# THE YIELD CURVE AND MONETARY POLICY

*In this article Michael Reddell examines the yield curve, which is used as an important indicator in the assessment of monetary conditions.*

## Introduction

The yield curve (or the term structure of interest rates) is a term describing the relationship between the yields on securities which have all characteristics in common except the term to maturity. Various theories have been developed over recent decades to explain the shape of the yield curve, drawing on a range of insights into individual and financial market behaviour.

Over the last two years, in particular, the slope of the yield curve, and specifically the 'yield gap' between 90 day and five year securities, has assumed a prominent place in the Bank's list of indicators of monetary conditions. This article outlines the major theoretical approaches to interpreting the yield curve and assesses the reasons why the Bank finds the traditional expectations view to be the most useful starting point for analysis. This approach is then related to the Bank's monetary control framework. The article concludes with some brief comments on the role and limitations of the use of the yield curve in the Bank's analysis and policy formulation process.

## Theories of the Yield Curve

The first rigorous attempt at explaining the term structure of interest rates in conceptual terms was the pure expectations hypothesis, developed in the late 1930s. The pure expectations hypothesis is that an interest rate[1] on a long maturity bond or deposit is a geometric average of expected future rates on a series of otherwise identical short-term bonds. The relationship between current long-term rates and current short-term rates (i.e. the slope of the yield curve) is therefore said to depend entirely on the relationship between current short-term rates and expected future short rates.

The reasoning behind this approach is intuitively plausible. Participants in financial markets are simply assumed to maximise their expected wealth, regardless of the term of the security they deal in to achieve this outcome. Consider, for example, an investor with funds to spare for, say, ten years who faces the choice of investing in a ten year bond now, or investing in a five year bond now and rolling over the proceeds of that bond into another five year bond in five years' time. To maximise his expected wealth the investor must first not only know the current five and ten year bond rates, but also hold an expectation as to the five year bond rate in five years' time. Once these expectations are formed, if investing in the successive five year bonds offers the higher expected wealth an individual investor will take that option. However, as many investors spot this profitable opportunity and are willing to shift out of ten year bonds into five year bonds – despite the fact that this may be a maturity for which they may have no fundamental demand – ten year bond rates will rise until the expected return is identical on either investment option. At this point there would be no unexploited profit opportunities, and long-term rates would be simply an average of the sequence of expected future short-term rates.

The expectations hypothesis underlies much modern analysis of the yield curve. However, its validity as a description of market developments relies on some strong assumptions. First, it abstracts from issues such as taxation and transactions costs. Secondly, it requires that at least some investors of significant size are risk-neutral (i.e. concerned only with average expected yields and not with the variability of returns). Furthermore, these investors must be willing and able to arbitrage away any potential yield differences. (One risk-neutral speculator with unlimited credit resources would be sufficient to achieve this outcome.) The effect of these assumptions is that, in aggregate, investors can be treated as if they regard the certain yield on a ten year bond purchased now as no more attractive than the same expected yield derived from a certain yield on a five year bond purchased now plus an uncertain yield on a five year bond purchased in five years' time. The theory also requires that investors behave as if they hold clear expectations of future short-term rates far into the future. This assumption may be reasonable when dealing with relatively short periods (perhaps up to five years) in an environment of relatively stable inflation. However, expectations are unlikely to be well determined in countries where low and stable inflation rates are not the norm and where longer maturity periods are being dealt with; in the case of a 30 year bond holding, for example, the theory would require investors to behave as though they have a clear expectation of one year bond rates in 29 years' time.

Nevertheless, the expectations hypothesis is a powerful analytical tool. If the hypothesis is correct, then a flat yield curve, in which the long rates are equal to the shorter term rates, implies that future short rates are expected to be the same as the current short rate in every future year. Similarly, an upwards sloping yield curve implies that future short-term rates are expected to rise above current levels, and a downward sloping yield curve (as has been observed in New Zealand in recent years) that future short-term rates are expected to be below current short-term rates.

