Pass-Through of Interest Rate Shocks to Lebanese Deposit Rates

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Executive Summary

Traditional customer deposits are the main funding source of Lebanese commercial banks (80–85% of liabilities). Although they are contractually short term (mainly one month) paying fixed interest rates, these deposits are historically known to be a stable source of funding and therefore exhibit a sticky behavior to changes in market interest rates.

This sticky behavior gives Lebanese banks a high bargaining power to control the pass-through of market shocks and therefore control their sensitivity to interest rates.

In this paper we modeled the behavioral versus contractual repricing of customer deposits. In other words, we measured the real impact of interest rate shocks on the bank's profits and economic value of shareholders' equity.

For this matter, we have gathered interest rate data from 2003 until the end of 2011 since earlier data is no longer relevant to the actual state of the banking sector and the Lebanese economy in general. We used LIBOR as a proxy for market interest rates and the Banking Sector Average Rate as a proxy for interest rates paid by Lebanese banks on customer deposits.

After reviewing the literature concerning this subject and applying different econometric models, we came to the conclusion that an Error Correction Model (ECM) is the most appropriate to reach the results we are aiming for.

Within this ECM framework, we were able to identify the short and long run pass-through rates in response to interest rate shocks. In addition, we formulated an impulse response function that will measure the speed, in months, it would take a shock to be transmitted to rates paid on deposits.

Results showed that 6.8% of a market shock will be passed-through immediately while the final pass-through rate is 33%.

These results would make it possible to determine the behavioral duration (repricing date) of customer deposits when market interest rates fluctuate.

A positive shock in interest rates, which is the standard stress test used to measure banks' sensitivity to interest rates, will usually yield a negative impact as assets' duration is higher than liabilities' duration.

When considering the results of our model, the behavioral duration of liabilities will be higher than the contractual one which will lower the duration gap between assets and liabilities and thus the negative impact of positive interest rate shocks.

1- Introduction

The objective of this article is to identify the impact of market interest rate changes on interest rates paid by Lebanese banks on term and saving deposits. For the purpose of our study, we employ an error-correction model to identify the adjustment of interest rates on USD term deposits in Lebanon following changes in market interest rates. The main advantage of this empirical method is that it allows us to capture both short run and long run domestic deposit interest rate dynamics. In addition, we determine a pass-through rate and the time lag in months that will take a market interest rate shock to be absorbed by the Lebanese Banking System. Our results show that an interest rate shock in global markets is partially passed through over a period of time to USD term and saving deposits interest rates.

2- Data

For our model, we selected data from 2003 until 2011 as we consider data prior to 2003 not relevant to the actual relation we have between USD LIBOR and BDL published deposit rates. The turning point was the Paris Club II conference that was held in November 2002. After the conference, the mood in Lebanon was optimistic which allowed the Central Bank to cut interest rates (lower spread between interest on FC deposits and international market interest rates) while FX reserves were rising (which also helped decrease the rates on deposits). Disruptions on the political level occurred between 2003 and 2011 but had no major long term effect on deposit interest rates. A rise of bank liquidity in the banking system after mid 2008 and of reserves at the central bank coincided with drops in international benchmark rates (most importantly, the Fed Funds target) to face the crisis and its global economic impact. The lower interest rate environment internationally left bank liquidity (excess over lending) with restricted investment opportunities while incurring a relatively high cost of funds. The booming economy at the time (GDP growth in the 8% region) resulting from political stability paved the way for liquidity to be poured into the system also due to a favorable rate spread and a preference of Lebanese expects to take familiar Lebanese Risk vs. unknown risks they would face abroad as bankruptcies and Government support for Banks repeated abroad (home bias).

Consequently, this environment allowed Lebanese banks to lower interest offered on deposits during the last months of 2009 benefiting from a reduction in the risk premium required by investors to place their funds in Lebanon. Before explaining this observation in a quantitative way, we introduce the two variables used in the model.

2.1- Banking Sector Average Rate (BSAR)

The main variable of the model is the weighted average interest rate paid on term deposits in Lebanon. The historical time series data is collected by the Lebanese Central Bank and is available on its official website[1]. With respect to circular BDL18 issued by Lebanese Central Bank in 1992, each Lebanese Bank should report on monthly basis the below table.

