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Forecasting the Yield Curve for Brazil

Daniel O. Cajueiro[*] Jose A. Divino [†]
Benjamin M. Tabak [‡]

Abstract

In this paper, the recent Functional Signal Plus Noise - Equilibrium Correction Model (FSN-ECM) developed in Bowsher and Meeks (2008) and the model developed by Diebold and Li (2006) (DL) are applied to forecasting 12-dimensional yields for Brazil at the one, three, six, and twelve months ahead horizons. Empirical results suggest that the FSN-ECM produces very good forecasts at the short-term (one month) outperforming both the DL and random walk benchmarks. However, the DL model produces better forecasts at the long-term. These results suggest that different models may be used to forecast the yield curve, depending on the forecasting horizon. If our concern is on long-term forecasts as it is usual for institutional investors, then the DL model should be preferred.

Keywords: Yield Curve, Forecast, Emerging Markets, Interest Rates.

JEL: E43, E47, C53, G10, G15.

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1 Introduction

The construction of yield curve forecasts is crucial for portfolio managers, risk managers, financial institutions and policy making. Furthermore, the yield curve has been shown to be an important leading indicator for economic activity and inflation [Duarte et al. (2006), Venetis et al. (2003), Stock and Watson (2003), Estrella and Hardouvelis (1991), Estrella and Mishkin (1997), Ang et al. (2006)]. It is also crucial for pension insurance companies, which have to produce forecasts of investments and liability flows. Therefore, since forecasting the evolution of the term structure is important for fixed income security pricing, managing interest rate risk, and estimating discount factors that are necessary to calculate market prices of bonds the development of forecasting models has been in the top of the agenda of researchers in the recent years.

Notwithstanding the recent effort on the development of forecasting models for the yield curve, there is to date only a handful of papers that have provided empirical evidence of the forecast accuracy of these models. Duffee (2002) shows that affine models such as the one presented in Dai and Singleton (2000) are dominated by random walk forecasts. The author argues that models that are able to produce accurate forecasts and are also consistent with finance theory can make an important contribution to the financial literature. In a recent paper, Diebold and Li (2006) (DL) have shown that a dynamic variant of the Nelson-Siegel (1987) components framework can be useful to model the yield curve and provide a consistent way of generating forecasts of the yield curve. In the case of the US, the authors show that their model outperforms traditional benchmarks such as the random walk model. However, their model does not outperform the random walk forecast for short-term forecasts (one-month ahead). Recently, Bowsher and Meeks (2008) have introduced a new model, the so-called Functional Signal Plus Noise with an Equilibrium Correction Model (FSN-ECM), which produces very good forecasts at the one-month ahead horizon in terms of mean squared forecast error. Furthermore, the authors show that this model outperforms the DL model and random walk at the short-term[1].

Despite the recent advances in the forecasting literature, there has been little evidence supporting the usefulness of these models to forecast yields

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[1] See also Koopman et al. (2009).

from emerging market countries[2]. This is due mainly for two reasons: (1) the lack of good quality data; (2) when the data is available it covers a very limited time span, which makes it very difficult to reach sound conclusions. In order to fill this gap, at least partially, we analyze the Brazilian fixed income market, which is a very large market with many financial instruments with high liquidity.

We produce forecasts for the Brazilian yield curve using the DL dynamic version of the Nelson and Siegel exponential approach and the FSN-ECM. We find that: (1) The FSN-ECM is able to explain relatively well the yield curve at the 1-month forecasting horizon and also the shorter maturities of the yield curve (up to 6-months) at forecasting horizon of 3-months; (2) DL is able to explain relatively well the yield curve at long forecasting horizons (up to 12-months).

In the following, we will introduce the methodology in section 2. Data employed in the paper is described in section 3. Section 4 reports results, and section 5 concludes the paper.

2 Methodology

The FSN-ECM specifies a vector autoregression representation for the knot-yields which may be written as an equilibrium correction model (ECM). The resulting FSN-ECM model is written in a linear state space form, allowing for the use of the Kalman Filter to compute forecasts.

