

The Term Spread and GDP Growth in Australia

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Abstract

This paper analyses the significance of the spread between short and long term interest rates for predicting GDP growth in Australia, and whether the predictive relation deteriorates, as theory suggests, with the adoption of a credible inflation-targeting regime. We test whether the significance of the term spread is sensitive to the inclusion of other conditioning variables which may be useful in forecasting GDP growth, and whether forecasting significance is due primarily to the expected change in short-term interest rates, the term premium, or a combination of the two. There is some support for the proposition that the rationally-expected term spread has become less significant with the adoption of inflation targeting.

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1 Introduction

The use of financial-market data to predict economic activity has a long history. Tobin's 'q theory' for investment, for example, is based on the idea that if stock-market valuation of the capital stock is greater than its replacement value, firms have an incentive to invest. So changes in q should help predict changes in capital formation. Alternatively, a consumption capital asset pricing model (CAPM) predicts that a change in the real interest rate changes the relation between present and future real consumption as households reallocate consumption across time. Changes in the real interest rate should help forecast changes in consumption. As a third example, changes in the 'term spread' – the difference between nominal yields on long and short-term risk-free securities – have been postulated to forecast changes in inflation and real output. As pointed out by Ang, Piazzesi and Wei (2006), every US recession after the mid-1960's was predicted by a negative-sloping yield curve, observed within 6 quarters of the impending recession. More general linkages between asset prices, output and inflation were surveyed by Stock and Watson (2003). They conclude that 'there is evidence that the term spread is a serious candidate as a predictor of output growth and recessions. The stability of this proposition in the United States is questionable, however, and its universality is unresolved' (p.801).

Our objective is to investigate the significance of the term spread in real GDP growth regressions in Australia. Our analysis is innovative in two main ways. We study the stability of the relation across successive monetary policy regimes – denoted the 'Checklist' and 'Targeting' regimes – since, as is outlined in the following section, there are a number of arguments as to why adoption of a credible inflation-targeting regime is likely to break the nexus between changes in the term spread and future GDP growth. Since it may be that observed changes in the significance of the term spread are due to changes in the risk premium rather than the monetary regime itself, our second innovation is to decompose the separate effects of the 'pure expectations' term spread and the 'term premium' on cumulative GDP growth.

The rest of the paper is organised as follows. A literature review is provided in the following section, while data and sample separation are described in section 3. Results are presented in the fourth section, beginning with analysis of a basic regression model for cumulative and marginal growth. Alternative specifications of the basic model are then considered. The last part of this section uses the expectations model of the term structure to estimate the importance of the term premium in driving our results. The fifth section draws conclusions.

2 Literature Review

Several arguments have been advanced as to why a move to an inflation-targeting regime reduces the predictive ability of the term spread. One particular argument sometimes put forward in financial-market commentary concerns the risk premium, the proposition being that under a credible inflation-targeting regime longer-term fluctuations in inflation are likely to be lower than otherwise, cutting the risk premium on long-term nominal securities¹. However, whether a cut in the inflation risk premium leads to a cut in the nominal interest-rate risk premium depends on the relationship between the volatility of the real interest rate and the choice of monetary regime. If, in practice, an inflation targeting regime achieves a greater degree of price stability at the expense of higher volatility in real variables, it is not clear *a priori* that the volatility of the long term nominal rate, and hence the risk premium, will decline under inflation targeting. Our empirical analysis is designed to throw light on this issue.

The second line of argument is based on models in which the expectations model of the term structure applies – so the risk premium is exogenous. At its simplest, the term spread measures the difference between current short-term rates and the long-term average of future short-term rates, and hence provides a measure of the stance of monetary policy. On this interpretation, the measure

¹Gürkaynak et al (2006) support the view that the adoption of a transparent inflation-targeting regime in the UK has played a significant role in anchoring long-term inflation expectations.

is likely to change as monetary regimes change. The informal argument of Bordo and Haubrich (2004) is as follows. Under a credible monetary policy, an inflationary shock has no effect on the rate on long bonds but increases the short-run nominal rate. A temporary adverse real shock also increases the short rate as people attempt to smooth consumption while the long rate is, again, unaffected by the temporary shock. So, while a fall in the term spread could result from either an inflationary or real shock, it is only in the former case that a fall in the spread is associated with a fall in activity.

They then consider the case where the lack of a credible inflation target is characterised in terms of inflation being a random walk. In that case an inflationary shock is expected to persist and both long and short nominal rates rise by an equal amount, leaving the term spread unchanged. A temporary real shock, however, leads to a cut in the spread in the same way as before. Reasoning along these lines then leads Bordo and Haubrich to conclude that, since the noisy signal from inflationary shocks is absent in the ‘non-credible policy’ periods, one is more likely to find that falls in the term spread are associated with falls in real activity in these periods. This proposition is not rejected by their empirical analysis, based on United States data from 1879 onwards.