	Monthly Average	Weight
Interest Rate on Term Deposits		
Interest Rate on Current Accounts		
Interest Rate on Saving Deposits		
Accounts Maturity		
1 Month		
3 Months		
6 Months		
1 year and above		
Total		

Then, the central bank will calculate the weighted average using the following formula:

$$\mathrm{BSAR} = \frac{\sum_i \mathrm{Customers'Deposits}_i \times \mathrm{Interest\ Rate}_i}{\sum_i \mathrm{Customers'Deposits}_i}$$

2.2- London InterBank Offered Rate (LIBOR)

LIBOR is a weighted average interest rate at which a selection of banks are prepared to lend each other unsecured funds on the London money market. The selection of banks is made every year by the British Bankers' Association with assistance of the Foreign Exchange and Money Markets Committee. Thomson Reuters collects the rates from the panel of Banks then eliminates the highest and lowest 25% before calculating the weighted average of the mid values.

We chose LIBOR as a proxy of market interest rates since we suspected its relationship with Lebanese rates. This is due to a significant portion of Lebanese bank assets being directly linked to LIBOR. In addition, a simple correlation measure between LIBOR and Lebanese rates will yield a coefficient near 1.

2.3- Descriptive statistics of the two variables

Before we start identifying an econometric causality relationship between LIBOR and BSAR, we show in Figure 1 the historical trend of both interest rate series since 2003. We observe a partial pass-through in addition to a lagged response of BSAR to fluctuations in LIBOR. Although the two time series are non stationary, still we can study their interdependency using first differences if we can identify a cointegration relationship between them.

[1] Official website of the Lebanese Central Bank: it www.bdl.gov.lb

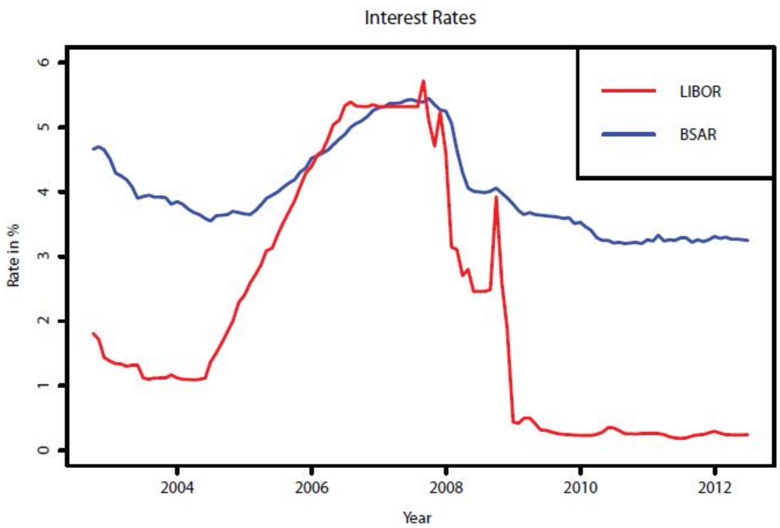

Figure 1: BSAR versus LIBOR

We observe that both variables behave in a similar fashion though LIBOR experiences higher volatility than BSAR. In addition, it's worth mentioning that large changes in LIBOR have a high impact on BSAR.

We employ an Augmented-Dickey Fuller test to assess the stationarity of first differences of the two variables. Results show stationary in first differences. However, working with first differences would only help determining short-run relationships. Given that we intend to model, both long-run and short-run relationships, we will need instead to employ an error correction model to investigate the interdependency between LIBOR and BSAR.

	DBSAR	Dlibor
Mean	-0.01	-0.01
STD	0.08	0.31
VaR	-0.22	-0.75
Media	-0.01	0.00
VaR	0.1	0.3
ADF(p-Value)	0.01	<0.01

3- Error Correction model

3.1- Definition

The error-correction mechanism is a transformation of a general linear model incorporating past values of both the explained variable (interest on term deposits in Lebanon) and the explanatory variables (LIBOR).

One of the interesting ECM outputs is an explicit estimation of short term deviations from long-run equilibrium.

