An Empirical Study on the Predictive Ability of the Domestic Yield Curve to Forecast Output and Inflation in the Philippines

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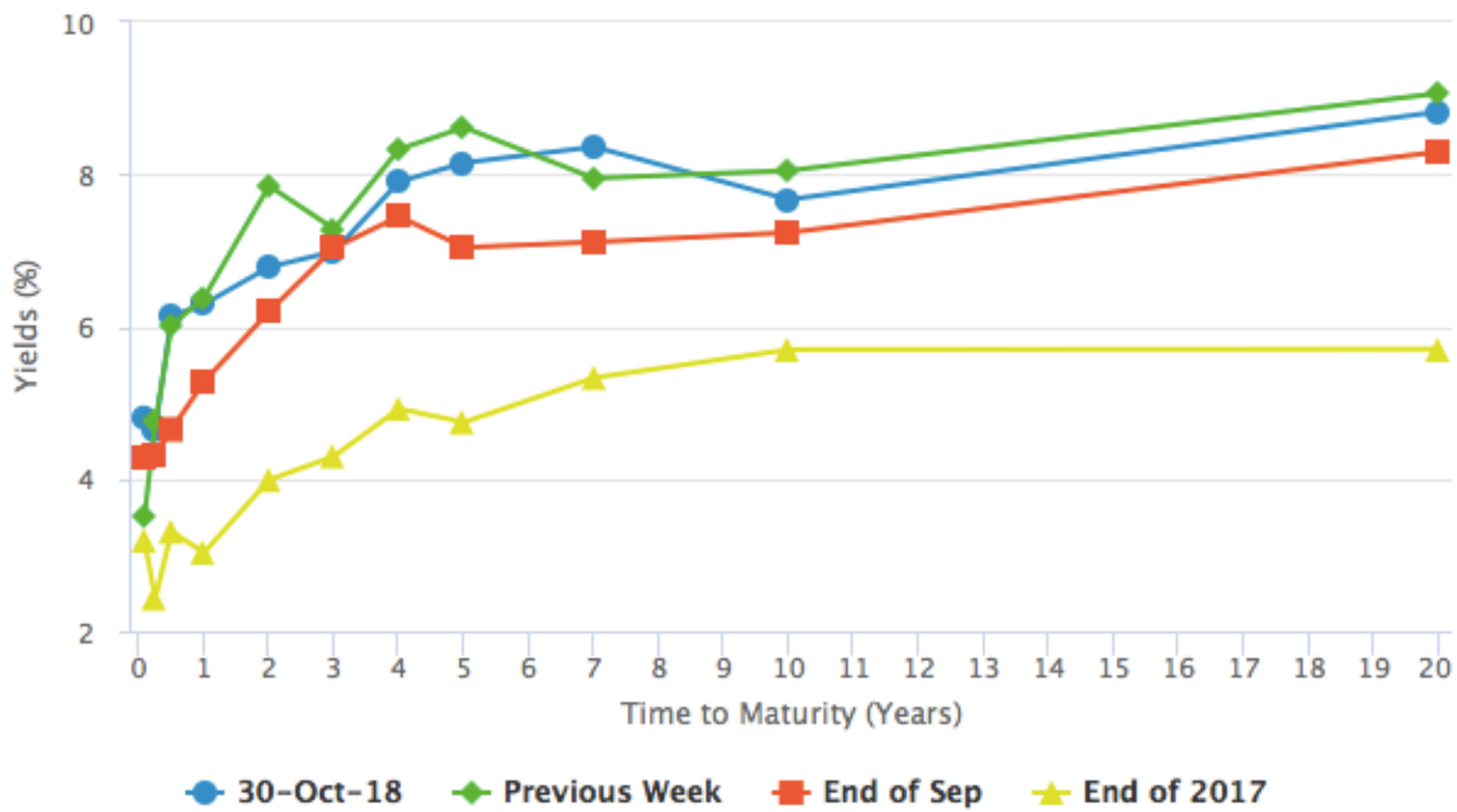
The Yield Curve is one of the most closely watched financial indicator of all time

- Concerning with the growth and stability of the economy, current and future information on economic activities and inflation are important to all academic agents
- The policy makers of today must take into account the forward looking of the economy