Ellingsen and Söderström (2001) develop a closed-economy model the conclusions of which can be interpreted in a similar way. Their model is based on Svensson (1997, 1999)². The central bank sets the cash rate by optimising a quadratic intertemporal loss function which has as arguments deviations of inflation and output from their target values (zero). The model comprises (i) a Phillips curve where the change in inflation depends on the output gap and an i.i.d. inflation shock, (ii) an aggregate demand equation in which the change in the output deviation depends on the real interest rate and an i.i.d. demand

²An implication of their model – that the response of the yield curve to shocks depends on whether or not the private sector attributes monetary policy actions to changes in preferences for inflation stabilisation – has been tested for Australia and New Zealand over the period 1989 - 2003 by Claus and Dungey (2006). They find some support for this proposition for Australia, but results for New Zealand are weaker.

shock, (iii) a modified expectations theory of the term structure in which the n -period rate is the average of expected future short rates up to maturity $n-1$, plus an exogenous term premium.

Ellingsen and Söderström (2001) consider a number of scenarios, two of which are relevant to the present paper. In the ‘symmetric information’ case, the private sector has the same information set as the central bank and also knows central bank preferences, summarised by λ , which is the relative preference weight on the output spread. In this case, they show that interest rates of all maturities are positively related to both supply (Phillips curve) and demand shocks, with the magnitude diminishing with maturity.

They also consider the asymmetric-information case where the current value of λ is known only to the bank. This feature is similar to the so-called Checklist period in Australia when the Reserve Bank was known to be targeting a number of variables, but the bank’s preference weights were not known. We interpret this as the lack of a credible monetary policy. Ellingsen and Söderström (2001) show that, in this case, interest rates on long bonds move in the opposite direction to the innovation in the (short) central-bank rate. For example, a supply shock which generates an increase in the bank-rate would also lead to a clockwise rotation in the yield curve (short rates rising and long rates falling) if the bank’s action revealed its preferences as being tough on inflation (a lower λ than the private sector had previously believed).

It is therefore a common prediction of both these models – Bordo and Haubrich (2004) and Ellingsen and Söderström (2001) – that changes in the term spread are more likely to help forecast GDP growth in periods in which the credibility of monetary policy is low.

The two Australian analyses most closely related to the present paper are Lowe (1992) and Alles (1995), who investigate stability of the relationship between the nominal term spread and cumulative real GDP growth over two sub-samples, with the break between them occurring in 1982(2). They use a variety of definitions of the term spread. They show that there is a stronger relation between the term spread and GDP growth in the latter of the two sub-samples;

that the term spread performs better than indexes of leading indicators; and that the forecasting performance of the term spread is highest for cumulative GDP growth from two to eight quarters ahead.

The choice of sample periods for these earlier studies is determined by deregulation of Australian interest rates – the authorities moved from a tap system to a tender system for issuing Treasury notes in December 1979, and for government bonds in July 1982. The information content of the yield curve is likely to increase as interest rates are market determined, making it more likely that the term spread is a predictor of economic activity. Lowe (1992) and Alles (1995) confirm this to be the case, finding that the forecasting performance of the term spread, using a variety of measures of the spread, improves in the second of their two sub-samples which begins in 1982(3). However these earlier studies did not test whether the forecasting performance of the term-spread relationship is sensitive to the adoption of an inflation-targeting regime, which in this paper we take to have occurred in the first quarter of 1993.

We test the stability of the relationship between the term spread and output in two stages. First we test whether the relationship between the term spread and output is stable across monetary regimes. Then, to provide a sharper test of the theoretical models described above, we ask whether the effect of the spread depends on monetary policy actions, and whether the source of any instability lies in a change in the effect of the risk premium or the perfect-foresight term spread. A finding that the perfect-foresight term spread is insignificant in forecasting GDP growth under inflation targeting would support the predictions of Bordo and Haubrich (2004) and Ellingsen and Söderström (2001).

3 Data

All data are quarterly and range from 1972(1) – 2008(1). Interest rates (the cash rate and 5 year Treasury bond rate for Australia, and the 3 month Treasury bill rate and the 5 year Treasury bond rate for the US) are the mean of three monthly

annualised yields. Data were obtained from Reserve Bank Bulletin Tables F01 and F02, and the Federal Reserve Bank of St Louis FRED database. Space constraints limit our analysis to the 5 year - cash rate measure of the term spread for Australia; we choose the 5 year - 3 month term spread in the US³. Changing patterns in the Australian component series can be seen in the monthly data shown in Figure 1, where the 5-year bond rate was set by Treasury in earlier periods and the cash rate was by the Reserve Bank in later periods.

Figure 1 near here.

