The Monetary Policy Expectation and Long Term Interest Rates in Australia☆

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【Summary】

This paper investigates the impact of monetary policy expectation on long term interest rates in Australia. Three month OIS (Overnight Indexed Swap) rate is used as market expectation of monetary policy. As for long term interest rates, AGB (Australian Government Bond) yields of two years, three years, five years and ten years and NTCB (NSW Treasury Corporation Bond) yields of three years, five years and ten years are used. The RBA (Reserve Bank of Australia) can partially influence AGB yields of two years, three years, five years and ten years and NTCB yields of three years, five years and ten years through the expectation of monetary policy formed in financial market. The expectation of monetary policy can give more impact on shorter maturities of AGB and NTCB yields. In other words, the impact gets smaller as the maturities of AGB and NTCB yields get longer.

Keywords: Monetary Policy Expectation, Long Term Interest Rate
JEL Classification: E44, E52, G10

☆ The research for this paper is supported by Grant-in Aid for Scientific Research (KAKENHI 22530305) from JSPS.

1. Introduction

As Woodford (1999) shows that the forward-looking nature of financial markets can have important implication for determining the optimal setting of monetary policy, the effectiveness of monetary policy depends on the speed and extent of the transmission of monetary policy expectations to other asset prices. This paper investigates the impact of monetary policy expectation on long term interest rates in Australia. Monetary policy decisions by the RBA (Reserve Bank of Australia) are expressed in terms of a target for the cash rate, which is the overnight money market interest rate.

This paper uses OIS (Overnight Indexed Swap) rate as monetary policy expectation. OIS rate is on a derivative contract on the overnight rate. OIS rate is a measure of the market's expectation of the overnight funds rate over the term of the contract. There is very little default risk in the OIS market because there is no exchange of principal. The funds are exchanged only at the maturity of the contract, when one party pays the net interest obligation to the other. They trade OIS based on their expectation of overnight funds rate level within a certain period[1].

So far the impact of monetary policy on long term interest rates has never been investigated by using OIS rate in Australia. They do not have futures contract for overnight cash rate in Australia. In addition to that, long term interest rates from AGB (Australian Government Bond) and NTCB (NSW Treasury Corporation Bond) markets are used to investigate the impacts of monetary policy expectation. Thus this paper distinguishes itself from other works.

As for literatures analyzing monetary policy expectation by using futures contracts in US, Krueger and Kuttner (1996), Kuttner (2001), Söderström (2001), Lange et al (2003), Faust et al (2004), Sack (2004) and Gürkaynak et al (2007) are cited.

Krueger and Kuttner (1996) analyze the federal funds futures rates' ability to forecast the funds rate, and by extension, short-run movements in monetary policy. They conclude that although federal funds futures rate exhibits a small premium, the market efficiently incorporates virtually all publicly available quantitative information that can help forecast changes in the federal funds rate.

Kuttner (2001) estimates the impact of monetary policy actions on bill, note, and bond yields, using data from the futures market for federal funds to separate changes in the target funds rate into anticipated and unanticipated components. The conclusion is that interest rates' response to anticipated target rate changes is small, while their response to unanticipated changes is large and highly significant.

[1] Thornton (2009) explains OIS market.

Söderström (2001) concludes that a number of occasions, the futures-based expectations have either predicted positive target changes that did not occur or predicted no target change when in fact the target was reduced. These occasions have tended to arise in the months of September and December, yielding the negative intercepts.

Lange et al (2003) indicate that factors other than the autoregressive properties of the federal funds rate appear to have played a more important role in enhancing the predictability of FOMC actions. Among these other factors, the Federal Reserve has implemented a number of changes that may have improved the transparency of the process of setting monetary policy.

Faust et al (2004) measure the impact of the surprise component of Federal Reserve policy decisions on the expected future trajectory of interest rates by analyzing prices of federal funds futures contracts. One of the conclusions is that they find that the effect of a monetary policy tightening is to reduce the price level significantly at all horizons up to about four years,

Sack (2004) demonstrates how to extract the expected path of policy under the assumption that the risk premia are constant over time, and under a simple model that allows the risk premia to vary. The results provide evidence that the risk premia on those contracts do, in fact, vary over time. The impact of this variation is fairly limited for futures contracts with relatively short horizons, but it increases as the horizon of the contract lengthens.

