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Are Forward Interest Rates Unbiased Predictors of Future Spot Rates? Evidence from the Kuwaiti Interbank Market

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Abstract. The predictive power of the term structure of interest rates is tested using three, six and twelve month Kuwaiti interbank offerred rates (KIBOR) for the period 1979Q1-1990Q1 obtained from a Kuwaiti local commercial bank. The results of unit root, cointegration and coefficient restriction tests suggest that the forward interest rates implied in the term structure are unbiased predictors of future spot interest rates. This finding indicates the possibility of estabishing a local market for interest rate risk management (IRRM) products.

I. Introduction

An important implication of the Market Expectation Theory (MET) of the term structure of interest rate is that forward interest rates are unbiased and efficient predictors of future spot rates. As such, future spot rates can be predicted using forward rates.

Most earlier evidence on the predictive power hypothesis is reported in American studies. Conclusion of these studies have been mixed. Some have found evidence consistent with the predictive power of forward rates, Park [1], Hardouvelis [2] and Fama [3]. Fama [3,4] also found a time varying risk premium that impairs the predictive power of the forward rate. Similar evidence for the presence of a risk premium is reported by Startz [5] and Lee and Jo [6].

Several Australion studies report the more recent evidence on the hypothesis. Trevor and Thorp [7], Tease [8] and Young and Flower [9] found the forward rate to be an efficient and unbiased estimator of the future spot rate. Tease [8] also concludes that even a constant term premium does not exist in the Australion market. Other studies found evidence inconsistent with the hypothesis of unbiased and

efficient predictive power of the forward rates [Juttner, Tuckwell and Luedecke [10], Yip [11], Heaney [12], Alles [13]. Moreover, Alles [13] suggests that the poor predictive power of forward rate may be more due to the variance of the expected term premium than to the market's rational expectation error variance.

This study aims to add evidence to the literature of the predictive power hypothesis using Kuwaiti data. The findings of this study have important practical implications emanating from the usfulness of the forward rates. These rates can be used to construct a zero coupon yield curve and to predict future spot rates. A zero coupon yield curve is important for the proper valuation of bonds and is prerequisite for the development of a market for forward rate agreements and interest rate swaps. The ability to predict future spot interest rates is also important for financial planning and risk management.

The rest of the paper is organized as follows. Section II gives a description of the Kuwaiti Dinar (KD) interbank market. Section III presents the relationship between the future spot rate and the forward rate as postulated by the MET. Section IV presents an outline of the methodology of econometric testing used in this study. Section V describes the data used in this study, presnts the results and discusses their interpretation. A concluding summary is given in Section VI.

II. The (KD) Interbank Market

Although the National Bank of Kuwait dates back to 1952 and the Gulf and Commercial Bank were founded in 1960, the majority of the other Kuwait banks only opened their doors for the first time in the early seventies. Indeed, the Central Bank of Kuwait was only formed in 1968.

As the number of banks grew, the Central Bank introduced several instruments to enable the banks to improve their operating efficiency: It accepted one month deposits at 4.5 percent and rediscounted 3 month commercial paper at 5 .5 percent. These in turn both set the interest rate parameters for and fed to the beginnings of the Kuwaiti interbank market.

By the start of the next decade, the interbank market had reached a level that it was to maintain for the following seven years, representing around 15 percent of the consolidated banks' balance sheets. An exception to this was during the two years following the 1982 stock market (Souk Al-Manakh) collapse when this share rose as high as 25 pwrcent, as those banks least affected by the crisis supported those badly hit until such time when the Central Bank's rescue package began to take effect.

In late 1987, the Central Bank unveiled perhaps its most important instrument of monetary policy when it introduced Kuwait Government Treasury bills and bonds. Since the interbank market served for some banks as an outlet for surplus funds, it was not surprising that over the following two years the interbank market's importance declined

to 10 percent of the combined bank's balance sheets as these surplus funds were transferred to Treasury bills.

