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Basic Pricing Methodology For Islamic Profit Rate Swap

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Abstract : Islamic bond market is growing at an astonishing speed without breaking the barriers and constraints set by Shariah principles advocated in Holy Quran. The present trend in Sukuk market is to price the bonds with variable profit rates linking the profit rate to Islamic interbank offered rate. Hence the financial institutions and banks face a peculiar problem in managing the funds as the durations of borrowing and lending does not match and this results in erosion of equity drastically. This problem compels the Islamic financial institutions to swap cash flows. The Commerce International Merchant Bank (CIMB) first introduced Islamic swap contract in June 2005 in Malaysia and Islamic swap market has grown in tandem with Sukuk market. Islamic swaps are based on profit rates. Pricing framework for Islamic swap is not yet available as it is in its infant stage. Islamic Interbank offered Rate (IIBOR) could form the basis for these swaps. We have attempted to prepare a basic framework without touching the probability of default to price and find out a reasonable upfront payment for these swap contracts. We hope that this framework will be considered as a basis for further debate and improvement. This framework will also provide a forum for debate and will be useful for lending organizations and academia, who can fine-tune this.

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I. Introduction

A swap is an agreement between two parties to exchange cash flows. The agreement specifies the cash flows and the dates when the cash flows are to be paid. The most common types of swaps are interest rate swaps, currency swaps, commodity swap, equity swap, and credit swap (Abken, 1993). Swap market participants include banks, mutual funds, and financial institutions (FIs). Intermediaries are dealers who assist in matching the parties of swap contract for a commission from both the sides. Sometimes, they themselves create an OTC (Over The Counter) market for swaps and quote bid and ask rates. There are three parties to a swap agreement, the institution which wants to buy fixed cash flows (swap buyer) by giving up floating rate cash flows. The institution, which sells the fixed cash flows by accepting floating cash flows, is the swap seller. The institution or bank which brings the parties together (the buyer and seller) and acts as an intermediary is the swap dealer. The commission paid to the swap dealer is the cost of the swap contract. The swap seller will be placed in a disadvantage over the swap buyer because the variability in cash flow is a challenge to manage. Planning and budgeting variable cash flow are difficult because the rates are determined periodically only after each installment of cash flow is swapped (Brown, 1994). The variable cash flows are computed based on interbank offered rate (plus a risk premium) (Dufreesne, 1998) prevailing at the date of swapping. In addition, the default risk is more for the swap buyer when the yield rate goes up and vice versa. In case of Islamic swap the profit rate is normally linked to Islamic Interbank Offered Rate (IIBOR), and this rate is dynamic, hence the profit rates that are to be applied to calculate the floating cash flows are known only after the first swap. The uncertainty exist in variable cash flow is to be valued and to be paid to the other party upfront by the party whose total present values of cash flow is lesser.

II. Why Swap?

Financial Institutions (FI) and banks act as intermediaries between borrower and lenders. Lenders are the depositors who demand market rates of return for their deposits. On the other hand the borrowers of funds demand loans on fixed rates. This creates cash flow mismatch for a financial institution. Duration is a weighted average period within which a FI or bank should get ready to return the money to the deposit holders. Technically duration is the slope of price yield curve which is useful to quantify the future loss when yield rate moves up. Both assets and liabilities have duration and if duration of liability is not equal to duration of assets, (duration gap) (Jarrow, 1997) then the FI or bank will face problem of default and associated risks. For some FIs and banks the duration gap may be negative, for others it may be positive. This duration mismatch is to be managed. To adjust this duration gap, the FIs or banks exchange the cash flows resulting in swap contracts. A swap contract is illustrated below.

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Company A	Company B
$D_A > D_L*k$ Swap floating cash flows for fixed cash flows **Buyer of Swap**	$D_A < D_L*k$ Swap fixed cash flows for floating cash flows **Seller of Swap**
Source of Funds (Borrowing) Long–term Liabilities like bonds and debentures	**Source of Funds (Borrowing)** Short–term deposits from public
Application of Funds (Investment) Short-term loans like consumer loans	**Application of Funds (Investment)** Long-term loans like property loans
Source and application of funds do not match	Source and application of funds do not match
Fixed cash flows purchased at X% Floating cash flows sold at IIBOR + Y%	Fixed cash flows sold at X% Floating cash flows purchased at IIBOR + Y%

D_A = Duration of assets
D_L = Duration of liabilities
K = Gearing ratio (Debt assets ratio)
X = Agreed percentage of profit or interest
Y = Risk premium