The GDP growth series are derived from 2005-06 base-period seasonally adjusted chain volume GDP. Cumulative future GDP growth – $(400/k) \ln(y_{t+k}/y_t)$ – is used as the dependent variable⁴. This variable is denoted CG2 and so on to refer to, for example, $(400/2) \ln(y_{t+2}/y_t)$. Data for the term spread and CG4 are shown in Figure 1, with the latter half of the sample showing a reduction in volatility for both series. Data were tested for stationarity using ADF tests over the longest available sample period (1959 to 2008 for the various transformations of GDP data, 1972 to 2008 for the term spread, and 1953 to 2008 for the US term spread), and the null of a unit root was rejected in all cases.

Figure 2 near here.

³The cash rate was chosen as the short end of the spread so as to align our analysis with that of Ellingsen and Söderström (2001); in their model the short interest rate is the cash rate. The long end was chosen to be the 5-year bond rate so as not to lose too many observations when implementing the Hamilton-Kim decomposition. Monthly ‘cash-rate’ data are a splice of the series for the 11 am call rate and the interbank cash rate. For Australia, monthly cash-rate data are within-month averages of daily data, while available 5-year bond data are end-of-month data. Monthly US data are averages of business days. Interest-rate data are not seasonally adjusted.

⁴Earlier analyses based on so-called marginal growth models with the dependent variable defined as 2 quarter growth k periods ahead (i.e. $(400/n) \ln(y_{t+k}/y_{t+k-2})$) proved uninformative, as did Probit and Logit models, with the dependent categorical variable defined in terms of GDP slowdowns of varying degrees of severity. In some sub-samples there is only a small number of recession episodes which limits the extent to which stability across monetary regimes can be examined. Further detail can be provided on request from the authors.

Sub-samples have been chosen as follows:

Sample One: (Early): 1972(1) – 1984(4)

Sample Two (Checklist) : 1985(1) – 1992(4)

Sample Three: (Targeting) 1993(1) – 2008(1)

The beginning and end points for the full sample are determined by the availability of data. The beginning of the Targeting sample represents the start of the Reserve Bank’s inflation-targeting regime⁵. Choosing the break between the Early and Checklist samples is more problematic, as monetary deregulation occurred gradually in Australia. As mentioned earlier, official interest rates were deregulated in stages, starting in 1979. The exchange rate was floated in December 1983. Finally, the policy of targeting the growth rate of M3 was formally abandoned in January 1985. On this basis, we choose 1985(1) as the beginning of Checklist sample, during which monetary policy was conducted by adjusting interest rates in response to variation in a ‘checklist’ of economic variables.

A final consideration concerns the effects of changes in the private-sector information set, rather than changes in central bank objectives. Instead of defining sub-samples in terms of the break between the checklist and inflation-targeting, it may be more important to consider the effect of changes in the way monetary policy was communicated to Australian financial markets. In this respect a break occurred in January 1990, after which the Reserve Bank’s monetary policy actions were communicated immediately. The post-1990 period also coincides with rapid disinflation which occurred before the adoption of inflation targeting. Accordingly, the robustness of the Targeting results will be checked by analysing a Post 1990 sample, running from 1990(1) to 2008(1)⁶.

⁵Although the inflation-targeting regime was formalised in 14 August 1996, by an exchange of letters between the then Treasurer and the designate Reserve Bank Governor, most accounts recognise that the Reserve Bank had started targeting inflation early in 1993 – see for instance Grenville (1997) or Macfarlane (1998).

⁶If 1990(1) is taken as the break point, there are too few observations in the shorter Checklist sample for meaningful analysis, so only Post 1990 results are reported.

4 Results

This section comprises several parts. We first investigate stability across sub-samples using a regression relating cumulative growth to the term spread, lagged growth rates and the US term spread. A variant of the basic regression is then examined for evidence of specific monetary-policy effects. The last part of this section uses the expectations theory of the term structure to disentangle the ‘expected-rate-change’ and ‘term premium’ effects.

4.1 Basic regression

The basic regression equation (1) is used to quantify the relationship between the term spread and cumulative GDP growth over the following k quarters, where s represents the Australian term spread and s^{US} the US term spread.

$$(400/k) \ln(y_{t+k}/y_t) = \alpha_0 + \alpha_1 s_t + \sum_{j=0}^3 \beta_j (400) \ln(y_{t-j}/y_{t-j-1}) + \beta_4 s_t^{US} + \epsilon_t \quad (1)$$

The primary objective of the present paper is not to develop a forecasting equation for cumulative growth, but to examine changes in the estimate of α_1 across monetary regimes. We allow for the possibility that the persistence of output growth means that past values of GDP growth are likely to impact the term spread and are also useful predictors of cumulative growth⁷. We have also included the US term spread because its omission would likely result in a mis-specification bias in the estimate of α_1 (correlation coefficients for s and s^{US} are, for the three sub-samples, 0.007, 0.684 and 0.642 respectively). Other potential regressors such as those used by Valadkhani (2004) were not included, either because they are uncorrelated with s , or the data are no longer available. The definition of the dependent variable implies overlapping data, resulting in autocorrelated errors – we therefore apply a Newey-West (1987) correction. Results are provided in Table 1.