For the first two years after the liberation of Kuwait, the interbank market was practically non-existent representing around only 1 percent of the bank's combined balance sheets. This was probably understandable since the Central Bank was effectively managing the liquidity of some of the banks through the sale and purchase of Treasury bill holdings. Gradually however, as the Central Bank encouraged the banking system to stand on its own two feet, the interbank market grew to its current level at which it represents 6 percent of the consolidated balance sheet.

The parameters for today's interbank market continue to be determined by Central Bank policy and actions just as they were twenty-five years ago. Only the instruments have changed. The one month deposit at 4.5 percent and the 3 month discount "window" at 5.5 percent have been replaced by 1 week purchase and re-sale agreement of Treasury Bills at 8.125 percent and 6 month Treasury Bills at around 7 percent and 7.25 percent respectively. However, the availability of these Treasury Bills at the weekly auction does not encourage the placement of interbank term deposits and the existence of the Central Banks Repo facility makes the overnight market sometimes less than efficient.

In its concern to protect the Kuwaiti Dinar, the Central Bank maintains a positive spread between the yield on Kuwaiti Treasury Bills and U.S. deposit rates on the assumption that this will indirectly influence the level of interest that banks pay on customer deposits. Consequently, it can be said that the Kuwaiti Interbank market is also determined indirectly by U.S. deposit, but no direct link exists.

To put the Interbank Market's size into perspective, it is only 10 percent of the size of KD Private Customer Deposits. However, it is the average of each bank's deposit rates supplied daily to the Central Bank which determines KIBOR on which the majority of corporate loans are priced. In general, interbank rates are indicative since so little business is transacted. Market forces do, however, directly determine the rates for shorter periods, like one week or less, and for overnight largely because the Central Bank has no instrument for absorbing liquidity between the weekly auction dates. Consequently, excess liquidity can drive overnight rates down to 1 percent or less. On one hand, a shortage of liquidity will simply trigger usage of the Central Bank's Repo facility. A small offshore KD interbank market exists, but since the Central Bank prohibits Kuwaiti banks from placing KD deposits offshore, its influence on the domestic market is minimal.

The Kuwait interbank market is unlikely to grow much beyond its current size despite the efforts of the Central Bank to stimulate it. Ironically, the Central Bank's banking supervision is about to introduce new regulations which could discourage

interbank activity even more. Maximum maturity mismatch requirements will force banks to shift from interbank placements to Treasury Bills in order to improve their liquidity.

To sum, the KD interbank market lacks the main feature of most other interbank markets-liquidity. It cannot be relied upon aa source of incremental funding as, say, the Eurodollar or the U.K. Sterling markets can. It is mostly a cash management tool and occasionally an alternative investment vehicle.

III. Theoretical Issues

The (MET) posits that the forward interest rate implicit in the term structure is an efficient and unbiased predictor of the next period spot interest rate. Market efficiency is sometimes used interchangeably with unbiasedness. The latter implies that

$$f_t = r^e_{t+1} \tag{1}$$

Where f_t is the forward rate and r^e_{t+1} is the spot rate expected to prevail at time $t+1$, but this expectation is made at time t such that

$$r^e_{t+1} = E(r_{t+1}|\Omega_t) \tag{2}$$

Where E is the expected value operator and Ω_t is the information set available at time t. The rational expectations hypothesis stipulates that the actual value of the spot rate is equal to the expected value plus a random error. This relationship can be represented by

$$r_{t+1} = r^e_{t+1} + \varepsilon_{t+1} \tag{3}$$

Where ε_{t+1} is a white noise random error which has the porperties $E(\varepsilon_{t+1}) = 0, E(\varepsilon^2_{t+1}) = \sigma^2_\varepsilon$ and $E(\varepsilon_{t+1}\varepsilon_{t+1+j}) = 0 \quad \forall_j \neq 0$. Therefore

$$r_{t+1} = f_t + \varepsilon_{t+1} \tag{4}$$

If market participants are risk averse (as opposed to risk neutral) they would require a positive risk premium to compensate them for risk bearing. Thus, equation (1) is modified to obtain

$$f_t = r^e_{t+1} + \rho_t \tag{5}$$

Where ρ_t is a risk premium determined at time *t*. The behavior of the risk premium may be represented by