The expectations hypothesis also offers important conclusions for monetary policy and the analysis of monetary conditions. To the extent that the hypothesis is valid, the authorities cannot alter the shape of the yield curve unless they also manage to change expectations of future short-term interest rates relative to current short-term rates – by altering expected inflation and/or expected real short-term interest rates. Attempting to increase the slope of the yield curve simply by selling short-term bonds and buying long-term bonds without any fundamental changes, for instance to the system's base liquidity, would be fruitless in anything other than the

[1] Defined throughout this article as the yield to maturity rather than the coupon interest rate.

very short-term. Investors and traders would shift out of long bonds into short bonds to take advantage of the arbitrage opportunities until the initial term structure was restored. On the other hand, if a policy action, such as a reduction in primary liquidity or the settlement cash target, increased the yield gap, then the expectations hypothesis would imply that the gap between current and expected future short-term rates had been increased by the policy change.

An alternative approach to understanding the yield curve is the segmented markets theory. Here, bonds of different maturities are considered to be imperfect substitutes for one another. At the extreme, each investor is concerned only with minimising risk (defined as the variance around the average expected return over the desired holding period), and is therefore interested only in a particular maturity structure regardless of the expected returns on alternative maturities. Under this extreme version of the theory, expectations of future short-term rates are of no relevance in determining long-term rates, and so interest rates for each maturity are determined solely by the underlying supply and demand for funds at that maturity (reflecting, for example, investment project length and future planned consumption patterns). For example, even though a ten year bond might yield less than two successive five year bonds are expected to yield, investors with a ten year investment horizon will prefer the ten year bond because of the certainty of return. Because of this risk aversion, bond markets are segmented into separate markets for bonds of different maturities. The authorities could therefore alter the term structure to promote or discourage various types of savings or investment activity, simply by altering the relative supplies of long and short-term securities through open market operations. The slope of the yield curve would, however, tell us nothing about expected future interest rates, and would be of no use as an indicator of the appropriateness of the monetary policy stance.

This extreme version of the segmentation hypothesis does not have wide credence as a description of financial markets in most modern economies. The assumptions of the theory are contradicted by the existence of speculators – investors or traders who are willing to exploit arbitrage opportunities by adopting an open position in maturities or instruments for which they do not have a fundamental demand – and by borrowers willing to take on floating rate loans to fund long term projects. Extreme forms of segmented market theories may be of more use in analysing economies with less sophisticated financial markets, which lack deep secondary markets, and which do not have (for regulatory or social reasons) a tradition of financial sector trading and arbitrage activity.

Irrespective of how well developed financial markets may be, even speculators must limit their exposures. As a result, there may be some degree of segmentation between markets for instruments of different maturities, at least in the short term, depending on the depth of secondary markets and the extent of speculative arbitraging activity. Various attempts have been made in the literature to blend elements of both expectations and segmentation theories to take account of these possibilities.

Hicks, the original formulator of the expectations theory, sought to incorporate such factors by advancing the 'liquidity preference' hypothesis, in which it is claimed that long bond rates are an average of expected future short rates plus a liquidity or risk premium which rises steadily with the term to maturity of the long bond. The hypothesis is claimed to explain the historical 'fact' that in normal circumstances the slope of the yield curve has an upward bias. Advocates of the liquidity preference hypothesis argue that an increasing liquidity premium arises because lenders (savers) generally have short desired holding periods, and prefer to buy short-term bonds or deposits to reduce capital-value risk. Borrowers, on the other hand, are presumed to issue bonds (or borrow) in order to finance long-term fixed capital investment and prefer to issue long bonds to minimise the uncertainty of debt service costs over the life of the asset.