⁷A more general approach would be to estimate a VAR in the term spread and output growth, and to generate k -step ahead forecasts by iterating the VAR. We follow Stock and Watson (2003) in using a linear regression specification.

Table 1 near here.

When it is significantly different from zero, the estimated spread coefficient is positive suggesting that, in accord with priors, an increase in the yield spread precedes an increase in growth. Estimates of α_1 are not significantly different from zero in the Checklist period and significant, for CG2 and CG8, in the Targeting period. The coefficient on the US term spread is positive and significant for CG6 and CG8 in the Checklist period but negative at all time horizons in the Targeting sample. These results are reinforced for the Post 1990 sample, where the coefficient on the term spread is positive and significant at all time horizons, while the coefficient on the US term spread is significant and negative at all time horizons. These results appear to be at variance with Valadkhani (2004), who found that both the Australian and the foreign term spread were positive and significant for CG2 to CG12.⁸ To investigate this further, however, we re-estimated (1) over his sample period, 1980(1) to 2002(1). For CG4, CG6 and CG8 the two sets of estimates of α_1 and γ_1 are reasonably close so that differences between estimates in Table 1 and those of Valadkhani (2004) appear to result from sample selection, rather than model selection and the later-vintage dataset used in this paper.⁹

The preliminary conclusion is that, comparing the Checklist and Targeting periods, results do not support the predictions of Bordo and Haubrich (2004) and Ellingsen and Söderström (2001), that the term spread is less likely to be significant in an inflation-targeting regime. The term spread is not significant in the Checklist sample, but it is significant (for two- and eight-quarter time horizons) in the Targeting sample. If attention is focussed on the Post 1990 sample, the spread is always significant and positive.

We now provide further analysis of the cumulative growth regression to test if the predictive power of the term spread can be better understood by spec-

⁸Valadkhani's (2004) model included the TRYM model measure of the term spread for Australia's major trading partners, the change in M1, the change in the S&P/ASX200 index and the composite leading indicator as regressors.

⁹Details of these estimations can be obtained from the authors.

ifying alternative models¹⁰. Following Dotsey (1998), (1) is augmented by an additional term that captures the effect of tight monetary policy. The intuition supporting this is that yield inversions (negative term spreads) may simply be a function of tight monetary policy, and hence it is only in periods where the cash rate is rising that the yield curve forecasts a slowdown in growth. Alternatively, it may be that tight monetary policy, and not a yield inversion, precedes any slowdown in growth, and hence the addition of the monetary policy proxy term may reduce the significance of the term spread coefficient.

4.2 Effect of monetary tightening

To consider the effect of monetary tightening, the following regression is performed:

$$\begin{aligned} & (400/k) \ln(y_{t+k}/y_t) \\ = & \alpha_0 + \alpha_1 s_t + \alpha_2 d_t + \sum_{j=0}^3 \beta_j (400) \ln(y_{t-j}/y_{t-j-1}) + \gamma_1 s_t^{US} + \epsilon_t \quad (2) \end{aligned}$$

where the dummy variable d_t takes the value 1 if the cash rate is raised by at least 50 basis points over the preceding two quarters, and s_t again represents the term spread. As before, the expected sign on the coefficient on the spread (α_1) is positive, while α_2 is expected to be negative.

Table 2 near here.

Results for the Checklist sample are similar to those in Table 1. Estimates of α_1 are of similar magnitude and always insignificant. The monetary tightening dummy has the wrong sign for CG2 and CG4 and is never significant. We interpret these results to indicate that, because it was not until 1990 that the Reserve Bank signalled changes in monetary policy by announcing changes in

¹⁰We have also explored nonlinearities in the relationship. This approach decomposes the spread into three components: normal values; unusually high values; and unusually low values, to test if these different ranges result in different relationships between the spread and economic growth. No significant nonlinearities were found.

the cash rate, our tightening dummy may not reflect the way in which monetary policy was implemented and hence market perceptions of tightening in monetary policy which had actually taken place. Results for the Targeting sample are more clear-cut. Both the tightening dummy and the term spread have the expected sign and are significant for CG2, CG6 and CG8 and the size of the estimated term spread coefficient is similar to that found in the basic regression. These results suggests that the significance of the term spread is not attributable to episodes of monetary tightening¹¹. There is some commonality in results across the Targeting and Post 1990 samples – in both cases the term spread is generally positive and significant, contrasting with the priors based on Bordo and Haubrich (2004) and Ellingsen and Söderström (2001). Recall that these priors are generated by arguments which assume an exogenous and fixed risk premium. It was noted earlier, however, that there was a change in both nominal interest volatility and real GDP volatility over the second part of our sample period — most likely this translated into changes in the risk premium, confounding the above results. The second extension to the basic model, therefore, is to use the pure expectations model of the term structure to decompose the effects of the term spread on cumulative GDP growth into two components – the rationally-expected change in short-term interest rates and the term or risk premium.