This ECM will allow us to assess the following:

- Short term reaction of interest rates in response to a shock
- Long run equilibrium coefficient
- The speed of adjustment towards the long run equilibrium after a shock

This turns out to be very useful for the purpose of our study as we are modeling the elasticity and the time it takes for an interest rate shock in global markets to be absorbed by the Lebanese banking sector.

This will allow us to assess the effective impact of an interest rate shock on the Bank's economic value of shareholders' equity. Since customer deposits constitute the major part of Lebanese bank liabilities, a reduction and delay of an interest rate shock on these deposits in response to a shock in the market will reduce interest rate repricing risk (reduce sensitivity of Shareholders Economic value sensitivity to interest rate shocks)[2].

We run the following EC Model (c.f. Bondt(2002)):

$$\Delta \mathrm{BSAR} = \alpha_1 + \alpha_2\, \Delta \mathrm{LIBOR} - \beta_1 (\mathrm{BSAR}_{t-1} - \beta_2\, \mathrm{LIBOR}_{t-1})$$

Where the coefficient α_2 determines the short-term pass-through, β_2 the final pass-through and $1 - \alpha_2/\beta_1$ the speed (in months) at which market interest rate shocks are passed to Term Deposits.

3.2- Model Results

We got the following VEC Model:

$$\Delta \mathrm{BSAR} = 0.4469 + 0.06478\, \Delta \mathrm{LIBOR} - 0.13798(\mathrm{BSAR}_{t-1} - 0.3329\, \mathrm{LIBOR}_{t-1})$$

Applying Student test, p-values of all coefficients are less than 0.5% therefore statistically significant. In addition we got an adjusted R^2 equal to 33.44%. As a result, we confirm the existence of a long-run equilibrium between the rates and a short-term pass-through after a shock in LIBOR of 6.48% whereas the final pass-through stands at 33.29%. The mean speed of adjustment is around 7 months.

While analyzing residuals of the model, we identified two outliers that occurred in LIBOR during the financial crisis of 2008. The Kolmogorov-Smirnov test confirmed the normality of residuals while it was rejected by the Jarque-Bera test before removing these two outliers. Once we remove these two data points, the Jarque-Bera test couldn't reject the normality hypothesis anymore. Figure 2 represents the QQ-plot of residuals and shows the normality.

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[2] Details Section 5

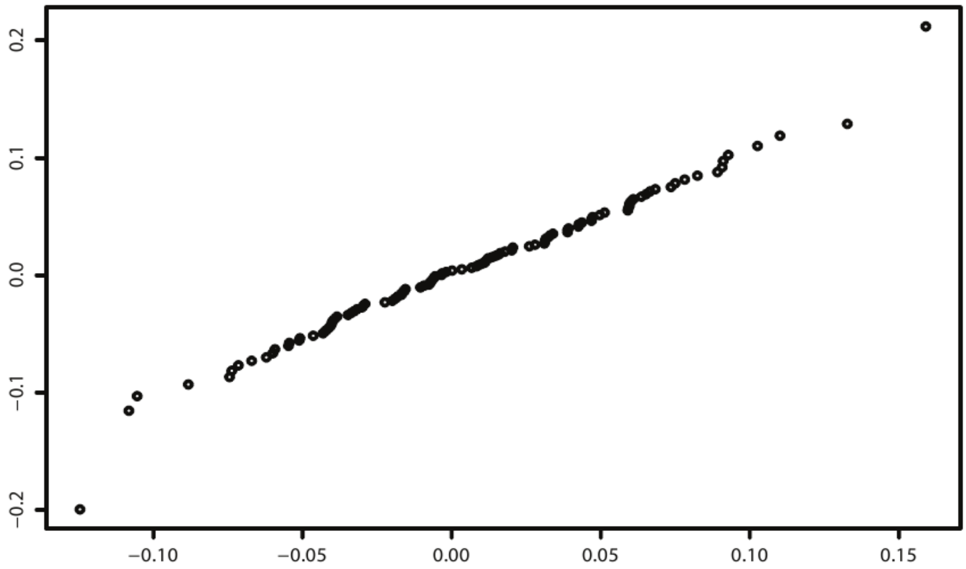

Figure 2: QQplot of Residuals

In order to validate the error-correction equation, we still have to study the stationarity of residuals. Figure 3 represents the auto-correlation function that shows a low correlation in lags. Also, the Augmented-Dickey-Fuller test confirms stationarity with two lags. Thus, the equation can be employed to measure the impact of shocks in LIBOR on BSAR.