In a swap contract the fixed payer is placed in an advantageous position than the float payer. It results in zero sum game meaning that the float payer's loss is the fixed payer's profit. To avoid this win-lose situation both the parties are to be placed on equal footing by paying an upfront payment. To prevent this arbitrage profit and to exchange cash flows at arms length the following condition is to be satisfied.

$$FXCF_{pv} = (IIBOR+Y)_{pv} \qquad (1)$$

Fixed Payer PV = Floating Payer PV
FXCF = Fixed Cash Flows
Y = Risk Premium
IIBOR = Islamic interbank offered profit rate
pv = Present Values

a) Swap Risk Exposure

The swap market is mostly operating without any collateral and this causes credit risk exposure for banks and FIs which are involved in this market. The banks may even lose millions of RM if the other party defaults. Moreover, many new controversial swaps are structured by the participants who have even negative interest rate payments like 'inverse floater swaps'. The Bank for International Settlement is concerned about the risks involved in swap market, in addition to other risks, hence recommended capital adequacy norms under Basel II. To protect the parties to swap and also to minimize the legal and reputation costs the swap agreements are strictly regulated. A healthy swap market is expected to bring immense benefits for the swapping parties in the form of risk reduction.

b) Swap Market

The swap market in western countries under the conventional financing system has registered significant growth in recent years. It is the largest segment of the OTC derivative market. Across currencies, the Bank for International Settlements reports that the notional value of outstanding swaps is now over $71 trillion, with USD denominated swaps accounting for almost $24 trillion, as per International Swap Derivatives Association (ISDA) 2010 report. Collateralization has always been an important feature of the OTC swap market (Litzenberger (1992), is currently widespread and has been rapidly growing over the past five to ten years. ISDA (2010) reports that there is currently more than $719 billion worth of collateral insuring OTC derivative obligations and the amount of collateral in circulation increased by about 70% in the current decade.

c) Islamic Swap In Malaysia

On the footsteps of conventional swap agreement the Islamic swap market started emerging. The Malaysian government wishes to develop Malaysia as an international Islamic financial hub. Towards this objective it tries to link the home Islamic products with global Islamic products floated in Arabian countries, through alliances and collaborations. As such, it encourages the banks and financial institutions to develop new innovative Islamic financial products in equity and derivative markets. Already infrastructure is created in the last decade for Islamic financial products such as Sharia Board, legal and regulatory frameworks specifically in the areas of accounting, auditing, and tax. The next step is to offer products and markets to grow and sustain. The growth of the Islamic capital market is dependent on the risk management that requires derivatives that are to be Sharia compliant to meet the Islamic financial needs. In Malaysia there is no OTC market for swap. However, there exist an off market customized swap. The first Islamic profit rate swap was entered into by CIMB in June 2005 with two legs, one is fixed profit rate and the other floating profit rate leg

linked to KLIBOR (Kuala Lumpur Interbank Offered Rate). According to Islamic swap, a notional asset is sold for a notional sum by a company on credit basis and will collect installments computed with variable profit rate. This creates an Islamic loan liability with floating profit rate. The floating rate cash flow is acquired by CIMB by offering fixed profit rate cash flow, which is Sharia Compliant. The Standard Chartered Bank and Bank Muamalat Malaysia Bhd entered into a second swap contract to swap US$10m in November 2006. These are the initial steps initiated by the Malaysian Sharia council to broaden the range of Islamic financial derivative products. These steps are critical for the growth and management of Islamic financial instruments to expand and to exploit opportunities exist in Islamic capital market.

Bank Islam provides specific Swap dealings as follows

Wiqa' Profit Rate Swap

An agreement to exchange profit rates between two counterparties (normally consist of a Fixed Rate Party and a Floating Rate Party)

Wiqa' Cross Currency Swap (WCCS)

An arrangement between two parties to exchange a series of profit and/or principal payments denominated in one currency, for another series of profit and/or principal payments denominated in another currency, based on a notional principal amount over agreed period.

Two major differences can be identified while comparing the conventional swap with Islamic profit rate swap. In conventional finance when default or delay occurs in repayment the lender will add the interest accrued to the principal and calculate compound interest and also will add a penal charges for the default. IN Islamic finance only penal charges will be collected independently without adding the defaulted amount with the amount lent. Secondly the profit rate charged by the Islamic swap is not like conventional interest rate, it is a markup independent of length of time. Conventional swap rate is time based while Islamic swap rate is negotiation based.