Let τ be the maturity of a zero-coupon or discount bound with face value of \$1 and $y_t(\tau)$ its yield to maturity from time t to $t+\tau$. In addition, define $S_{\gamma_t}(\tau)$ as a dynamically evolving, natural cubic spline signal function or latent yield curve. It interpolates to the latent yields $\gamma_t = (\gamma_{1t}, ..., \gamma_{mt})'$. That is, $S_{\gamma_t}(k_j) = \gamma_{jt}$ for $j = 1, 2, ..., m$, where $S_{\gamma_t}(\tau) = (S_{\gamma_t}(\tau_1), ..., S_{\gamma_t}(\tau_N))'$ has m knots positioned at the maturities $k = (1, k_1, ..., k_m)$, which are deterministic and fixed over time. The vector γ_t is referred to as the knot yields of the spline.

The FSN-ECM model for the time series of N-dimensional observed yield curves, $y_t(\tau)$, with $t = 1, 2, ..., T$, is given by:

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[2] An important exception is the work of Vicente and Tabak (2008) that study Brazilian yields and show that the DL model dominate forecasts made from affine models and is also better than random walk forecasts for some maturities and forecast horizons.

$$y_t(\tau) = S_{\gamma_t}(\tau) + \epsilon_t \tag{1}$$

$$\Delta\gamma_{t+1} = \alpha(\beta\gamma_t - \mu_s) + \Psi\Delta\gamma_t + \nu_t \tag{2}$$

where, by Theorem 2 of Bowsher and Meeks (2008) or Poirier (1973), $S_\gamma(\tau) = W(k,\tau)\gamma$, an $N \times m$ interpolation matrix that depends only on τ and the knots position k. In addition, α is a $m\times(m-1)$ full rank matrix, and the matrix β is uniquely defined by $\beta'\gamma_t = (\gamma_{j+1,t} - \gamma_{j,t})_{j=1}^{m-1}$. The initial state $(\gamma_1', \gamma_0')'$ has finite first and second moments given by μ^* and Ω^* respectively. The vector $u_t = (\epsilon_t', \nu_t')'$ is a vector white noise process.

Note that the state equation (2) is consistent with the case where the knot-yields γ_t are integrated of first order, I(1), and the $(m-1)$ spreads between them are cointegrated. In that case, $E[\Delta\gamma_{t+1}] = 0$ and $\mu_s = E[\beta'\gamma_t]$. The N-dimensional $S_{\gamma_t}(\tau)$ is also I(1) and has $(N-1)$ stationary yield spreads which are cointegrated.

Under the previous conditions, Bowsher and Meeks (2008) argue that the FSN-ECM model can be written in a linear state space form. This representation allows for the use of the Kalman filter to perform both quasi-maximum likelihood estimation (QMLE) and 1-step ahead forecast.

Define FSN(m)–ECM(p) as a model in which the spline $S_{\gamma_t}(\tau)$ has knots positioned at m different maturities, meaning that the knot vector k is m-dimensional, and the maximum lag order of the ECM state equation (2) is p for γ_{t+1}. Differently from Bowsher and Meeks (2008), who consider models with $m \in \{5,6\}$ and $p \in \{1,2\}$, we address here the cases of $m \in \{3,4,5\}$ and $p = 2$. We consider only $m \leq 5$ because our set of maturities, which contains only 12 maturities, is much smaller than the one considered in Bowsher and Meeks (2008), which contains 36 maturities. Furthermore, a model with a smaller number of knots also implies that less parameters have to be estimated, reducing the possibility of overfitting of the data used in the estimation step.