The question of the size and direction of any liquidity premium is essentially an empirical issue. Although there is a widespread perception that liquidity premia increase with the length of time to maturity, the question is by no means clear-cut. There is no strong prior reason to expect that savers and their agents have short desired holding periods, and are primarily concerned with capital risk rather than income risk (consider, for example, the long term commitments of life insurance and superannuation companies). Similarly it is not unquestionable that borrowers have long holding periods and are primarily concerned to avoid income rather than capital risk (for example, the incidence of variable rate loans which give the borrower no certainty as to nominal debt servicing costs). To the extent that liquidity premia do exist in normal circumstances they are at least as likely to relate to the relative depth of secondary markets in various maturities as to the sort of factors outlined above. For example, in the New Zealand government securities markets there are very few maturities in which there is sufficient volume to support a liquid secondary market. In those maturities for which there are liquid markets, such as the July 1992 stock, there is clear evidence that investors are willing to take a lower yield as a tradeoff for the ability to withdraw easily from the market – a factor particularly important to overseas investors.

More recently, a further refinement of the various term structure theories has developed in the 'preferred habitat' approach. Market participants are assumed to be risk averse and are acknowledged to be

uncertain about future interest rates. Although speculators exist, it is asserted that hedgers, with 'preferred habitats' equal to their desired holding period, generally dominate market outcomes. Funds will move away from the preferred habitat only when the greater expected return is perceived to outweigh the risk. The yield on longer term bonds is said to be equal to the averages of current and expected future short-term yields plus a risk premium. However, the risk premium on any particular maturity may be positive or negative, and may vary over time or with different maturities. This approach can incorporate a range of factors. These include the differing relative fundamental supplies and demands at each maturity, liquidity premia, and changing levels of speculative activity. The approach, which generally assumes that the yield curve will, on average, be upward sloping, also allows for the increasing degree of uncertainty regarding expected future rates the further into the future one looks. In general, however, this risk premium type of theory lacks a strong theoretical grounding and assumes, without rigorous exposition, particular attitudes to different risks by economic agents, without offering any clear empirical conclusions.

## Evaluation

There has been little formal empirical testing of the theories of the yield curve in the New Zealand context.[2] Until recently New Zealand financial markets have been constrained by reserve ratios, administratively set government security yields, and controls on private sector interest rates. As a result of these factors secondary securities markets were shallow or non-existent. All these factors helped make formal testing largely irrelevant – it was clear from the regulatory structure why most interest rates were what they were. Even now, almost four years after the freeing up of interest rates, insufficient data make it difficult to conduct useful tests even if the methodological problems could be overcome. In terms of methodology, the key problem in all empirical testing of the expectations theory is that expected future short-term rates are not readily measurable. Furthermore, the theory provides no explicit account of how these expectations are formed.

If the behaviour of interest rates is sufficiently dominated by variable risk premia, then expectations may be largely irrelevant in explaining movements in the slope of the yield curve. Most analysts would acknowledge that liquidity preference, uncertainty and risk factors may be relevant at times in explaining short-term changes in the slope of the yield curve. For instance, in late 1987, following the sharp downturn in the sharemarket, there was clearly a heightened degree of uncertainty and preference for shorter term quality assets. It is also clear that in New Zealand not all markets are of similar depth and liquidity.

While these factors are acknowledged to have some importance, the presence of speculative arbitrage activity and the absence of significant legal restrictions, have led the Bank (and a number of private sector commentators) to consider that the basic expectations approach still provides the most useful starting point for analysis. Moreover, the increasing array of sophisticated technology and financial instruments, together with falling transactions costs, increase the likelihood that the expectations approach will hold, since profitable trading opportunities will increasingly be exploited. Nevertheless, as with all frameworks and indicators, the data and the interpretations are rarely clearcut.

## The Yield Curve and Monetary Policy

If the expectations approach does hold approximately, it may be asked why monetary policy adjustments do in fact alter the slope of the yield curve even though inflation expectations appear to change only very slowly. Why in these cases does arbitraging activity not counter any movement in short-term interest rates and, in the absence of a change in inflation expectations, return the yield curve to the level and slope prevailing prior to the policy change?