Philippines LCY Government Bond Yield Curve

Closing of 30-Oct-18

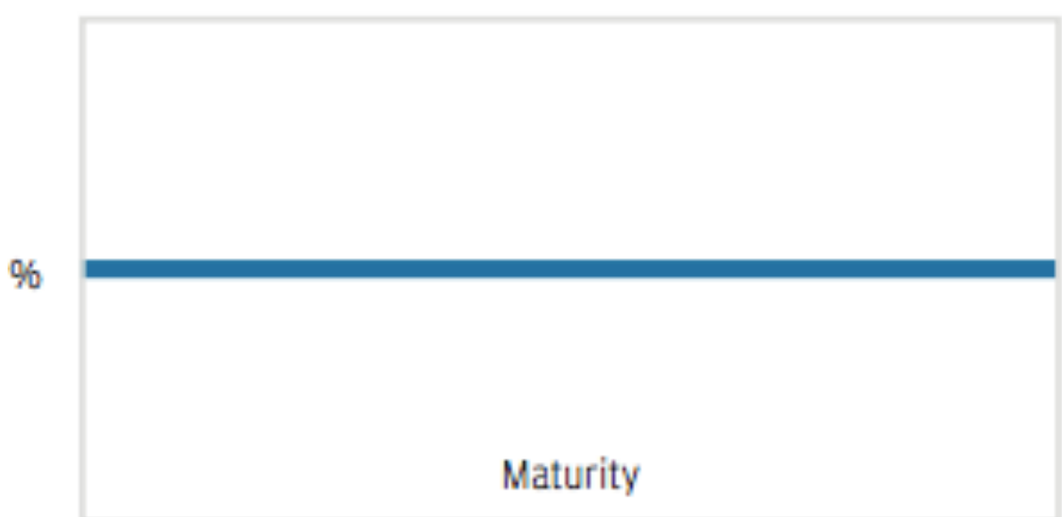


plots the interest rates of bonds with equal credit quality but with different maturing dates at a specific point in time

Source: asianbondsonline.adb.org

Normal Yield Curve

Inverted Yield Curve



Flat Yield Curve

Does the yield curve hold predictive content for domestic output growth and inflation?

Statement of the Problem

1. To Investigate the usefulness of the yield spread to predict inflation and output growth in the Philippines.

2. To assess whether the US yield curve is a better predictor for domestic inflation and output growth compared to using the domestic yield curve.

3. To test whether the expectation effect have more impact in predicting output growth compared to the term premium effect through spread decomposition.

Objectives of the Study

Scope and Limitation

1. To examine the ability of term spread to predict output and inflation using linear regression or OLS model using quarterly zero-coupon bonds yield from 1999 – 2017

2. The 5Y-3M, 10Y-3M, and the model that exhibit the best goodness-of-fit from the robustness checks will be observed

3. Difference in the maturities of the term structure and across types of securities

Theoretical Framework

Predictive power of the yield curve for output

Based on the expectation hypothesis

market participants anticipate an economic boom and higher rate of return on investment

expected future short rates exceed the current short rate

Theoretical Framework

Predictive power of the yield curve for inflation

Based on the Fisher's equation

$$\pi_t^n \approx i_t^n - r_t^n$$

$$(\pi_t^n - \pi_t^m) \approx (i_t^n - i_t^m) - (r_t^n - r_t^m)$$

Where π_t^n, i_t^n, r_t^n denote inflation rate, nominal interest rate, and real interest rate from time *t* to *t* + *n*.

Theoretical Framework

International Financial Linkages

Spillover Effects

US debt security markets are more liquid than emerging economy ones

There is a pass-through from US policy interest rates to the domestic interest rates.

Empirical Methodology

OBJECTIVE 1	OBJECTIVE 2	OBJECTIVE 3
Ordinary Least Square (OLS) regression using the domestic term spread as the independent variable	Ordinary Least Square (OLS) regression using the US term spread as the independent variable	The decomposed Fisher's equation will be regressed by method of instrumental variable estimation

Empirical Methodology

Most studies found usefulness of slope of yield curve using OLS

- Wheelock & Wohar (2009) did survey of the literature.
- Mehl (2006) found its usefulness in emerging countries.
- Hamilton (2001) decomposed the sources of its predictive power.