Gürkaynak et al (2007) evaluate the empirical success of a variety of financial instruments in predicting the future path of monetary policy. They find that federal funds futures dominate all the other securities in forecasting monetary policy at horizons out to six months.

The remainder of this paper is as follows. Section 2 describes the data and provides summary statistics. Section 3 discusses the framework of the analysis. Section 4 presents the results. Section 5 concludes.

2. Data

Three month OIS (Overnight Indexed Swap) rate is used as market expectation of monetary policy by the RBA. The daily closing data are provided by Tullett Prebon (Australia) Pty Ltd. OIS is the rate on a derivative contract on the overnight rate and is a measure of the market's expectation of the overnight funds rate over the term of the contract as mentioned in section1.

AGB (Australian Government Bond) yields of two years, three years, five years and ten years and NTCB (NSW Treasury Corporation Bond) yields of three years, five years and ten

years are used as long term interest rates. These daily data are provided by the RBA. The movement of three month OIS rate, two year AGB yield and ten year AGB yield are provided in figure 1. The descriptive statistics of data are provided in Table 1.Whole sample period is from July 2, 2001 to February 25, 2010.

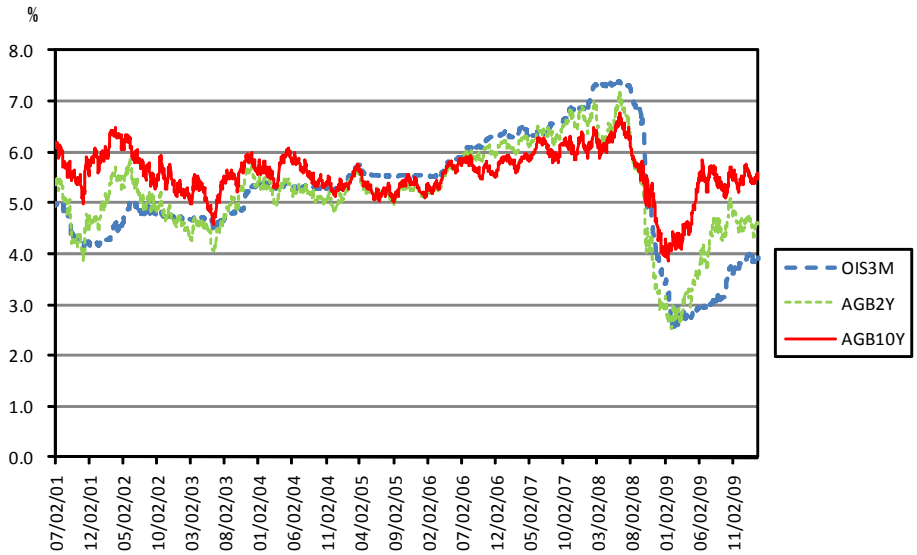

Fig.1 The movement of 3 Series

Notes:
OIS3M = OIS 3 Month, AGB2Y = AGB 2 Year, AGB10Y = AGB 10 Year
Data Source
OIS 3 Month = Tullett Prebon (Australia) Pty Ltd
AGB 2 Year and AGB 10 Year = Reserve Bank of Australia
Whole sample period is from July 2, 2001 to February 25, 2010.

Table 1

Descriptive Statistics of Data for Analysis

Variable	Average	SD	Min	Max	Median
OIS3M	5.222	1.135	2.520	7.400	5.305
AGB2Y	5.207	0.887	2.515	7.190	5.230
AGB3Y	5.305	0.774	2.805	7.050	5.290
AGB5Y	5.436	0.625	3.260	6.860	5.425
AGB10Y	5.578	0.466	3.860	6.780	5.590
NTCB3Y	5.632	0.736	3.745	7.590	5.525
NTCB5Y	5.791	0.600	4.250	7.480	5.700
NTCB10Y	5.930	0.461	4.690	7.270	5.900

Notes:
Whole sample period is from July 2, 2001 to February 25,2010.