In order to carry out the estimation procedure, the following non-singular transformation of the state equation is performed.

$$\varphi_t = (\gamma_{1,t}, \gamma_{2,t} - \gamma_{1,t}, ..., \gamma_{m,t} - \gamma_{m-1,t})' = \begin{bmatrix} 1 & 0_{1\times(m-1)} \\ \beta' & \end{bmatrix} \gamma_t = Q\gamma_t \tag{3}$$

where β' is defined as in (2). The state equation may be written as the VAR:

$$\Delta\varphi_{t+1} = Q\alpha(\beta' Q^{-1}\varphi_t - \mu_s) + Q\Psi Q^{-1}\Delta\varphi_t + \eta_t \tag{4}$$

where $\eta_t = Q\nu_t$ and $\Omega_\eta = Var[\eta_t] = Q\Omega_\nu Q'$.

In the estimated FSN(m)–ECM(p) forecasting models, the covariance matrix Ω_η is diagonal and $\Omega_\epsilon = \sigma_\epsilon^2 I_N$ has the one free parameter, σ_ϵ^2. The Kalman filter is initialized by using $(\gamma_1', \gamma_0') = (\mu^*, \Omega^*)$, where $\Omega^* = 0$ and μ^* is set equal to the yields $(y_o(k)', y_{-1}(k)')'$.

Observe that, for computational purpose, the state equation (4) can be rewritten as:

$$\varphi_{t+1} = [I + Q\alpha\beta' Q^{-1} + Q\Psi Q^{-1}]\varphi_t + Q\Psi Q^{-1}\varphi_{t-1} - Q\alpha\mu_s + Q\nu_t \tag{5}$$

Define the X_t vector as:

$$X_t = \begin{bmatrix} \varphi_t \\ \varphi_{t-1} \\ 1 \end{bmatrix}$$

Then, the state space representation becomes:

$$X_{t+1} = \begin{bmatrix} A & B & \overline{C} \\ I & 0 & 0 \\ 0 & 0 & I \end{bmatrix} X_t + \begin{bmatrix} Q \\ 0 \\ 0 \end{bmatrix} \nu_t \tag{6}$$

where $A = [I + Q\alpha\beta' Q^{-1} + Q\Psi Q^{-1}]$, $B = Q\Psi Q^{-1}$, and $\overline{C}$ is the vector $-Q\alpha\mu_s$. While the matrix A is fully estimated, B is assumed to be a diagonal matrix as in Bowsher and Meeks (2008) when $m \leq 5$, which is always the case here.

DL suggests modeling the yield curve using an extended version of the Nelson and Siegel (1987) approach, which is given by:

$$y_t(\tau) = \beta_{1t} + \beta_{2t}(\frac{1 - e^{-\lambda_t \tau}}{\lambda_t \tau}) + \beta_{3t}(\frac{1 - e^{-\lambda_t \tau}}{\lambda_t \tau} - e^{-\lambda_t \tau}) \tag{7}$$

where the β_{1t}, β_{2t} and β_{3t} are interpreted as latent dynamic factors. These $\beta' s$ correspond to long (level), medium (slope) and short-term factors (curvature). We compute forecasts using the DL model assuming that β_i, for $i = 1, 2, 3$, follows a first-order autoregressive processes and forecasting the β_i in a similar fashion as Diebold and Li (2006).

3 Data

We use data for Brazilian interest rates swap contracts for 1, 2, 3, 6, 9, 12, 15, 18, 21, 24 and 30 months maturities[3]. In these contracts, the buyer part pays a fixed rate over an agreed principal, and receives a floating rate over the same principal[4]. There are no intermediate cash-flows and the contracts are only settled on maturity. The daily interest rates (fixed rates) are negotiated by parties. The BM&F (Brazilian Mercantile Exchange - Bolsa de Mercadorias e Futuros) guarantees these contracts and, consequently, those interest rates can be seen as proxies for default-free interest rates[5]. These interest rates are the major benchmark in the Brazilian fixed income market.