4.3 Decomposition of the term spread

The approach of Hamilton and Kim (2002) was to decompose the term spread follows:

$$i_t^{5year} - i_t^{cash} = \left(\frac{1}{n} \sum_{j=0}^{n-1} E_t i_{t+j}^{cash} - i_t^{cash} \right) + \left(i_t^{5year} - \frac{1}{n} \sum_{j=0}^{n-1} E_t i_{t+j}^{cash} \right). \quad (3)$$

Hence the spread contains expectations of future changes in short-term interest

¹¹We also experimented with inclusion of a variable which interacts the tightening dummy and the term spread. Results were very similar to those reported in Table 2.

rates, $\left(\frac{1}{n} \sum_{j=0}^{n-1} E_t i_{t+j}^{cash} - i_t^{cash} \right)$, and a term premium for risk or liquidity, denoted $\left(i_t^{5year} - \frac{1}{n} \sum_{j=0}^{n-1} E_t i_{t+j}^{cash} \right)$. However we note that by taking an arithmetic rather than geometric mean of the various cash rates, Hamilton and Kim (2002) introduce an approximation error into the data – in its more usual form the first bracketed term in would be $100 \left(\left[\prod_{j=0}^{n-1} \left(1 + \frac{E_t i_{t+j}^{cash}}{400} \right) \right]^{\frac{4}{n}} - 1 \right)$ with the expectation replaced by the actual value of the future cash rate on the perfect-foresight assumption. That this approximation error may have important implications can be seen from Figure 3, which plots the averaging error (the difference between the 20-quarter arithmetic and geometric means of the cash rate) and the term spread. Clearly, the averaging error is large relative to the term spread so our decomposition is based on the geometric mean¹².

Figure 3 near here.

Substituting the decomposition into (1) and following the same approach as in Hamilton and Kim (2002) gives

$$\begin{aligned}
(400/k) \ln(y_{t+k}/y_t) = & \alpha_0 + \lambda_1 \left(100 \left(\left[\prod_{j=0}^{n-1} \left(1 + \frac{i_{t+j}^{cash}}{400} \right) \right]^{\frac{4}{n}} - 1 \right) - i_t^{cash} \right) \\
& + \lambda_2 \left(i_t^{5year} - 100 \left(\left[\prod_{j=0}^{n-1} \left(1 + \frac{i_{t+j}^{cash}}{400} \right) \right]^{\frac{4}{n}} - 1 \right) \right) + \zeta_t
\end{aligned} \tag{4}$$

where the disturbance term is a combination of rational interest-rate forecasting errors and the disturbance term in (1). Because the bracketed terms on the right hand side of (4) may be correlated with the disturbance term, we use instrumental-variables estimation using variables known at time t as instru-

¹²Data shown in Figure 3 for the averaging error terminate 20 quarters before the end of the sample period because of the forward-looking nature of the expectations model in (4). Because the averaging error increases nonlinearly with the cash rate, the error is numerically larger than in Hamilton and Kim's (2002) US study.

ments. As instruments, we used a constant, the four lagged values of quarterly GDP growth rate, and the US term spread s^{US} ; variables used previously as regressors in OLS estimation of (1). Hamilton and Kim (2002) argue that periods of high interest rate volatility depress the price of long term bonds, increasing their yield. Since high interest-rate volatility is associated with low GDP growth, λ_2 is expected to be positive.

Table 3 near here.

Turning to the results in Table 3, the pattern of estimates of λ_1 are quite different than for α_1 in Tables 1 and 2, and provide some support for our priors. Now the 'rational-expectations term spread' is positive and significant in the Checklist sample, but not significantly different from zero in the Targeting sample. Consistent with the observed reduction in interest-rate volatility in the Targeting period, the coefficient on the term premium is significant in the Checklist period, but not in the Targeting sample.