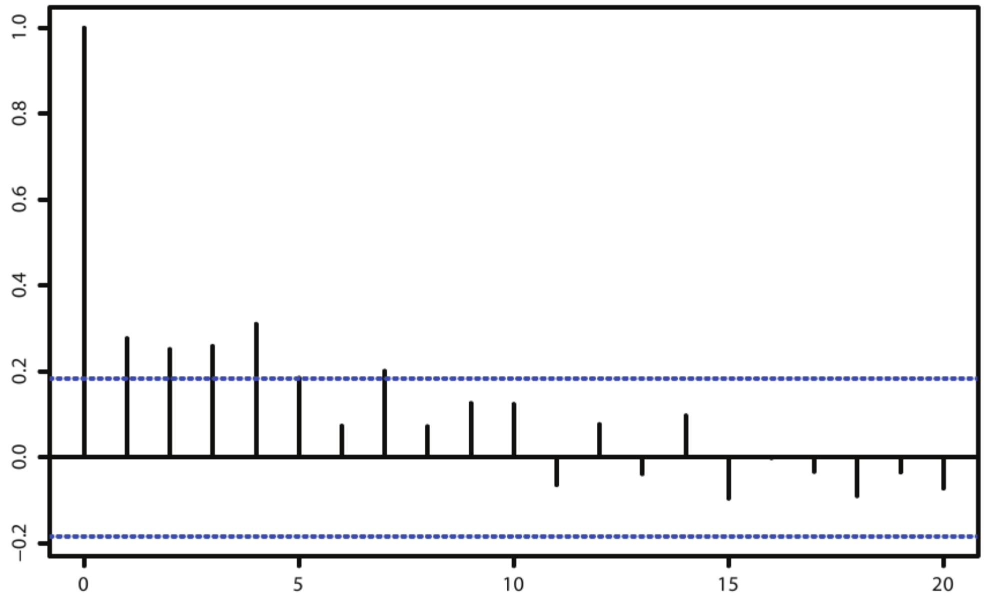

Figure 3: Autocorrelation function of Residuals

The next important step of the study is to draw the impulse response function. We provide a brief description of this function calculation in Appendix A. Figure 4 shows a representation of the impulse response function.

It proves the existence of a positive relationship when a shock takes place. The non-cumulative pass-through rate decreases with time reaching 1 basis point after 12 months.

On the other hand, Figure 5 shows (cumulative pass-through) the convergence of BSAR to its long-run equilibrium.

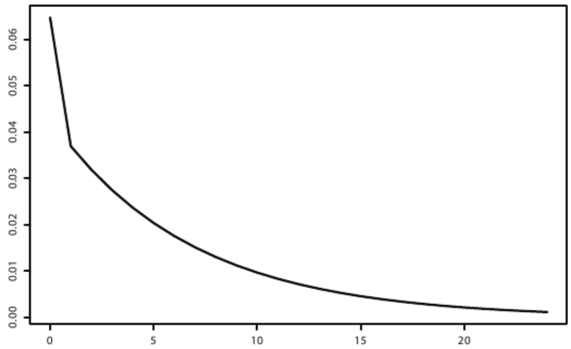

Figure 4: Impulse Response Function

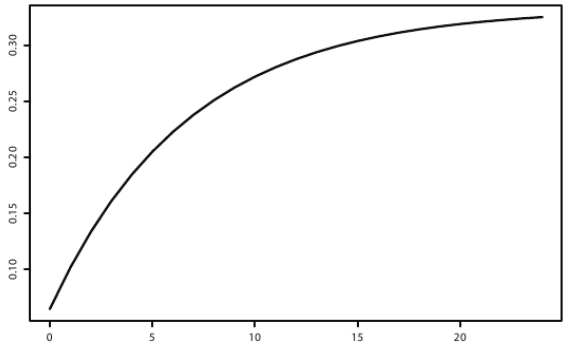

Figure 5: Cumulative Response Function

4- Shock Analysis

We represent in the following table the speed of adjustment of Lebanese rates following a shock. Results show that 86.4% of the long-run effect will be absorbed by the Lebanese Banking sector deposit rates in the first year. We study the impact of a 200 bps positive jump (recommended in the Pillar 2 of the Basel II accord) in LIBOR on BSAR and we obtain the following:

Short-Run: $0.0647 \times 200\text{bps} = 12.95\text{bps}$

Impact after one year: $0.8644 \times 0.3329 \times 200 \text{ bps} = 57.56\text{bps}$

Long-Run: $0.3329 \times 200 \text{ bps} = 66.58 \text{ bps}$

Maturity	% of the long-run	Maturity	% of the long-run
3 Months	48.41%	15 Months	91.31%
6 Months	66.95%	18 Months	94.44%
9 Months	78.83%	21 Months	96.44%
12 Months	86.44%	24 Months	97.72%

To be more conservative, we assume that the shock will be totally absorbed in 12 months by the Lebanese Banking sector deposit rates. Therefore, we shift the cumulative impulse response function (divide all the number by 0.8644) to obtain the following curve which will be used to model the impact of a shock in LIBOR on the repricing of USD customers' deposits.

In Figure 6, we show the real and the adjusted impact of a 200 bps Libor shock on BSAR.

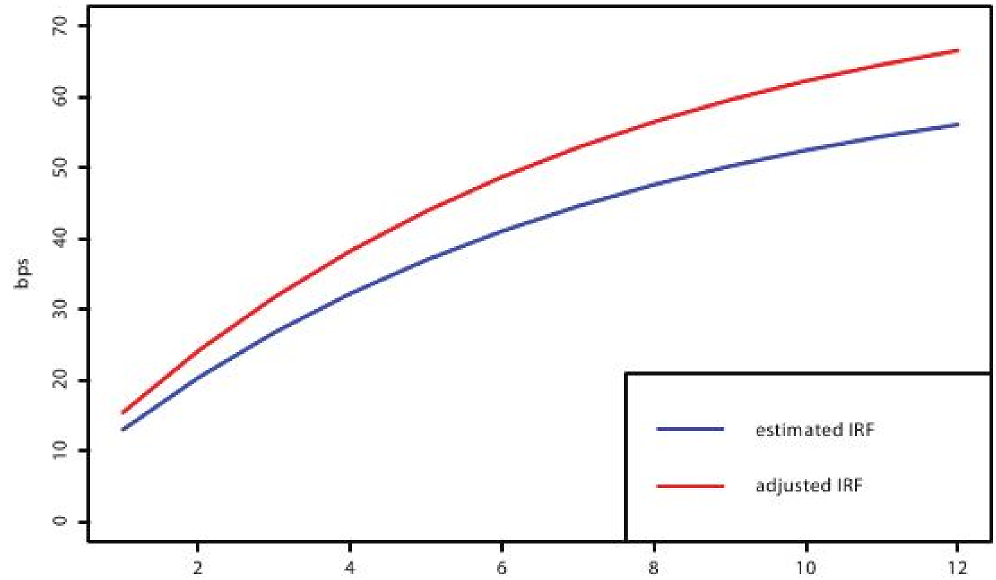

Figure 6: Pass-Through resulted from a 200 bps shock in Libor

5- Application

As previously mentioned, we concentrate on a hypothetical Lebanese bank's customer deposits which constitute the majority (80%-90%) of the bank's liabilities. the biggest portion of these deposits has a residual contractual maturity below or equal to 1 month. Though this is the simplest assumption for deposits' repricing, it doesn't however reflect their behavioral repricing profile.

In this section, we formulate a methodology for rebucketing deposits in the bank's repricing gap (a report typically used by banks to give a picture of their repricing interest rate risk) according to their behavioral repricing that we got from our model.

As mentioned previously, our model estimates a total pass-through of 33% from which 86% within a year time.

To be more conservative, we will assume the following:

- We suppose that the long-run impact is totally passed through within 1 year then we construct the cumulative impulse response function which converges to 100% instead of 86% (as detailed earlier).
- The remaining 67% will be passed through at the end of the first year.

We will use the impulse response function we developed earlier, to determine the percentage of deposits that are repriced at each point in time.