Test for Unit Root Presence

Augmented Dickey-Fuller Test for Stationarity

Test for Autocorrelation

Durbin's h

the critical range for the h-stat is -3.291<h<3.291

Empirical Methodology

$$Y_t^k = \beta_0 + \beta_1 Spread_t + \beta_2 Y_{t-n}^k + \varepsilon_t$$

$$Y_t^k = \beta_0 + \beta_1 Spread_t + \beta_2 Y_{t-n}^k + \beta_3 Lead_t + \varepsilon_t^k$$

where:

Y_t^k = output growth/inflation in the next k-period
$Spread_t$ = difference between the long rate and the short rate
Y_{t-n}^k = period lag of dependent variable
$Lead_t$ = leading economic indicators (PCA)

Empirical Methodology

$$y_t^k = \alpha_0 + \alpha_1\left(\frac{1}{n}\sum_{j=0}^{n-1} i_{t+j}^m - i_t^m\right) + \alpha_2\left(i_t^n - \frac{1}{n}\sum_{j=0}^{n-1} i_{t+j}^m\right) + u_t$$

Expected change of short term rate

Time-varying term premium

where:

i_t^n= Long term interest rate
i_t^m= Short term interest rate

Evaluation of Estimation Method

Goodness-of-Fit

In-Sample Measures

R-squared
Adjusted R-squared
F-statistic
Akaike Information Criterion
Shwarz Information Criterion

Forecasting Power

Out-of-Sample Measures

Root Mean Squared Error (RMSE)
Mean Absolute Error (MAE)
Mean Percentage Error (MPE)
Mean Absolute Percentage Error (MAPE) Relative RMSE

Goodness-of -Fit Criteria Across Estimation for Output

using the domestic yield curve

	10Y_3M	5Y_3M	5Y_2Y
R-squared	0.687446	0.694689	0.710146
Adjusted R-squared	0.66695	0.674668	0.691139
F-Statistic	33.54151	34.69899	37.36261
AIC	195.7992	194.2517	190.8228
SIC	206.7474	205.2	201.7711
Durbin's h	1.935889	2.060135	2.046473