3. Framework of Analysis

3.1 Unit Root Test

It is necessary to check if the data used in this paper contain unit roots because the empirical analysis from mid-1980's through mid-1990's show that such data as interest rates, foreign exchange and stocks are non-stationary. The ADF (Augmented Dickey Fuller) test test and the KPSS (Kwiatowski/ Phillips/ Schmidt/ Shin) test are used[2]. The ADF test defines null hypothesis as 'unit roots exist' and alternative hypothesis as 'unit roots do not exist'. Fuller (1976) provides the table for the ADF test. On the other hand, KPSS test defines null hypothesis as 'unit roots do not exist' and alternative hypothesis as 'unit roots exist'. First, original data are checked if they contain unit root. Next, data with first difference are analyzed if they have unit root to confirm that data are I (1) process.

3.2 Cointegration Test

Generally OLS method is used to analyze the relationship among variables. However when the non-stationary variables are included, ordinary hypothesis test tends to draw mistaken results since the coefficient of determination and t-statistics do not follow a simple distribution.

Granger and Newbold (1974) call this problem 'Spurious Regression'. Phillips (1986) points out two things as to the analysis of non-stationary data— (1) the coefficient of determination tend not to measure a relationship among variables, (2) the estimated equation with low Durbin-Watson ratio can possibly have a problem of spurious regression.

According to Engle and Granger (1987), Eq. (1) is estimated by OLS to find if the residual contains unit root[3]. MacKinnon (1991) provides the table for critical values. Cointegraion tests are applied for 7 pairs of interest rates after it is confirmed that all the variables are I (1). A pair of OIS three month and long term interest rate (AGB of two years, three years, five years and ten years and NTCB of three years, five years and ten years). Eq. (1) is indicated to analyze a relationship between three month OIS rate and two year AGB yield.

$$y_t = \alpha + \beta x_t + u_t \qquad (1)$$

y_t = two year AGB (Australian Government Bond) yield

x_t = three month OIS rate

[2] For details, see Dickey and Fuller (1979), Dickey and Fuller (1981) and Kwiatkowski et al (1989).

[3] For details, see Engle and Granger (1987).

When series x and y are both non-stationary I (1), they are said to be in a relationship of cointegration if their linear combination is stationary I (0). The cointegration relationship between these two variables shows that three month OIS rate and two year AGB yield are in the long-run equilibrium. In other words, market expectation on monetary policy is incorporated in two year AGB yield.

In addition to testing if three month OIS rate and two year AGB yield have a cointegration relationship, the cointegration vector (1,−1), β in Eq.1 (1), is checked with the method of dynamic OLS by Stock and Watson (1993). Eq. (2) is used to test if β = 1 can be rejected. Δx_t is lead and lag variable of three month OIS rate. If β = 1 cannot be rejected, two year AGB yield changes with an equivalent degree of three month OIS rate. The cointegration vector test is conducted only on a pair of samples when they have a cointegraton relationship.

$$y_t = \alpha + \beta E_t(x_t) + \sum_{i=-p}^{p} b_i \Delta x_t + u_t \qquad (2)$$

The conclusion that monetary policy expectation is fully incorporated in a maturity of market interest rate can be drawn when these two variables are both in a cointegration relationship and one to one relationship.

The methods for testing whether monetary policy expectation is fully incorporated in a maturity of long term interest rate are summarized as follows.

(1) Test data if they are I (1) by unit root tests.

(2) Conduct cointegration test on pairs of data confirmed to be I (1).

(3) Conduct cointegration vector test on pairs of data confirmed to be in cointegration.

When cointegaration is confirmed but β = 1 can be rejected, monetary policy expectation is partially incorporated in a maturity of market interest rate.

4. Result

4.1 Unit Root Test

ADF test and KPSS test are conducted for original series. Both tests show that all the variables contain unit roots. The results are shown in Table 2 and Table 3. Next, ADF test and KPSS test are conducted for first differenced series. The results of ADF test show that all data do not contain unit roots. The results of KPSS test except for OIS 3 month show that there is no sign of unit root. Results of KPSS test for level stationary (lag=4) and trend stationary (lag=4, 12) show that OIS three month contain unit roots[4].

[4] KPSS test for level stationary(lag=4) shows that first difference of OIS three month does not contain unit root at the 1% level.

Table 2

ADF unit root test (Original Series)

Variable	Without Trend	With Trend
OIS3M	-0.757	-0.974
AGB2Y	-0.542	-1.590
AGB3Y	-0.540	-1.961
AGB5Y	-0.514	-2.471
AGB10Y	-0.484	-3.135
NTCB3Y	-0.586	-2.048
NTCB5Y	-0.521	-2.587
NTCB10Y	-0.421	-3.368

Notes:
* indicates significance at the 5% level.
5% critical values are −2.86 (without trend) and −3.41 (with trend).