The data is sampled daily, beginning on December 5, 1997 and ending on March 11, 2008. We have chosen this time period due to data availability. Before 1997, there is very little information on long-term maturity interest rates and they were illiquid. Liquidity of these yields increased after 1997. The full sample has 2,531 observations, and has been collected from the BM&F. Figure 1 presents a description of the data. An important issue is that there is a structural break in the Brazilian time series due to the abandonment of the crawling-peg exchange rate regime and adoption of a flexible exchange rate in January of 1999 with posterior institution of the Inflation Targeting regime in June of 1999. Therefore, interest rates volatility has decreased substantially in the recent period, since there are more degrees of freedom for monetary policy and exchange rates to absorb, at least partially, external shocks.

Place Figure 1 About Here

From the discussion above, it is clear that forecasting the yield curve for the Brazilian economy is a difficult task. For example, Lima et al. (2006) employ a VAR model to forecast long-term yields and show that the random walk outperforms that model. This result is robust to the inclusion of the true path of short-term interest rates within the VAR framework to forecast long-term yields.

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[3] In the recent period, longer term maturities have gained liquidity. However, since they were very illiquid in the period under analysis, they were not employed.

[4] We choose to study the behavior of these yields because there are no available long time series for yields on Brazilian government bonds.

[5] BM&F also plays the custodian role.

We construct monthly yields as averages of daily yields for each month. Hence, we make monthly forecasts for each maturity using both the FSN-ECM and DL models.

4 Empirical Results

Our purpose is to compare the out-of-sample forecasts of the two alternative models, FSN-ECM and DL with benchmark forecasts given by the random walk model. Bowsher and Meeks (2008) have shown that the FSN-ECM outperforms the DL for the case of the US. It is interesting to test whether their conclusions can also be drawn from the Brazilian fixed income market.

We make forecasts for the FSN-ECM and DL models and define forecast errors at $t + h$ as $\hat{y}_{t+h}(\tau) - y_{t+h}(\tau)$ where y_{t+h} and $\hat{y}_{t+h}$ correspond to the actual and predicted future yields and τ is the maturity. In order to make out-of-sample forecasts, we first estimate the FSN-ECM and DL models using the first half of the sample. We then reestimate the models including the next month and excluding the first month of the previous sample. We continue until we have exhausted the entire sample. Therefore, we update all the parameters for both models in each month and make forecasts for 1, 3, 6 and 12-months-ahead for the yield curve. We estimate the FSN-ECM model using 5, 4 and 3 knots to compare the results.

Table 2 presents results for the FSN-ECM, DL, and random walk (RW) forecasts. Forecasts using the DL model allways produce lower mean squared forecast errors (MSFE) than random walk forecasts (with the exception of 3-months horizon forecasts for longer term maturities). Forecasts made with the FSN-ECM model outperform the DL and random walk in terms of MSFE only at the 1-month ahead forecasting horizon. This model also predicts well short-maturity yields (up to 3-months) at most forecasting horizons.

Place Table 2 About Here

We compare the out-of-sample forecasting performance of FSN-ECM and DL models in terms of MSFE, and we test whether these models forecast are significantly superior than random walk benchmark forecasts by applying the popular Diebold and Mariano (1995) (DM) test. Let $\{d_i\}_{i=1}^{n}$ be a function of the difference of square forecast errors produced by two models. We can write d_i as:

$$d_i = (\hat{y}_{t+h,j}(\tau) - y_{t+h}(\tau))^2 - (\hat{y}_{t+h,RW}(\tau) - y_{t+h}(\tau))^2, \qquad (8)$$

where $j = FSN - ECM$ or $j = DL$. The variables $\hat{y}_j$, and $\hat{y}_{t+h,RW}$ are the h-steps ahead forecasts at time t of the FSN-ECM, DL and random walk (RW) models, respectively.

DM proposes a test to check whether the average loss differential $\bar{d} = \frac{1}{n}\sum_{i=1}^{n} d_i$ is statistically different from zero, which is given by:

$$DM = \frac{\bar{d}}{\sqrt{\frac{\hat{\delta}}{n}}} \xrightarrow{d} N(0,1) \tag{9}$$

where $\hat{\delta}$ is an estimate of the long run covariance matrix of the d_i. We employ the Newey and West (1987) estimate for $\hat{\delta}$, which allows controlling for serial correlation in the forecasting errors.