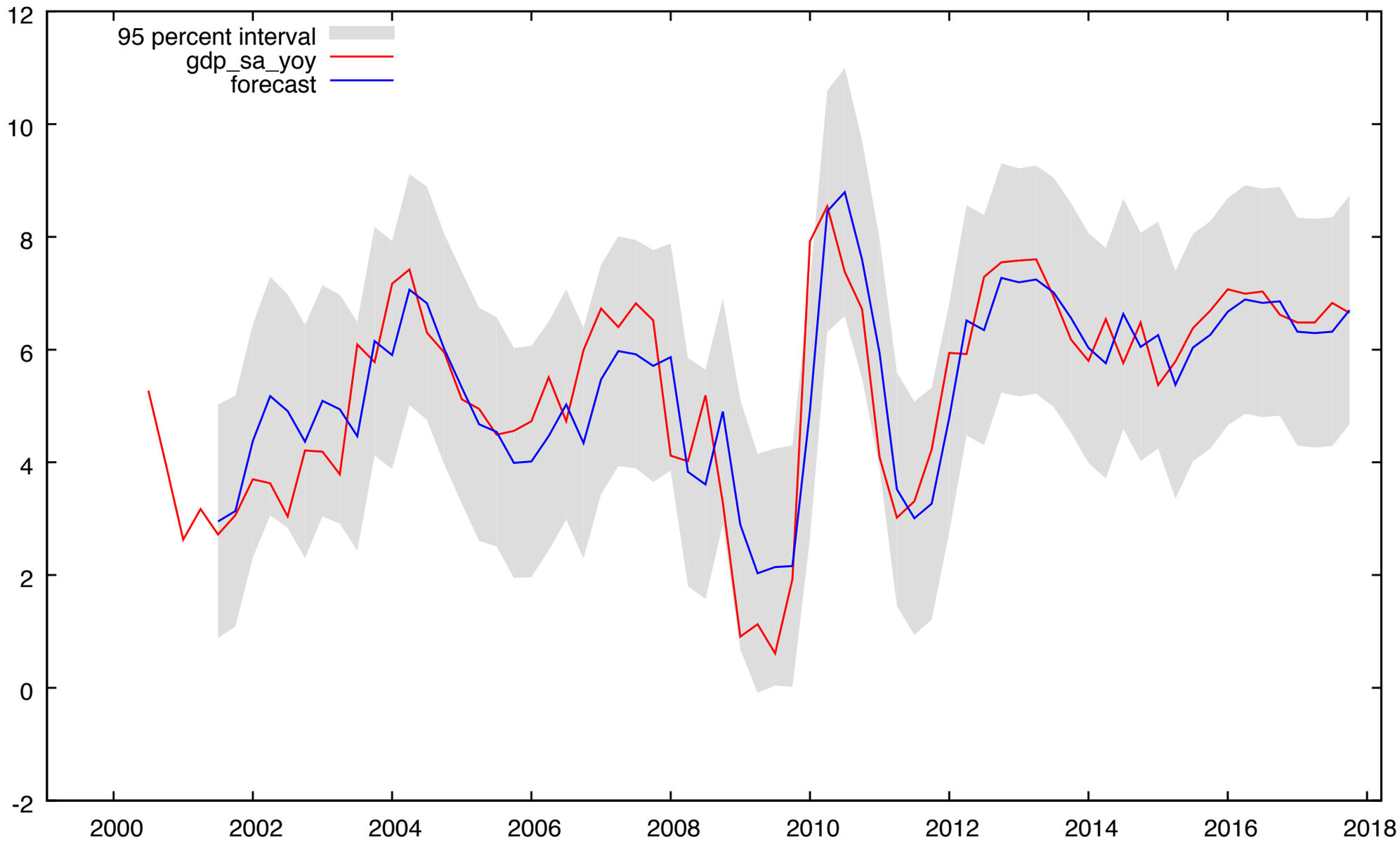
Results are from models with leading economic indicators

Findings:

- *The domestic yield curve contains predictive content for output growth.*
- *Y5_2Y model has the best goodness-of-fit among the models observed*
- *Results are all robust*

One Step Ahead Forecasts for Output Growth using the Domestic Yield Spread

Observed versus Predicted Values (5Y_2Y spread)



Goodness-of -Fit Criteria Across Estimation for Inflation

using the domestic yield curve

	10Y_3M	5Y_3M	10Y_6M
R-squared	0.849517	0.848028	0.850066
Adjusted R-squared	0.840533	0.838955	0.841115
F-Statistic	94.55842	93.46788	94.96591
AIC	180.1738	180.8827	179.9107
SIC	191.5571	192.266	191.294
Durbin's h	-1.419612	-1.963405	-1.339288

