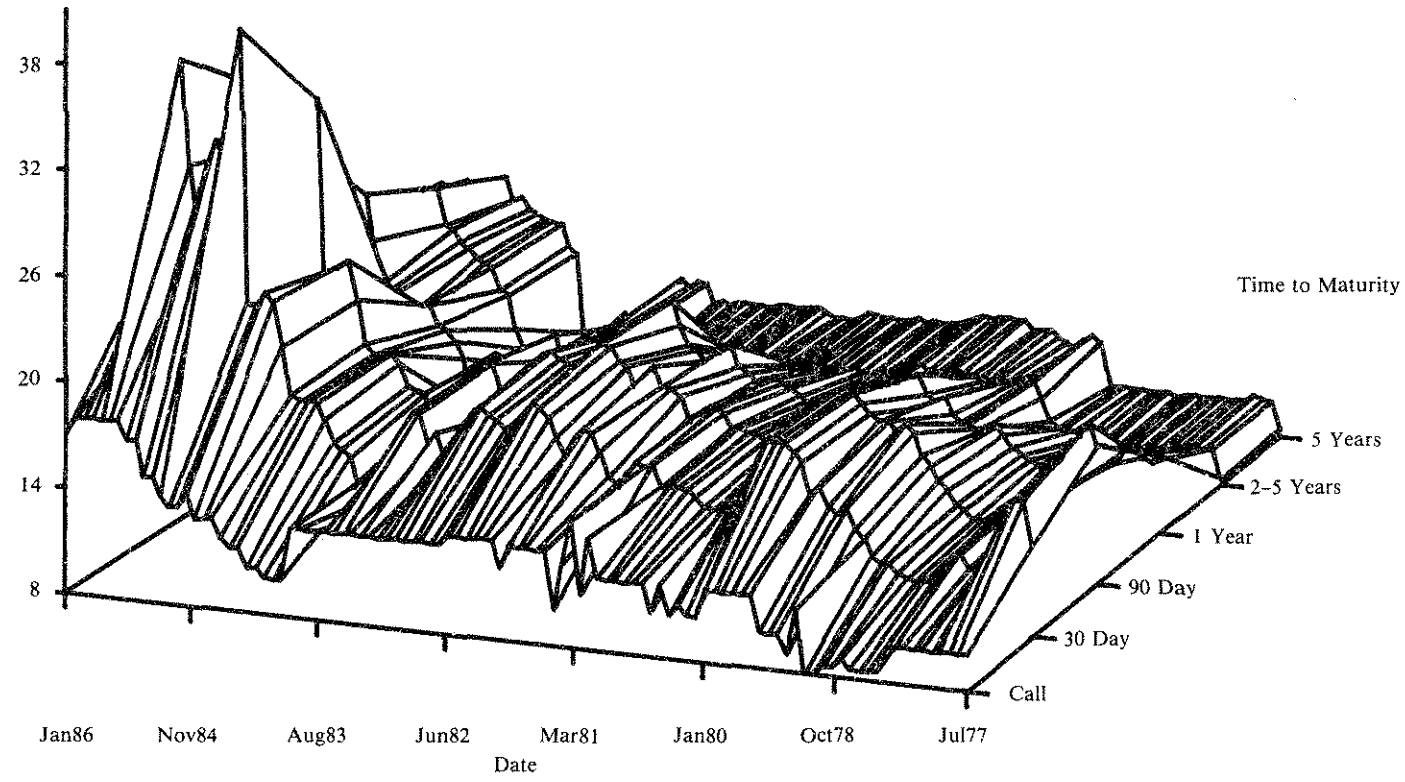
Figure 3: Interest Rate Spread Between Short and Long Rates, Highlighting the Cyclical Movement Between the Rates



While turning points in the short rate and spread between short and long have occurred in unison, no consistent level of interest rates has signalled these points. For instance, the low experienced late in 1978 was 3 to 4 per cent lower than that in the middle of 1980. Government stock yields declined after 1980 while short instruments climbed to a peak of 19 per cent early in 1982. In a similar manner, securities subject to heavy interest rate control during 1983 and 1984 experienced reductions in yields while the relatively free commercial bill market felt upward pressure on rates. Short and long rates were therefore moving in opposite directions, generating a peak in the middle of 1984. The peaking of the spread between short and long securities in 1985 occurred at historically high interest rate levels. Despite both short and long securities exceeding previous maximum rates, the spread between the two was also at historically high levels. Maximums and minimums were therefore experienced at a wide array of interest rate levels.

The combination of interest rate environments and cyclical movements in the spread between short and long rates meant the yield curve underwent constant change throughout this period. A three dimensional plot of the New Zealand yield curve over the sample period presented in figure 4 illustrates this. Figure 4 highlights the relationship between the cyclical pattern of the spread and the shape of the yield curve. Periods of relatively low interest rates, and thus generally low spreads are associated with flatter yield curves while pronounced humps occur when rates are at relative peaks and accordingly the spread is at a maximum. Shallow curves are easily identified late in 1978, the middle of 1980 and for a period in the middle of 1983. These coincide with minimums in the spread and relative lows in interest rates. Similarly, peaks in the hump are identified late in 1979, early in 1982 and late 1984/1985, in conjunction with maximums in short interest rates.

Fig 4: Term Structure of Interest Rates
New Zealand July 1977 to Jan 1986



Conclusion

The predominance of a 'hump' shaped yield curve is explained differently by the expectations and segmentation theories. The expectations hypothesis, as outlined above, suggests expectations of high short-term interest rates over the immediate future and an expectation of a decrease thereafter, underlies the yield curve. A major contributing factor to the level of interest rates in New Zealand has been expectations of inflation, and as these have changed the relative position and shape of the yield curve has altered. The negative slope of the yield curve past the 'hump' consistently suggests that inflation has been expected to decline at some date in the future.

On the other hand, the segmentation hypothesis would suggest an excess supply of short securities and an excess demand for long securities underlies the yield curve. The excess supply of short securities decreases their price pushing up short-term interest rates, while an excess demand for long securities (relative to short instruments) raises the price and decreases long-term interest rates. The New Zealand yield curve is probably a function of both aspects, as the preferred habitat theory suggests. Supply and demand in various maturity regions are intertwined with expectations of future interest rates which are in turn closely associated with expected inflation rates.

The graphical analysis undertaken in this article has identified shifts in the yield curve over the sample period. Some shifts of the yield curve were a direct function of the cyclical trend in the spread between short and long-term interest rates. Different yield curves were characteristic of peaks and troughs of the cycle, thus reflecting different interest rate environments.

The cycle itself may, however, have been partly a function of the various regulations and controls the financial sector has been subject to. The tap system of government stock issue prior to 1983 underpinned the secondary market for long-term stock. This administratively determined interest rate may have restricted movement in long-term interest rates and thus accentuated the cyclical pattern observed in short rates. A further factor influencing the yield curve over the period arose from 'shocks' to the system that temporarily distorted existing trends. A good example of this was the interest rate controls of the 'freeze' period. Over the period from mid-1977 however, the yield curve appears not to have been affected by major shifts in expectations or maturity preferences; consequently the curve has tended to maintain its underlying humped shape.