$$\rho_t = \mu + \xi_t \tag{6}$$

Where μ is the mean value of the risk premium and ξ_t is white noise. Hence

$$r_{t+1} = -\mu + f_t + \varepsilon_{t+1} - \xi_t \tag{7}$$

A model specification for testing market efficiency is therefore given by

$$r_{t+1} = \alpha + \beta f_t + u_{t+1} \tag{8}$$

Where $u_{t+1} = \varepsilon_{t+1} - \xi_t$ is an error term reflecting the impact of news arriving during the contract period and $\alpha = -\mu$. By applying the lag operator to equation (8) we obtian

$$r_t = \alpha + \beta f_{t-1} + u_t \tag{9}$$

Testing unbiasedness on the basis of equation (9) amounts to testing the restriction $(\alpha, \beta) = (0,1)$. For unbiasedness to hold, the spot rate must be cointegrated with the lagged forward rate with a cointegrating vector (-1,0,1).

IV. Research Methodology

Testing for cointegretion and the coefficient restrictions implied by the unbiasedness hypothesis requires that the interest rate variables are of the same order of integration. To determine whether the variables are integrated of the same order, the Augmented Dickey-Fuller [14] ADF unit root test and the Phillips - Ouliais [15] $\hat{Z}_\alpha$ and $\hat{Z}_t$ unit root tests are conducted on the levels and first differences of the time series.

The Dickey-Fuller (ADF) test is performed by estimating the regression

$$\Delta x_t = \alpha + \beta T + \gamma x_{t-1} + \sum_{i=1}^{m} \delta \Delta x_{t-1} + u_t \tag{10}$$

where x_t is the interest rate under consideration, and T, time trend, is included only if its coefficient, β, is non-zero. The order of augmentation, m, is selected to be large enough so that u_t is white noise. The null hypothesis that x_t has a unit root (non-stationary) is supported if γ is significantly different from zero. However, the distribution of the t-test for γ is not standard, rather, it is that given by Fuller [16].

The Phillips-Ouliaris $\hat{Z}_\alpha$ and $\hat{Z}_t$ test statistics are derived from the OLS estimation of the following regression equation:

$$x_t = \alpha x_{t-1} + v_t \tag{11}$$

The $\hat{Z}_\alpha$ statistic is then given by

$$\hat{Z}_\alpha = N(\alpha - 1) - (1/2)(S_T^2 - S_v^2)\left[N^{-2} \sum_{2}^{N} \upsilon_{t-1}^2 \right] \tag{12}$$

where N is the sample size, $\hat{\alpha}$ is the estimated value of α and

$$S_v^2 = N^{-1} \sum_{1}^{N} V_t^2 \tag{13}$$

$$S_T^2 = N^{-1} \sum_{1}^{N} V_t^2 + 2N^{-1} \sum_{s=1}^{k} W_{sk} \sum_{t=s+1}^{N} V_t V_{t-s} \tag{14}$$

for some window size such as $w_{sk} = 1 - s / (k+1)$. The Z_t statistics is given by

$$Z_t = \left[\sum_{2}^{N} V_{t-1}^2 \right]^{1/2} (\alpha - 1) S_t - (1/2)(S_T^2 - S_v^2)\left[S_T \left(N^{-2} \sum_{2}^{N} v_{t-1}^2 \right)^{1/2} \right]^{-1} \tag{15}$$

Phillips and Ouliaris [15] have demonstrated that these two test statistics have limiting distributions that are free of nuisance parameters.

If the null hypothesis of a unit root is not rejected for the level series but is rejected for the first difference series, then the variable is integrated of order one.