III. Review of Literature

One of the early studies on the pricing of equity swaps was made by Chance & Rich (1998). They used arbitrage-free replicating portfolios to derive pricing formulas for a number of equity swaps such as plain vanilla equity swaps, variable notional swaps, and cross currency swaps. Kijima & Muromachi (2001) have studied equity swaps in a stochastic interest rate economy. In their model, the market is driven by Wiener process and the volatilities of the interest rates and of the equity prices are assumed to be deterministic functions of time, implying a Gaussian economy. Recently, Liao & Wang (2003) have provided a generalized formula for pricing equity swaps with a constant notional principal. They extend swaps to the international capital markets, allowing the underlying equity to be foreign and the notional principal to be specified in an arbitrary currency. Liao &Wang assumes a Gaussian economy where the market is driven by a multidimensional Wiener process and the volatilities of bond prices, equity prices and exchange rates are assumed to be deterministic. Their study shows that for swaps on foreign equity markets, the swap value is dependent of both the dynamics of the equity price process and the exchange price process. The traditional approach to interest rate swap valuation views swaps as portfolios of forward contracts on the underlying interest rate (Sundaresan, 1991, Sun, Sundaresan and Wang, 1993 and Duffie and Singleton, 1997). Under specific assumptions regarding the nature of default and the credit risk of the counterparties, Duffie and Singleton (1997) prove that market swap rates are on par with bond rates of an issuer who remains at LIBOR throughout the life of the contract. This result is extremely useful in practice for extracting spot yield rates, for pricing swap derivatives and for econometric testing of spot rate models.Despite the popularity of the traditional view, market practices bring into question some of the underlying assumptions of the forwards approach. To mitigate counterparty credit risk, market participants used number credit enhancements to improve the credit quality of swap contracts. Arguably, the most important credit enhancement is the posting of collateral and the current mark-to-market value of the swap contract (ISDA, 1999).This paper has special significance as it attempts to compute the risk involved in Islamic swap using hypothetical numerical example.

IV. Methodology

One of the challenges facing modern FIs and banks is pricing a swap agreement. To satisfy arbitrage (win–win principle) (Turnbull, 1987) normally the swap is priced in the conventional swap market on total net present values. There are two parties to swap the fixed payer and float payer. The float rate borrower will find it difficult to plan cash flows, budget them and control. Moreover, his incoming cash flows may not match with the cash outflows. Hence, he initiates the swap. The bank or an investor is ready to buy these floating rate cash flows for a price and in exchange the bank or FI is willing to offer fixed cash flows. The parties to the swap contract, in principle agree to exchange cash flows and not the principal or the loan amount. In other words one party will pay the other party the net amount resulting due to the change in the underlying rate (Minton, 1997). The underlying profit rate may be KLIBOR, but in Islamic finance IIBOR is adopted. The profit rate may be linked to IIBOR as threshold and a marginal fixed percent may be added to it to cover the default risk.

V. The Challenges

The parties to the swap agreement face three important challenges while dealing in swap contracts.

- Firstly, how to compute the future cash flows for floating rate leg.
- Secondly, how to address the issue of discounting factors that are to be applied in discounting both cash flows.
- Finally, the management of the credit risk or counterparty default risk.

The first challenge is to find out expected forward rates which will accrue in the future. These forward rates are computed in three different methods under conventional finance. The first method uses term structure techniques, the second method uses Black Derman Toy (BDT) recombining tree method, and under this method we have to specify the future volatility for every year of swap. Thirdly, the Heath Jerrow Merton (HJM) bushy tree method, under this method five volatility specification techniques exist, out of which any one may be used. Out of these three techniques, our paper applies the term structure yield rate method.

VI. Spot Yield Rates

The national governments issue treasury bonds for various time maturities namely 1 year, 2-year and so on to finance projects. These bonds are priced at par at inception indicating equality between the coupon rate and the yield rate. From these par yield rates that are available for government bonds for different maturity periods, it is possible to extract the expected yield rate of future years through bootstrapping. These yield rates are technically known as term structure spot yield rates. These term structure rates are again used in a forward iteration which produces the expected forward rates for computing floating rate cash flows. We calculate first the yield rate of a bond, which matures around Dec 2010. It was difficult to find an exactly Dec 2010 maturing bond and hence as an approximation a treasury bond closely maturing to Dec 2010 was taken to find the first semiannual spot yield rate. This approximation will not distort the result because the *datenum* function in MATLAB takes exact number of days for calculating yield rate. First Treasury bond, which matures in Dec 2010, will give the first semiannual rate by solving this equation.