Table 3 reports the results for the DM statistics. The null hypothesis is that the random walk MSFE equals the FSN-ECM and DL MSFE against the alternative hypothesis that the random walk MSFE is greater than the FSN-ECM and DL MSFE. The results suggest that the FSN-ECM outperforms the RW for 1 to 3-months maturity yields. Negative entries in the DM column of the table indicate a case for which point MSFE are lower when the alternative model is used (FSN-ECM or DL).

Place Table 3 About Here

The DM test indicates that the results are statistically significant and that mean squared forecast errors are much lower for the 1-month-ahead forecasting exercise.

Table 4 contains a summary of the empirical results comparing FSN-ECM and DL models using the DM statistics.

Place Table 4 About Here

The out-of-sample forecast exercise favors the FSN-ECM for short maturity yields at the short-term forecast horizon (1-month) an the DL for longer maturity yields at longer-term forecast horizons.

5 Conclusions

In this paper the FSN-ECM and DL models are applied to forecasting 12-dimensional yield curves for Brazilian bonds at the 1, 3, 6, and 12 months ahead horizons. Our general conclusion is that the FSN-ECM model is useful for short-term yield curve forecasts (up to 3-months), whereas the DL model seems to be appropriate for longer-term forecasts. These results are robust to changing the number of knots used in the FSN-ECM model. In addition, they corroborate the findings of Bowsher and Meeks (2008), suggesting that the FSN-ECM is very useful for short-term forecasting.

In a recent paper Vereda et al. (2008) employ a VAR approach to forecast the term structure of interest rates and find that incorporating macro variables can improve forecasting performance, especially for longer-term forecasts[6]. Further research could exploit whether the inclusion of macroeconomic or financial variables can help predict the yield curve. Furthermore, it would be interesting to compare the forecasting performance of the models using different datasets for a variety of countries.

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[6] Ang and Piazzesi (2003) also show that a significant proportion of the level and slope factors of the yield curve may be attributed to macro factors, particularly to inflation

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Table 1: Descriptive Statistics of Yields in the Brazilian Fixed Income Market.

	Mean	Std. Dev.	Maximum	Minimum
1M	19.64	6.73	63.27	11.05
2M	19.69	6.62	60.07	11.03
3M	19.77	6.54	58.90	11.01
6M	20.10	6.49	54.07	10.98
9M	20.45	6.74	54.00	10.81
12M	20.70	6.96	54.10	10.69
15M	21.02	7.25	54.93	10.62
18M	21.26	7.48	55.53	10.49
21M	21.47	7.67	55.92	10.44
24M	21.65	7.84	56.24	10.35
30M	21.96	8.10	56.38	10.20
Slope	2.33	4.66	20.15	(16.53)
Curvature	83.01	27.96	223.97	43.41

Table 2: MSFE for FSN-ECM (using 5 and 4 knots), DL and Random Walk (RW) Forecasts (in basis points)