Testing for cointegration is carried out on the basis of the Phillips- Ouliaris tests as applied to the residuals of equation (9). Testing for the $(\alpha, \beta) = (0,1)$ cannot be carried out on the basis of conventional standard errors and *t* statistics if the underlying variables (spot and forward rates) are nonstationary. Although the OLS estimates of α and β are superconsistent as demonstrated by Stock [17], they are not fully efficient and their standard errors do not have limiting normal distributions. This problem is tackled by correcting the conventional *t* statistics along the lines suggested by West [18]. The corrected standard errors, which are larger than the conventional OLS standard errors,

can be used to calculate *t*-statistics that have a standard distribution. This modification requires dividing the conventional t-statistics by $\sqrt{s/\sigma(0)}$ to make them asymptotically normal, in such a way that

$$\sigma(0) = \frac{1}{N}\sum_{t=1}^{m}\varepsilon_t^2 \tag{16}$$

and

$$s = \sigma(0) + 2\sum_{j=1}^{m}\left[1 - \left|j\right| / (m+1)\right]\sum_{t=|j|+1}^{N}\varepsilon_t\varepsilon_{t+|i|} \tag{17}$$

Where N is the sample size and ε is the OLS residual.

V. Results and Interpretation

The analysis in this paper is based on Kuwait 3- month, 6- month and 12- month KIBOR. End of quarter observations covering the peviod 1983Q1-1990Q2 are obtained from the dealing room of Burgan Bank, a Kuwaiti local commercial bank. From this data two implied forward interst rates are calculated as follows:

$$F3 = 400\left[\left\{\left(\frac{1+S6}{200}\right)\Big/\left(\frac{1+S3}{400}\right)\right\} - 1\right]$$

$$F6 = 200\left[\left\{\left(\frac{1+S12}{100}\right)\Big/\left(\frac{1+S6}{200}\right)\right\} - 1\right]$$

Where F3 and F6 are 3-month and 6-month forward rates while S3, S6 and S12 are 3-month, 6-month and 12-month spot rates.

The tests mentioned in the previous section were carried out using both the three-month and the six-month KIBORs. Table 1 reports the results of unit root tests on the levels and first differences of the three-month and six-month spot rates and the lagged three-month and six-month forward rates. A deterministic trend was not included in the augmented Dicky-Fuller regression since it turned out to be insignificant in all cases. The order of the test is zero in all cases as judged by the LM test for serial correlation. The results unambiguously show that the interest rate series are non- stationary (have a unit root) in levels and stationary in first differences, implying that they are I (1).

Table 1. Testing for unit root

Test Statistics	Level				Differences			
	3-m kibor		6-m kibor		3-m kibor		6-m kibor	
	S_{t+1}	F_t	S_{t+1}	F_t	S_{t+1}	F_t	S_{t+1}	F_t
ADF(m)	-2.09(0)	-2.07(0)	-1.99(0)	-1.79(0)	-5.10*(0)	-5.18*(0)	-5.08*(0)	-4.50*(0)
LM(4)	2.46	1.79	1.78	2.70	1.27	1.87	1.47	1.91
$\hat{Z}_\alpha$	-9.31	-9.30	-8.89	08.11	-25.71*	-20.38*	-27.08*	-24.03*
$\hat{Z}_t$	-2.29	-2.27	-2.21	-2.08	-5.06*	-5.50*	-5.20*	-4.60*

* Significant at the 5% level.

Table 2 presents the results of testing for cointegration and coefficient restrictions. For both maturities the spot and lagged forward rates are cointegrated, implying that the model represents a valid long- run relationship.

Table 2. Testing for cointegration and cofficient restrictions [Equation 9][a]

Coefficient estimates and test statistics	3-m kibor	6-m kibor
α	1.859	1.832
	(1.229)	(1.184)
β	0.761	0.780
	(0.160)	(0.155)
R^2	0.47	0.49
	-23.46*	-21.98*
$\hat{Z}_\alpha$	-23.46*	-21.98*
$\hat{Z}_t$	-4.45*	-4.22*
t^* ($\alpha = 0$)	1.51	1.51
t^* ($\beta = 1$)	-1.49	-1.41

* Significant at the 5% level.

a Figures in parantheses are West's corrected standard errors.

t^* is β West's corrected t-statistic

The results also show that the cointegrating vector is (-1,0,1), implying that unbiasedness holds very well. This is indicated by the West statistics for the hypothesis $\alpha = 0$ and $\beta = 1$, none of which is significant at the 5% level.