It is interesting to compare our results with those from Hamilton and Kim (2002) in their study using data from the United States. They estimated an arithmetic-average version of (3) using data from 1953(3) to 1988(4), with the spread defined as the difference between yields on 10 year Treasury bonds and 90-day Treasury bills. They found that expected changes in interest rates were significant for forecasting growth 12 quarters ahead, while the term premium was significant for forecasting growth up to 8 quarters ahead. Like us, they found that where both coefficients are significant, both are positive with λ_1 being larger than λ_2 . On this basis they conclude that the most important reason that a negative term spread predicts slower GDP growth in the US is that 'a low spread implies falling future short term interest rates' (p.351), but they are unsuccessful in their attempt to explain the positive sign of λ_2 in terms of the cyclical behaviour of GDP volatility.¹³

¹³A problematic feature of Hamilton and Kim's (2002) instrumental-variables approach is that it used the 3 month Treasury bill rate and the 10-year bond rate as instruments. It is not possible to reject the null of a unit root for either of these variables over the sample period 1953(3) to 1988(4).

5 Conclusions

This study has two objectives – to determine the degree to which the Australian term spread can forecast real GDP growth; and to examine whether this relationship, if shown to exist, has changed over time. Our hypothesis is that the adoption of a credible and transparent inflation targeting regime reduces the significance of the term spread.

Our initial results suggest that over some periods the term spread has been significant in cumulative GDP growth regressions which also include past quarterly growth rates and the US term spread as explanatory variables.

However we show that these initial results are sensitive to conditioning on other variables which might be useful in forecasting cumulative GDP growth. The first extension explores whether the term spread has predictive power once changes in the stance of monetary policy are taken into account — changes in stance are captured by a ‘tightening dummy’ which takes the value 1 if the cash rate is raised by at least 50 basis points over the preceding two quarters. There is a reasonably clear finding that in the Targeting regime the significance of the term spread is unaffected by inclusion of a dummy variable reflecting episodes of monetary tightening. This conclusion also holds if the change in monetary regime is assumed to have taken place in 1990(1), when the Reserve Bank began announcing its changes to monetary policy at the same time as the changes were implemented.

Our hypothesis — that the adoption of inflation targeting cuts the significance of the term spread — is, however, based on models in which the term premium is fixed. Given the decline in the volatility of interest rates and GDP growth over the Targeting period it is important to test whether changes in the significance of the term spread are due to changes in the ‘rational term spread’ or changes in the term premium. To this end, the second extension was to decompose the term spread into two components; the rationally expected change in the short term interest rate, and the change in the term premium. Results are now consistent with our hypothesis. The rational term spread is signifi-

cant in the Checklist period, but not in the Inflation Targeting sample. Over the Checklist sample, these results are similar to those obtained by Hamilton and Kim (2002) who explore the significance of the two components for a long post-war sample of data in the United States.

To conclude, it appears that, at least for forecasting Australian cumulative GDP growth, the role of the term spread changes with the monetary regime and with the volatility of nominal interest rates. There is some support for the proposition that the rationally expected term spread has become less significant with the adoption of inflation targeting.

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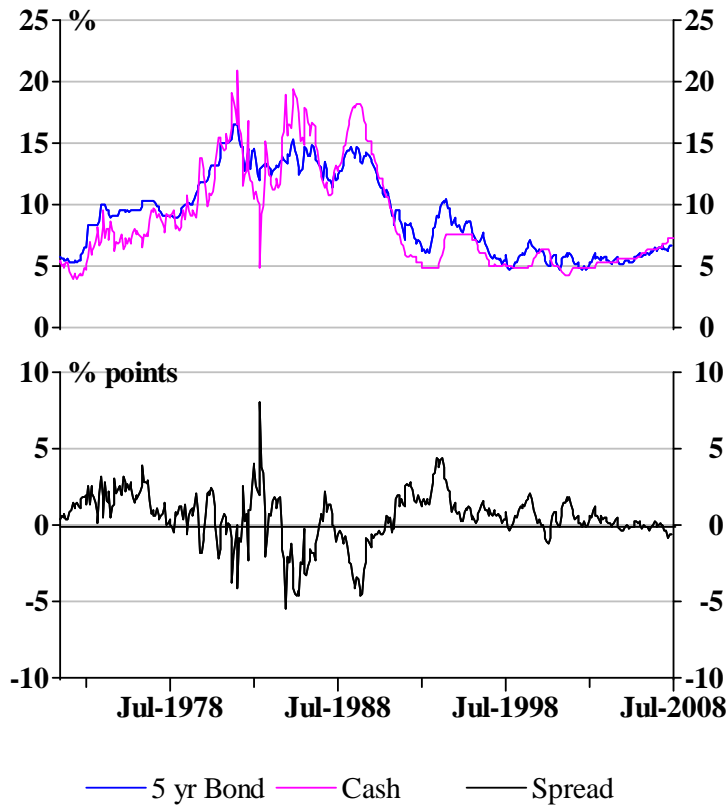