Table 3

KPSS unit root test (Original Series)

Variable	Lag = 4		Lag = 12	
	Level Stationary	Trend Stationary	Level Stationary	Trend Stationary
OIS3M	5.835*	5.406*	2.250*	2.085*
AGB2Y	4.185*	4.042*	1.622*	1.567*
AGB3Y	3.55*	3.354*	1.380*	1.304*
AGB5Y	2.518*	2.480*	0.982*	0.967*
AGB10Y	1.771*	1.582*	0.697*	0.623*
NTCB3Y	6.315*	3.232*	2.456*	1.259*
NTCB5Y	6.173*	2.464*	2.409*	0.964*
NTCB10Y	7.244*	1.800*	2.852*	0.711*

Notes:
* indicates significance at the 5% level.
5% critical values are 0.463 (level stationary) and 0.146 (trend stationary).

But KPSS test for level stationary (lag=12) indicates that OIS three month does not contain unit roots. Thus it is proper to judge that all variables for the analysis are non-stationary I (1). The results are shown in Table 4 and Table 5.

Table 4

ADF unit root test (first difference series)

Variable	Without Trend	With Trend
OIS3M	-9.048*	-9.111*
AGB2Y	-45.767*	-45.565*
AGB3Y	-46.121*	-45.884*
AGB5Y	-47.331*	-47.120*
AGB10Y	-35.354*	-35.244*
NTCB3Y	-49.783*	-49.551*
NTCB5Y	-47.759*	-47.559*
NTCB10Y	-29.004*	-28.948*

Notes:

* indicates significance at the 5% level.

5% critical values are −2.86 (without trend) and −3.41 (with trend).

Table 5

KPSS unit root test (first differenced series)

Variable	Lag = 4		Lag = 12	
	Level Stationary	Trend Stationary	Level Stationary	Trend Stationary
OIS3M	0.612*	0.318*	0.431	0.225*
AGB2Y	0.101	0.083	0.099	0.081
AGB3Y	0.071	0.066	0.072	0.068
AGB5Y	0.049	0.050	0.053	0.053
AGB10Y	0.033	0.030	0.038	0.034
NTCB3Y	0.077	0.071	0.082	0.075
NTCB5Y	0.057	0.057	0.063	0.063
NTCB10Y	0.035	0.033	0.040	0.038

Notes:

* indicates significance at the 5% level.

5% critical values are 0.463 (level stationary) and 0.146 (trend stationary).

1% critical values are 0.739 (level stationary), 0.216 (trend stationary).

Level Stationary (Lag=4) is not significant at the 1 % level.

4.2 Cointegration Test

Cointegration tests are applied for a pair of interest rates because it is confirmed that all the vabiables are I (1). A pair of OIS three month and long term interest rate (AGB of two years, three years, five years and ten years and NTCB of three years, five years and ten years). All pairs of data are found to be in a relationship of cointegration. In other words, market expectation on monetary policy is incorporated in all long term interest rates used for analysis.

Table 6
Cointegration test

Variable	Test Statistics
OIS3M－AGB2Y	-3.341*
OIS3M－AGB3Y	-3.402*
OIS3M－AGB5Y	-3.608*
OIS3M－AGB10Y	-3.914*
OIS3M－NTCB3Y	-3.452*
OIS3M－NTCB5Y	-3.644*
OIS3M－NTCB10Y	-3.674*

Notes:
* indicates significance at the 5% level.
5% critical value is −3.3377 from MacKinnon (1991).

Next cointegration vector tests are conducted for all pairs of data. The results show that β＝1 can be rejected for all pairs of data. Thus it can be concluded that three month OIS and all long term interest rates investigated are not in a relationship of one to one. When the impact of monetary policy expectation is compared, β gets smaller as the maturities of AGB and NTCB yields get longer.