This evidence on the forecast power of the forward rates produced by cointegration and coefficient restrictions testing is in contrast to the bulk of previous literature as

unbiasedness is more often violated. Two possible causes of the violation of unbiased efficiency are irrationality of expectations and risk aversion. Irrational expectation implies suboptimal information processing on the part of market agents. Risk aversion, on the other hand, induces market agents to require a term risk premium. The rational of a risk premium is that interbank deposits of different times to maturity are not perfect substitutes. Banks prefer to lend short to avoid interest rate fluctuation risk. They will demand a risk premium to lend long. Thus, the risk premium required by banks is expected to be positively related to interest rate volatility.

The rejection of unbiased efficiency is normally ascribed to the presence of risk premia rather than to irrationality of expectations. Two justifications are advanced for this practice: The first is that it is unlikely that agents are irrational, while the second is that it is difficult to test rational expectation if survey data is not available. Therefore it is more practical to attribute the violation of unbiasedness to risk premia.

The interest rate policy adopted by the CBK during the period of study effectively sets limits on the movement of these rates. Given the openness of the economy and the exchange rate arrangement of pegging the KD to a basket since 1975, the Kuwaiti authorities have traditionally tried to meet their objectives by controlling or influencing interest rates. Up until 1988, the authorities relied extensively on direct controls on both bank lending and deposit rates. For example, in harmony with Islamic usury Laws, a maximum rate of 10 percent is applied to loans over a year in maturity. Minimum rates are also applied to bank savings deposits.

In December 1988 the whole interest rate structure was linked to the discount rate. For example, the new regime sets a 2 percent margin for loans of less than one year and 2.5 percent for those greater than a year in maturity. Minimum rates on time deposits were likewise set with respect to the discount rate. Indeed, the margin for time deposits for less than three months was set at zero and that for time deposits of greater than six-month was only 1 percent above the discount rate.

Apart from the already extant minimum rate on passbook savings, the 1988 policy revision marked the first time that the central bank mandated a minimum rate on private deposits denominated in dinars. The discount rate became the pivot for the Kuwaiti interest rate structure with the December 1988 change. In effect, the post-1988 interest rate regime combined a fixed spread with a ceiling on loan rates, a system that had its own rigidities.

VI. Conclusion

In this study we use unit root and cointegration tests to examin the ability of the forward interest rate in predicting the future spot interest rate in the thin money market of Kuwait.

The issue of interest rate predictability is of particular importance for the infant money market of Kuwait. Because, if this predictability is valid for Kuwait, then it will be possible to construct a zero coupon yield curve and to estimate future spot rates from the implied forward rates. A zero coupon yield curve is important for the proper valuation of bonds and is a necessary prerequisite for the development of a market for forward rate agreements and interest rate swaps. The ability to predict future spot rates is important for financial planning and risk management.

Good quality quarterly data was obtained from the dealing room of a Kuwaiti local commercial bank. The cointegration and coefficient restrictions tests demonestrate that forward rates are efficient and unbiased predictors of future spot rates.

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هل لأسعار الفائدة الآجلة قدرة غير متحيزة على التنبؤ بالمستويات المستقبلية لأسعار الفائدة الفورية؟ دليل تجريبي من سوق الودائع المتبادلة بالدينار الكويتي بين البنوك التجارية

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ملخص البحث. تقوم هذه الدراسة باختبار القدرة التنبؤية لهيكل أسعار الفائدة باستخدام أسعار الفائدة على الودائع المتبادلة بالدينار الكويتي بين البنوك التجارية لثلاثة أشهر وستة أشهر واثني عشر شهرا خلال المدة من الربع الأول لعام ١٩٨٣م إلى الربع الثاني لعام ١٩٩٠م. وطبقا لنتائج اختبارات وحدة الجذر والتواكب وتقييد المعامل فإن لدى أسعار الفائدة الآجلة المشتقة من هيكل أسعار الفائدة قدرة غير متحيزة على التنبؤ بالمستويات المستقبلية لأسعار الفائدة الفورية. بناء على هذه النتائج، تصبح هناك إمكانية لإنشاء سوق محلي لأدوات إدارة مخاطر أسعار الفائدة.