Figure 1 Monthly Term Spread and Components

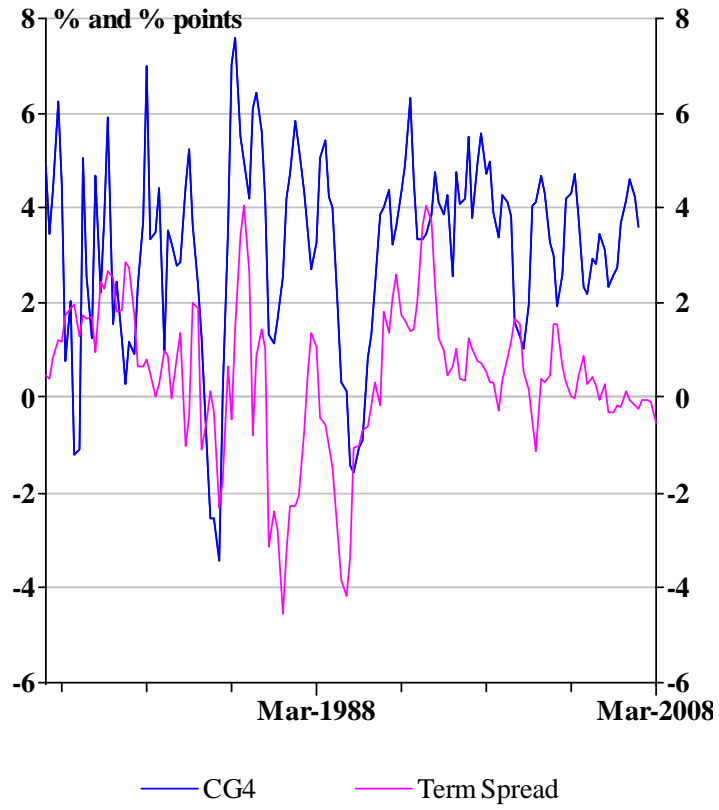


Figure 2 CG4 and Term Spread

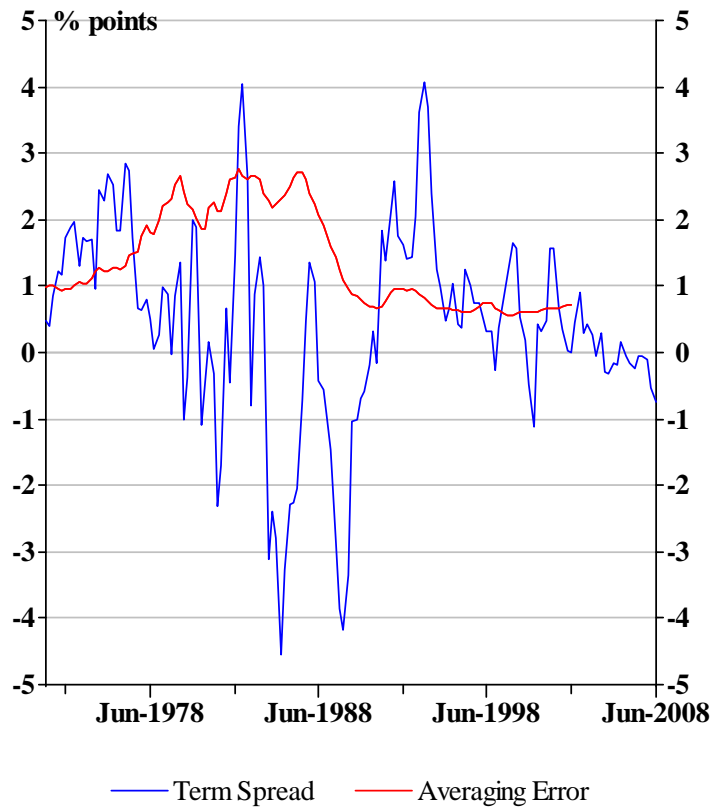


Figure 3 Arithmetic-mean averaging error

Table 1 Basic Regression

$$(400/k) \ln(y_{t+k}/y_t) = \alpha_0 + \alpha_1 s_t + \sum_{j=0}^3 \beta_j (400) \ln(y_{t-j}/y_{t-j-1}) + \gamma_1 s_t^{US} + \epsilon_t$$

Sample	k	α_1	p value	γ_1	p value	\overline{R}^2	SEE
	2	0.898	0.122	-0.153	0.768	0.052	3.714
1972(1)-1984(4)	4	0.460	0.376	0.314	0.437	0.036	2.528
Early	6	0.320	0.363	0.345	0.276	0.141	1.784
	8	0.307	0.194	0.347	0.145	0.290	1.318
	2	0.059	0.833	0.419	0.471	0.118	2.474
1985(1)-1992(4)	4	-0.020	0.951	0.795	0.263	0.039	2.071
Checklist	6	-0.061	0.806	1.368*	0.019	0.238	1.623
	8	-0.174	0.353	1.693*	0.000	0.472	1.201
	2	0.532*	0.009	-0.262	0.398	0.075	1.551
1993(1)-2006(4)	4	0.267	0.278	-0.173	0.563	0.020	1.075
Targeting	6	0.227	0.197	-0.239	0.298	-0.047	0.782
	8	0.281**	0.061	-0.197	0.383	-0.022	0.675
	2	0.896*	0.002	-0.667*	0.008	0.148	1.874
1990(1) - 2006(4)	4	0.766*	0.020	-0.556*	0.030	0.157	1.457
Post 1990	6	0.699*	0.015	-0.476*	0.025	0.254	1.090
	8	0.622*	0.004	-0.341*	0.041	0.299	0.873