Table 7
Cointegration vector test

Variable	β	Modified SE	Modified t Value
OIS3M－AGB2Y	0.697	0.051	5.941
OIS3M－AGB3Y	0.571	0.063	6.810
OIS3M－AGB5Y	0.415	0.066	8.864
OIS3M－AGB10Y	0.249	0.066	11.379
OIS3M－NTCB3Y	0.548	0.078	5.795
OIS3M－NTCB5Y	0.391	0.088	6.920
OIS3M－NTCB10Y	0.219	0.085	9.188

Notes:
* means that $\beta = 1$ cannot be rejected since modified t value is smaller than 5% critical value (1.96).

5. Conclusion

The purpose of this paper is to investigate the impact of monetary policy expectation on long term interest rates in Australia. Three month OIS (Overnight Indexed Swap) rate is used as market expectation of monetary policy by the RBA. As for long term interest rates, AGB (Australian Government Bond) yields of two years, five years and ten years and NTCB

(NSW Treasury Corporation Bond) yields of three years, five years and ten years are used.

AGB yields of two years, three years, five years and ten years and NTCB yields of three years, five years and ten years are in a relationship of long term equilibrium with OIS rate of three months. In other words, expectation of monetary policy by the RBA within a range of three months is incorporated in AGB yields of two years, three years, five years and ten years and NTCB yields of three years, five years and ten years. But expectation of monetary policy is not in a relationship of one to one with these long term interest rates.

The results of this paper have following policy implication. The RBA can partially influence AGB yields of two years, three years, five years and ten years and NTCB yields of three years, five years and ten years through monetary policy expectation formed in financial market. The RBA can give more impact on shorter maturities of AGB and NTCB yields. In other words, the impact gets smaller as the maturities of AGB and NTCB yields get longer.

【Reference】

Dickey,D.A and Fuller,W.A., 1979.Distribution of the estimators for autoregressive time series with a unit root. Journal of the American Statistical Association 74, 427-431.

Dickey,D.A and Fuller,W.A., 1981. Likelihood ratio statistics for autoregressive time series with a unit root. Econometrica 49, 107-1072.

Fausta,J., Swansonb,E.T. and WrightFaust, J.H., 2004. Identifying VARS based on high frequency futures data. Journal of Monetary Economics 51, 1107–1131.

Fuller,W.A.,1976. Introduction to statistical time series, John Wiley & Sons,Inc

Engle,R.F. and C.W.J. Granger.,1987.Co-integration and Error Correction: Representation, and Testing. Econometrica,55,251-276.

Granger,C.W. J and Newbold,P. 1974. Spurious regressions in econometrics. Journal of Econometrics 2,111-120.

Gürkaynak, R.S., Sack,B., Swanson.P and Eric. T. 2007. Market-based measures of monetary policy expectations. Journal of Business and Economic Statistics 25, 201-212.

Kwiatkowski,D., Phillips,P.C.B., Schmidt,P. and Shin,Y., 1992. Testing the null hypothesis of stationarity against the alternative of a unit root. Journal of Econometrics 54, 159-178.

Krueger,J.T. and Kuttner, K.N.,1996. The FED funds futures rate as a predictor of Federal Reserve policy. Journal of Futures Markets 16, 865-879.

Kuttner,K.N., 2001 Monetary policy surprises and interest: Evidence from the Fed funds futures market. Journal of Monetary Economics 47, 523–544.

Lange,J., Sack,B., and Whitesell,W., 2003. Anticipations of monetary policy in financial markets. Journal of Money, Credit, and Banking 35,889-909.

MacKinnon,J.,1991. Critical values for cointegration Tests. Engle,R.F and Granger C.W.J., ed, Long-run economic relationships: readings in cointegration, Oxford University Press,267-276.

Phillips,P.C.B.,1986. Understanding Spurious Regressions in Econometrics. Journal of Econometrics, 33,pp.311-340.

Sack,B., 2004. Extracting the Expected Path of Monetary Policy from Futures Rates. Journal of Futures Markets, 733-54.

Söderström,U, 2001. Predicting Monetary Policy with Federal Funds Futures Prices. Journal of Futures Markets 21, 377–391.

Stock,J.H. and Watson,M.W., 1993. A Simple Estimator of Cointegrating Vectors in Higher Order Integrated Systems. Econometrica 61,783-820.

Thornton, D. L., 2009. What the Libor-OIS spread says. Economic SYNOPSES.No.24.

Woodford,M.,1999. Optimal monetary policy inertia. Manchester School Supplement. 67, 1-35