Maturity	FSN-ECM 5 Knots	FSN-ECM 4 Knots	DL	RW
Panel A: 1-month-ahead forecasts.				
1-month	0.37	0.41	0.47	0.72
2-months	0.43	0.47	0.52	0.73
3-months	0.48	0.50	0.54	0.73
6-months	0.58	0.54	0.62	0.80
9-months	0.66	0.60	0.69	0.88
12-months	0.75	0.69	0.78	0.97
15-months	0.83	0.78	0.87	1.08
18-months	0.90	0.86	0.94	1.19
21-months	0.97	0.92	0.99	1.28
24-months	1.02	0.96	1.02	1.37
30-months	1.09	1.01	1.05	1.53
Panel B: 3-months ahead forecasts				
1-month	1.45	1.41	1.76	1.90
2-months	1.53	1.48	1.77	1.87
3-months	1.61	1.55	1.78	1.83
6-months	1.86	1.78	1.88	1.78
9-months	2.11	2.00	2.00	1.85
12-months	2.36	2.22	2.15	1.98
15-months	2.56	2.42	2.29	2.14
18-months	2.72	2.61	2.42	2.30
21-months	2.87	2.77	2.53	2.46
24-months	3.00	2.90	2.62	2.60
30-months	3.20	3.05	2.75	2.86
Panel C: 6-months ahead forecasts				
1-month	2.51	2.42	2.80	3.34
2-months	2.68	2.59	2.83	3.32
3-months	2.85	2.77	2.87	3.30
6-months	3.37	3.31	3.02	3.28
9-months	3.86	3.79	3.20	3.39
12-months	4.29	4.21	3.40	3.56
15-months	4.65	4.59	3.59	3.77
18-months	4.96	4.93	3.76	4.00
21-months	5.23	5.22	3.91	4.21
24-months	5.47	5.47	4.03	4.41
30-months	5.88	5.82	4.21	4.79
Panel D: 12-months ahead forecasts				
1-month	4.28	4.29	4.06	5.03
2-months	4.55	4.58	4.09	5.06
3-months	4.80	4.85	4.12	5.07
6-months	5.46	5.55	4.24	5.03
9-months	6.03	6.13	4.42	5.09
12-months	6.51	6.63	4.65	5.21
15-months	6.93	7.07	4.87	5.37
18-months	7.31	7.49	5.08	5.56
21-months	7.65	7.86	5.27	5.74
24-months	7.97	8.19	5.43	5.91
30-months	8.52	8.72	5.68	6.25

Table 3: DM statistics comparing MSFE of FSN-ECM (using 5 and 4 knots) and DL model with random walk (RW) forecasts

Maturity	RW-DL	p-value	RW-FSN-ECM(4)	p-value	RW-FSN-ECM(5)	p-value
Panel A: 1-month Forecasts						
1 month	-2.61	0.00	-2.48	0.01	-2.66	0.00
2 months	-2.50	0.01	-2.21	0.01	-2.47	0.01
3 months	-2.56	0.01	-2.14	0.02	-2.38	0.01
6 months	-2.32	0.01	-2.37	0.01	-2.28	0.01
9 months	-2.09	0.02	-2.16	0.02	-1.97	0.02
12 months	-1.99	0.02	-2.03	0.02	-1.84	0.03
15 months	-1.95	0.03	-1.99	0.02	-1.86	0.03
18 months	-1.94	0.03	-1.97	0.02	-1.92	0.03
21 months	-1.93	0.03	-1.95	0.03	-1.92	0.03
24 months	-1.93	0.03	-1.96	0.02	-1.92	0.03
30 months	-1.93	0.03	-2.01	0.02	-1.89	0.03
Panel B: 3-months Forecasts						
1 month	-0.58	0.28	1.20	0.89	-0.99	0.16
2 months	-0.43	0.33	-0.81	0.21	-0.79	0.21
3 months	-0.20	0.42	-0.99	0.16	-0.56	0.29
6 months	0.37	0.64	-1.09	0.14	0.21	0.58
9 months	0.47	0.68	-1.02	0.15	0.72	0.76
12 months	0.43	0.67	-0.78	0.22	0.97	0.83
15 months	0.36	0.64	-0.67	0.25	1.01	0.84
18 months	0.25	0.60	-0.70	0.24	0.94	0.83
21 months	0.14	0.56	-0.67	0.25	0.86	0.81
24 months	0.03	0.51	-0.59	0.28	0.77	0.78
30 months	-0.17	0.43	-0.57	0.28	0.77	0.78
Panel C: 6-months Forecasts						
1 month	-0.92	0.18	-1.16	0.12	-0.99	0.16
2 months	-0.87	0.19	-1.29	0.10	-0.79	0.22
3 months	-0.81	0.21	-1.29	0.10	-0.56	0.29
6 months	-0.52	0.30	-1.17	0.12	0.11	0.54
9 months	-0.32	0.37	-1.12	0.13	0.11	0.54
12 months	-0.24	0.41	-1.05	0.15	0.82	0.79
15 months	-0.22	0.41	-1.01	0.16	0.92	0.82
18 months	-0.25	0.40	-0.98	0.16	0.94	0.83
21 months	-0.29	0.39	-0.95	0.17	0.93	0.82
24 months	-0.33	0.37	-0.92	0.18	0.90	0.82
30 months	-0.42	0.34	-0.90	0.18	0.81	0.79
Panel D: 12-months Forecasts						
1 month	-1.12	0.13	-1.51	0.07	-0.63	0.26
2 months	-1.17	0.12	-1.53	0.06	-0.41	0.34
3 months	-1.18	0.12	-1.53	0.06	-0.21	0.42
6 months	-1.10	0.14	-1.36	0.09	0.31	0.62
9 months	-0.96	0.17	-1.28	0.10	0.65	0.74
12 months	-0.79	0.21	-1.18	0.12	0.86	0.81
15 months	-0.65	0.26	-1.11	0.13	0.99	0.84
18 months	-0.55	0.29	-1.01	0.16	1.06	0.86
21 months	-0.48	0.32	-0.90	0.18	1.10	0.86
24 months	-0.44	0.33	-0.80	0.21	1.13	0.87
30 months	-0.42	0.34	-0.72	0.24	1.12	0.87