Note: * and ** represents significance at the 5% and 10% level of confidence respectively; OLS estimates corrected for autocorrelation and heteroskedasticity using Newey and West (1987). Coefficients on lagged GDP growth not shown.

Table 2 Monetary tightening and the Term Spread

$$(400/k) \ln(y_{t+k}/y_t) = \alpha_0 + \alpha_1 s_t + \alpha_2 d_t + \sum_{j=0}^3 \beta_j (400) \ln(y_{t-j}/y_{t-j-1}) + \gamma_1 s_t^{US} + \epsilon_t$$

Sample	k	α_1	p value	α_2	p value	γ_1	p value	\overline{R}^2	SEE
Early	2	0.600	0.288	-1.761	0.104	-0.174	0.713	0.076	3.667
	4	0.228	0.657	-1.373*	0.001	0.929	0.394	0.075	2.477
	6	0.155	0.635	-0.978*	0.000	0.334	0.249	0.177	1.747
	8	0.209	0.382	-0.579*	0.013	0.339	0.146	0.303	1.306
Checklist	2	0.187	0.603	1.394	0.407	0.404	0.502	0.129	2.459
	4	0.054	0.890	0.809	0.600	0.786	0.278	0.024	2.087
	6	-0.085	0.779	-0.263	0.839	1.371*	0.017	0.210	1.653
	8	-0.249	0.243	-0.823	0.319	1.703*	0.000	0.492	1.178
Targeting	2	0.712*	0.000	-1.601**	0.059	-0.445**	0.054	0.185	1.456
	4	0.380**	0.088	-1.046*	0.020	-0.300	0.209	0.125	1.016
	6	0.272	0.119	-0.461**	0.068	-0.280	0.180	-0.024	0.774
	8	0.324*	0.027	-0.414**	0.067	-0.241	0.262	0.004	0.666
Post 1990	2	1.018*	0.001	-1.250	0.116	-0.816*	0.001	0.175	1.844
	4	0.839*	0.007	-0.751**	0.070	-0.651*	0.008	0.168	1.447
	6	0.725*	0.010	-0.301	0.292	-0.504*	0.016	0.247	1.095
	8	0.647*	0.002	-0.275	0.332	-0.372*	0.032	0.294	0.876

Note: * and ** represents significance at the 5% and 10% level of confidence respectively; OLS estimates corrected for autocorrelation and heteroskedasticity using Newey and West (1987). Coefficients on lagged growth not shown.

Table 3 Geometric Decomposition of Term Spread and GDP Growth

$$(400/k) \ln(y_{t+k}/y_t) = \alpha_0 + \lambda_1 \left(100 \left(\left[\prod_{j=0}^{n-1} \left(1 + \frac{E_t i_{t+j}^{cash}}{400} \right) \right]^{\frac{4}{n}} - 1 \right) - i_t^{cash} \right) + \lambda_2 \left(i_t^{5year} - 100 \left(\left[\prod_{j=0}^{n-1} \left(1 + \frac{E_t i_{t+j}^{cash}}{400} \right) \right]^{\frac{4}{n}} - 1 \right) \right) + \epsilon_t$$

Sample	k	λ_1	p value	λ_2	p value
Early	2	0.654	0.745	1.668	0.682
	4	0.866	0.645	2.556	0.511
	6	1.332	0.592	3.430	0.476
	8	0.837	0.702	2.818	0.521
Checklist	2	0.408	0.141	0.114	0.804
	4	0.522*	0.001	0.383	0.208
	6	0.647*	0.001	0.471*	0.021
	8	0.713*	0.000	0.562*	0.024
Targeting	2	0.361	0.727	-2.110	0.177
	4	0.070	0.877	-0.627	0.216
	6	0.017	0.946	-0.132	0.710
	8	0.158	0.585	-0.188	0.753
Post 1990	2	0.310	0.294	-0.392	0.519
	4	0.330	0.182	-0.159	0.725
	6	0.330**	0.070	-0.082	0.806
	8	0.362*	0.025	0.137	0.667

Note: Estimation by instrumental variables with a constant, four lagged values of the GDP growth rate, and the US term spread as instruments; estimates corrected for autocorrelation and heteroskedasticity using Newey and West (1987).