The key to answering this question lies in the special nature of the demand for and supply of monetary base assets primary liquidity (PL) compared to the markets in other instruments. Unlike, say, bank bills or TCDs, the Reserve Bank has effective monopoly control over the supply of PL. The settlement institutions (mainly the banks), on the other hand, have a demand for PL which is principally related to the size of their balance sheets and to the size and volatility of net flows between the Reserve Bank and the private sector – none of which can be altered immediately by the banks. Because the Reserve Bank specifies that transactions with it must be settled in PL assets, there are – for the settlement institutions – no close substitutes for PL assets. The Reserve Bank's monopoly control over the supply therefore means that in practice any excess demand or supply is initially reflected almost entirely in interest rate movements on short-term securities. Unlike an attempt to alter the yield curve based simply on purchases and sales of freely marketable securities, a change in the yield curve generated by creating an excess demand or supply of PL cannot immediately be arbitraged away by offsetting portfolio adjustments in the private sector.

By way of example, consider a tightening in monetary policy achieved by reducing the average level of PL below the level that was previously consistent with banks' lending and funding plans. This reduction creates an excess demand for PL which the settlement institutions attempt to satisfy by bidding more aggressively for short-term deposits; short-term interest rates are

[2] Although, for some preliminary work in this area, see Keith Lloyd and Girol Karacaoglu, "Some Further Evidence on the Term Structure of Interest Rates in New Zealand", Reserve Bank of New Zealand Discussion Paper G87/3.

bid upwards and the yield curve steepens accordingly. If inflation expectations do not adjust immediately to the policy tightening, but react mainly to observed reductions in actual inflation, the entire yield curve is also likely to shift up, as speculators sell long-term assets to take advantage of the higher yields on shorter term maturities. However, because this arbitrage activity cannot generate any additional supply of primary liquidity, the excess demand by settlement institutions cannot immediately be satisfied. As a result real short-term interest rates remain high, but are expected to fall as banks adjust their lending and deposit portfolios and the inflation rate adjusts to the monetary policy measure.

The increase in short-term real and nominal rates resulting from a policy tightening will lead to a decline in credit demand through a variety of channels.[3] The resulting decline in lending reduces banks' demand for reserves (PL), so eventually eliminating the excess demand for PL, and permitting a fall in real short-term interest rates and hence in the slope of the yield curve. Thus, the steeper yield curve and higher overall real interest rate structure induced by the policy change will persist until the level of PL demand is reduced to match the new level of supply.

The precise impact on the yield curve of any particular policy tightening depends on a number of factors. These include the nature of settlement institutions' reactions to their unsatisfied demand for PL, the responsiveness of credit growth to interest rate movements and the responsiveness of inflation expectations to the announcement of a tightening in policy. The more rapidly the settlement institutions attempt to restore the initial relationship between PL and the size of their balance sheets, the greater will be the increase in short-term interest rates and the slope of the yield curve for any given policy tightening.

However, the major factor affecting the impact of a monetary policy change on the yield curve is the responsiveness of inflation expectations. There is no guarantee that the announcement of a tightening in policy will immediately change public thinking regarding the willingness or ability of the authorities to maintain anti-inflation policies. The linkages between monetary policy instruments and prices do not appear to be widely appreciated and, given New Zealand's history of stop-go approaches to monetary control, even if the linkages were understood, the level of credibility given to official objectives might still be low. It is only as perceptions change regarding long-term policy intentions, and hence likely inflation outcomes, that expectations will fall significantly, so ensuring that reductions are achieved in longer-term nominal rates and in the overall level of the yield curve. Hence, to minimise the costs of disinflation, an important aim of the authorities must be to enhance the overall credibility of the policy stance, and thus hasten the downward adjustment in inflation expectations and longer term real rates. The more slowly inflation expectations adjust the more costly will be the overall disinflation process.