For example, if the impulse response function shows that 7% of the shock is passed through the first month, therefore 7% of deposits will be repriced in 1 month. The remaining 93% are shifted to the 2nd month where we redo this procedure until we reach the 1 year point where all the remaining deposits are assumed to reprice.

This will yield us with the behavioral repricing of deposits which is further in time than their contractual repricing. Therefore, the behavioral duration of our liabilities will be higher than the contractual duration. This will lower the duration gap between assets and liabilities and as a result the bank's sensitivity to interest rate risk will decrease.

Maturity	1 Month	3 Months	6 Months	12 Months
1	7.69%	-	-	-
2	4.39%	-	-	-
3	3.78%	18.04%	-	-
4	3.26%	3.71%	-	-
5	2.81%	3.20%	-	-
6	2.42%	2.76%	32.21%	-
7	2.09%	2.38%	2.68%	-
8	1.80%	2.05%	2.31%	-
9	1.55%	1.77%	1.99%	-
10	1.34%	1.52%	1.71%	-
11	1.15%	1.31%	1.48%	-
12	67.70%	63.27%	58.63%	100.00%

We illustrate an application of the model in the below example summarized in the following table.

We suppose a bank holds 2,500,000 USD as customers' deposits distributed as represented in table cited above. The present value of deposits without any adjustment is equal to USD 2,487,491 whereas the adjusted present value declines to USD 2,429,173. The change in value of liabilities after a shock increased from -7,274 to -37,946. This shows that liabilities sensitivity is higher and will compensate the decrease in value of assets after a positive parallel shock in interest rates.

Maturity	*1 Month*	*3 Months*	*6 Months*	*1 Year*
Customer Deposits	*1'890'000 $*	*450'000 $*	*120'000 $*	*40'000 $*
Present Value				
Contractual	*2'487'491 $*			
Contractual +200bps	*2'480'217 $*			
Adjusted	*2'429'173 $*			
Adjusted + 200 bps	*2'391'228 $*			

6- Conclusion

Our model's intent is to identify the behavioral duration (repricing date) of customer deposits when market interest rates fluctuate. This alters the sensitivity of the economic value of shareholders' equity to interest rate shocks, a measure of interest rate risk used to assess capital requirements for banks.

Our econometric model shows the existence of a partial pass-through with a significant time lag of domestic USD deposit interest rates after an interest rate shock in global market benchmark interest rates. The resulting behavioral deposit repricing profile is shifted in time beyond the contractual one (i.e. it becomes longer). As a result, the interest rate duration gap between assets and liabilities decreases, implying lower interest rate repricing risk.

Appendix A – Impulse Response Function

In this part, we calculate the impulse response function of the following error correction equation:

$$\Delta BSAR_t = \alpha_1 + \alpha_2 \Delta LIBOR_t - \beta_1 (BSAR_{t-1} - \beta_2 LIBOR_{t-1})$$

$$BSAR_t = \alpha_1 + (1-\beta_1) BSAR_{t-1} + \alpha_2 LIBOR_t + (\beta_1 \beta_2 - \alpha_2) LIBOR_{t-1}$$

In the following, we suppose that the shocked interest rate is indicated by the symbol " ′ ". Therefore, if at time t LIBOR will increase ΔI in value, we have the following:

Time t:

$$\begin{cases} LIBOR'_t - LIBOR_t = \Delta I \\ BSAR'_t - BSAR_t = \alpha_2 \Delta I \end{cases}$$

Time $t+1$:

$$BSAR'_{t+1} - BSAR_t = (1-\beta_1)\alpha_2 \Delta I + (\beta_1 \beta_2 - \alpha_2)\Delta I$$

Time $t+2$:

$$BSAR'_{t+2} - BSAR_{t+2} = (1-\beta_1)(BSAR'_{t+1} - BSAR_t)$$

We denote $u_t = BSAR'_t - BSAR_t$ by the instantaneous impact of LIBOR on BSAR rate at time t thus if LIBOR realizes a shock of ΔI at time 0 thus we have the following:

$$\begin{cases} u_0 = \alpha_2 \Delta I \\ u_1 = (1-\beta_1)\alpha_2 \Delta I + (\beta_1 \beta_2 - \alpha_2)\Delta I \\ u_{t+1} = (1-\beta_1) u_t \end{cases}$$

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