Table 4: DM statistics comparing MSFE of FSN-ECM (using 5 and 4 knots) and DL model forecasts

Maturity	DL-FSN-ECM(4)	p-value	DL-FSN-ECM(5)	p-value
Panel A: 1-month Forecasts				
1 month	-1.36	0.09	-2.21	0.01
2 months	-0.98	0.16	-1.86	0.03
3 months	-0.85	0.20	-1.45	0.07
6 months	-1.37	0.09	-0.82	0.21
9 months	-1.28	0.10	-0.56	0.29
12 months	-1.09	0.14	-0.52	0.30
15 months	-0.99	0.16	-0.54	0.29
18 months	-0.92	0.18	-0.51	0.31
21 months	-0.85	0.20	-0.31	0.38
24 months	-0.77	0.22	0.04	0.51
30 months	-0.60	0.27	0.58	0.72
Panel B: 3-months Forecasts				
1 month	0.66	0.74	-1.32	0.09
2 months	0.29	0.61	-1.01	0.16
3 months	-0.33	0.37	-0.71	0.24
6 months	-1.01	0.16	-0.09	0.46
9 months	-0.85	0.20	0.34	0.63
12 months	-0.65	0.26	0.62	0.73
15 months	-0.49	0.31	0.75	0.77
18 months	-0.35	0.36	0.82	0.79
21 months	-0.21	0.42	0.89	0.81
24 months	-0.09	0.47	0.96	0.83
30 months	0.12	0.55	1.09	0.86
Panel C: 6-months Forecasts				
1 month	0.86	0.81	-1.01	0.16
2 months	0.67	0.75	-0.46	0.32
3 months	0.45	0.67	-0.06	0.48
6 months	-0.05	0.48	0.62	0.73
9 months	-0.09	0.46	0.99	0.84
12 months	0.00	0.50	1.23	0.89
15 months	0.07	0.53	1.37	0.92
18 months	0.13	0.55	1.47	0.93
21 months	0.19	0.58	1.57	0.94
24 months	0.25	0.60	1.67	0.95
30 months	0.33	0.63	1.84	0.97
Panel D: 12-months Forecasts				
1 month	0.97	0.83	0.41	0.66
2 months	0.95	0.83	0.70	0.76
3 months	0.94	0.83	0.90	0.82
6 months	0.89	0.81	1.29	0.90
9 months	0.74	0.77	1.53	0.94
12 months	0.57	0.72	1.69	0.95
15 months	0.45	0.67	1.80	0.96
18 months	0.38	0.65	1.89	0.97
21 months	0.35	0.64	1.99	0.98
24 months	0.33	0.63	2.09	0.98
30 months	0.32	0.62	2.27	0.99

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