All these factors suggest that there is no one-to-one relationship between the slope of the yield curve and the overall stance of monetary policy. Even under the pure expectations theory, the appropriateness of the slope of any particular yield curve depends on the desired rate of reduction in inflation, the rate at which inflation expectations adjust, and the existing pattern of those expectations. A policy tightening may initially result in a significant steepening of the yield curve as real short-term interest rates rise, with medium-term inflation expectations remaining largely unchanged. Whether the yield curve steepens or flattens subsequently depends on the relative speeds at which inflation expectations are revised downwards (which will impact most on long-term rates) and the excess demand for PL is reduced through lower credit demand (which impacts more on short-term rates). As the excess demand for PL is eliminated and inflation expectations are reduced, the slope of the yield curve will flatten and the size of the yield gap between any two particular maturities (say, 90 day bank bills and five year government stock) will fall towards zero. At each stage of this scenario the yield curve would be consistent with the achievement of the policy goals. Thus, a yield gap of any particular magnitude is, on its own, neither necessary nor sufficient to ensure the achievement of a particular inflation objective.

In assessing the appropriateness of the interest rate structure and the stance of monetary policy for the achievement of an inflation objective, it is important to judge the slope of the yield curve relative to private sector inflation expectations – since it is the private sector's perceived level of real interest rates which principally affects credit demand. If perceived real interest rate levels were judged to be insufficient to restrain credit demand, policy action would tend to be aimed at pushing the yield curve away from its existing level by generating a further excess demand for PL.

The judgements required on all the factors which may affect the yield curve make it inappropriate to specify particular rules regarding the appropriate size of the yield gap between, say 90 day bills and five year government stock – the main yield curve indicator used by the Bank.[4] For this reason, the Reserve Bank

[3] See "A Layman's Guide to Monetary Policy in the New Zealand Context" in the June 1987 *Bulletin* for more details.

[4] The observant reader will have noticed that 90 day bills and 5 year stock do not share common risk characteristics or cash-flow profiles, and so in terms of the strict demands of the theory we are not comparing like with like. This criticism is acknowledged but with short-term bank paper trading at only a slight margin over Government paper and the Bank not closely targeting any specific yield gap, the difference is unlikely to pose a problem. These instruments and maturities represent the best available in terms of deep and liquid markets least likely to be affected by factors other than expectations and policy decisions.

has not moved, either formally or informally, to target the yield gap within a narrow range, but instead uses the yield curve data in conjunction with a wide range of other indicators, including the exchange rate, and the monetary and credit aggregates.

For most of the last four years in New Zealand, the yield curve has sloped downwards, consistent with expected falls over time in inflation and short-term interest rates. The existence of a downward sloping yield curve during a disinflationary period has not been unique to New Zealand. The major industrialised countries experienced a similar phenomenon during their disinflationary periods earlier this decade. However, in most cases, the degree of inversion of the yield curve was not as great and the period over which short-term rates exceeded medium-term rates was not as long as in New Zealand. These differences primarily reflect the more entrenched nature of inflation in New Zealand (twenty years of inflation in excess of 5 per cent per annum) and thus the greater credibility problems facing the authorities, and the slower downward adjustment of expectations.

The objective of monetary policy is to achieve price stability by the early 1990s. As this goal is achieved, the shape and level of the yield curve can be expected to change significantly. Real interest rates can be expected to fall to levels similar to those in other low inflation countries, perhaps around 3-5 per cent and, provided price stability is maintained consistently, a relatively flat, probably upward sloping, yield curve could be expected to develop, with nominal interest rates falling to well below 10 per cent and possibly as low as 4-6 per cent.

## Summary

This article has outlined the major theoretical insights regarding the term structure of interest rates. The expectations-based interpretation of the term structure, modified as necessary by the various risk and uncertainty factors, provides the starting point for most of the Bank's use of the yield curve in the assessment of monetary conditions.

The yield gap has become an important indicator. However, no single yield curve is either necessary or sufficient to ensure the achievement of a particular inflation objective. Rather, the appropriateness of a given yield curve, and of the stance of monetary policy in relation to the price stability objective, continues to be assessed on the basis of information obtained from a range of indicators.