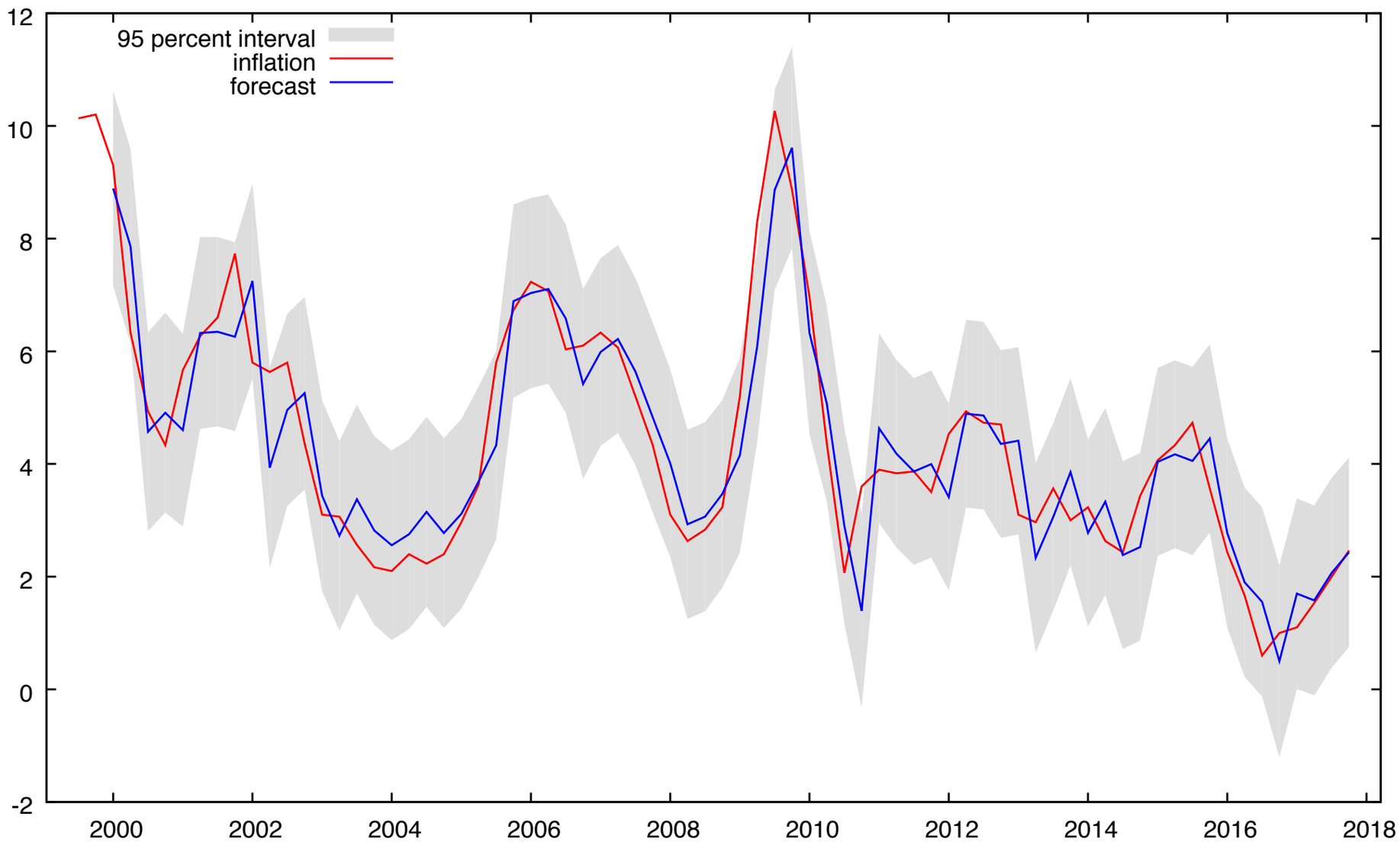
Results are from models with leading economic indicators

Findings:

- *The domestic yield curve contains predictive content for inflation*
- *Y10_6M model has the best goodness-of-fit among the models observed*
- *Results are all robust*

One Step Ahead Forecasts for Inflation using the Domestic Yield Spread

Observed versus Predicted Values (10Y_6M spread)



Goodness-of -Fit Criteria Across Estimation for Output

using the US yield curve

	10Y_3M	5Y_3M
R-squared	0.690558	0.685223
Adjusted R-squared	0.670266	0.664582
F-Statistic	34.03221	33.19695
AIC	195.1387	196.2669
SIC	206.087	207.2152
Durbin's h	1.760037	1.848699

Results are from models with leading economic indicators

Findings:

- *The US yield curve also contains predictive content for output growth.*
- *The US yield curve did not significantly outperform the domestic yield curve in forecasting output growth*
- *Y10_3M model has the best goodness-of-fit among the models observed*
- *Results are all robust*

Goodness-of -Fit Criteria Across Estimation for Inflation

using the US yield curve

	10Y_3M	5Y_3M
R-squared	0.8409	0.840982
Adjusted R-squared	0.831402	0.831488
F-Statistic	88.5298	88.58383
AIC	184.183	184.1461
SIC	195.5663	195.5294
Durbin's h	-0.894571	-0.951591

Results are from models with leading economic indicators

Findings:

- *The US yield curve also contains predictive content for inflation.*
- *The US yield curve did not significantly outperform the domestic yield curve in forecasting inflation*
- *Y10_3M model has the best goodness-of-fit among the models observed*
- *Results are all robust*

Comparative Table on Selected Forecast Evaluation Statistics

for Output Growth

	DOMESTIC YIELD CURVE		US YIELD CURVE	
	RMSE	Relative RMSE	RMSE	Relative RMSE
Y5_3M				
2 steps ahead	1.0223	0.9775	1.0371	0.9917
4 steps ahead	1.0068	0.9627	1.0205	0.9758
6 steps ahead	0.9909	0.9475	1.0052	0.9612
8 steps ahead	0.9772	0.9344	0.9922	0.9487
Y10_3M				
2 steps ahead	1.0341	0.9888	1.0295	0.9844
4 steps ahead	1.0179	0.9733	1.0128	0.9684
6 steps ahead	1.0021	0.9582	0.9972	0.9535
8 steps ahead	0.9887	0.9454	0.9838	0.9407
Y5_6M				
2 steps ahead	0.9950	0.9515		
4 steps ahead	0.9797	0.9368		
6 steps ahead	0.9647	0.9225		
8 steps ahead	0.9521	0.9104		

Comparative Table on Selected Forecast Evaluation Statistics

for Inflation

	DOMESTIC YIELD CURVE		US YIELD CURVE	
	RMSE	Relative RMSE	RMSE	Relative RMSE
Y5_3M				
2 steps ahead	0.8114	0.9679	0.8302	0.9903
4 steps ahead	0.8100	0.9661	0.8284	0.9881
6 steps ahead	0.8015	0.9561	0.8218	0.9803
8 steps ahead	0.7904	0.9428	0.8109	0.9673
Y10_3M				
2 steps ahead	0.8095	0.9656	0.8095	0.9656
4 steps ahead	0.8074	0.9631	0.8074	0.9631
6 steps ahead	0.7999	0.9542	0.7999	0.9542
8 steps ahead	0.7889	0.9410	0.7889	0.9410
Y5_6M				
2 steps ahead	0.8114	0.9679		
4 steps ahead	0.8100	0.9661		
6 steps ahead	0.8015	0.9561		
8 steps ahead	0.7904	0.9428		

Spread Decomposition Results

(expectation effect and term premium effect)

Model	Output Growth
Expectation Effect	-0.291035
Term Premium Effect	0.469217
Constant	5.478289

instrumented:Y10_US, FED funds_rate
instruments: short_rate, long_rate

Findings:

- *The term premium effect has more impact compared to the expectation effect in the yield spread forecasts*
- *The expectation effect does not hold true for the PH case*

Multi-step Ahead Spread Decomposition Results

(expectation effect and term premium effect)

Forecasting period	Expectation Effect	Term Premium Effect
2 step ahead	−0.9439***	1.8570***
	(0.2041)	(0.1446)
4 step ahead	−0.9794***	1.8933***
	(0.2086)	(0.1472)
6 step ahead	−1.0014***	1.9211***
	(0.2092)	(0.1470)
8 step ahead	−1.0098***	1.94387***
	(0.2125)	(0.1489)

values in the parenthesis are the standard deviations

Findings:

- *The predictive power of expectation hypothesis diminishes in the longer horizon whereas the impact of term premium effect appears stronger in the longer horizon.*

Findings in Relation to Objectives

1. The domestic yield spread contains information content that can help predict inflation and output growth in the Philippines.

2. The US yield curve also contains predictive content for domestic inflation and output growth, however it did not outperform the domestic yield curve in terms of forecast ability

3. The term spread decomposition showed that the term structure plays a more significant role than the expectation effect in predicting output growth using the yield curve

Summary of Overall Results

Conclusion

1. The reason why the yield curve can predict output and inflation is due to monetary policy.

2. Due to diminishing effect of the exchange rate pass-through to inflation, the forecasting ability of the US yield spread is not as strong as expected.

3. The time-varying term premium probably must take time to generate its impact hence, it presents the significant power in the longer horizon ahead.

Recommendations

1. Explore other econometric methodology other than OLS

2. Explore why the term premium plays a role in yield curve forecasts

3. Make use of other benchmark bonds

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