$$p_0 = \frac{i_1 + FV}{(1+y_1)} \quad \text{……first semiannual yield rate } y_1 \qquad (2)$$

p_0 = *Market price of treasury bond*
i_1 = *cash flow of first semi-annual*
FV = *Redemption payment*
Y_1 = *Yield rate of period one*

Substituting y_1 in the following equation and taking second treasury bond that is closely maturing in the second semiannual period will give the second semiannual yield rate y_2

$$p_0 = \frac{i_1}{(1+y_1)} + \frac{i_2 + FV}{(1+y_2)^2} \quad \text{….second semiannual yield rate } y_2 \qquad (3)$$

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To get n^{th} semiannual yield rate

$$p_0 = \frac{i_1}{(1+y_1)} + \frac{i_2}{(1+y_2)^2} + \text{.....} + \frac{i_n + FV}{(1+y_n)^n}$$

….. n^{th} semiannual yield rate y_n (4)

VII. Expected Forward Rates

To get the expected forward yield rates we follow forward iteration on spot yield rates, which were computed in the earlier step. The expected forward yield rate for the first semiannual period is same as yield rate y_1.

First semiannual expected forward yield = $efy_1 = y_1$ (5)

Second semiannual expected forward yield =

$$efy_2 = \frac{(1+y_2)^2}{(1+y_1)} \qquad (6)$$

Third semiannual expected forward yield =

$$efy_3 = \frac{(1+y_3)^3}{(1+y_2)^2} \qquad (7)$$

.
.
.

n^{th} *semiannual expected forward yield* =

$$efy_n = \frac{(1+y_n)^n}{(1+y_{n-1})^{n-1}} \qquad (8)$$

The expected forward yield rates are used to compute the floating cash flows of future periods.

VIII. Discounting Factors

Spot yield rates are used in discounting expected floating cash flows which were extracted by the bootstrapping backward iteration method. While fixed cash flows are discounted at a uniform profit rate which is agreed by the fixed payer of swap. In Islamic swap contract, profit rate is used instead of interest rate. We use MATLAB software for all computations. See the appendix I for the program.

IX. Counterparty Default Risk

The credit risk in swap contract (otherwise known as counterparty default risk) is crucial because one party is placed in a disadvantageous position than the other depending up on the future movement of real yield rate. In a volatile term structure, both the parties may equally be affected by counterparty default risk (Artzner, 1990; Cooper, 1991; Solnic,1990; Sorensen, 1984). In the upward slopping yield curve, the float payer is expected to be at risk in the beginning of the swap as the net cash flows are favourable for fixed payer. However, at the tail end of the swap contract, the fixed payer will receive net cash flows from the float payer. In case, if the float payer fails to honour his commitments results in default this affects severely the fixed payer. To reduce the default risk, the fixed payer of the swap may demand collateral from the float payer, or obtain performance bond under marking-to-market principle (Rendleman, 1992).

X. Data

We collected yield rates of government Islamic bonds on the run whose maturity is closer to every semiannual end. We take 1st July 2010 as the settlement date and we try to swap the cash flows once in six months for five years commencing from 31st December 2010 until 30th June 2015. From the government Islamic bond yield rates, we computed the term structure and forward rates through backward and forward iterations. We took a hypothetical swap amount of RM100,000 to illustrate the cash flows and net payments to each party on swap dates. We also compute present values of both fixed and floating cash flows and their difference. The difference in total present values of fixed and floating cash flows is the value of the swap. The lower present value party should pay upfront the higher present value party.

XI. The Results

Table 1 shows the implied zero rates which are extracted from the on the run yield rates and also the expected forward rates computed through forward iteration. This table also shows the floating cash flows, fixed cash flows and the net cash payable by one party to the other.

Table 1: Real IIBOR computed from implied zero rates

Semi annuals	Implied ZR	Implied FR	VRCF	FRCF	Net CF	Float PV	Fixed PV	Diff PV
Dec-10	3.13	3.13	3130	5450	-2320	3082	5366	-2284
Jun-11	3.25	3.37	3373	5450	-2077	3266	5278	-2012
Dec-11	3.45	3.86	3857	5450	-1593	3663	5177	-1514
Jun-12	3.61	4.07	4072	5450	-1378	3791	5074	-1283
Dec-12	3.86	4.84	4843	5450	-607	4402	4954	-552
Jun-13	4.1	5.31	5313	5450	-138	4705	4826	-122
Dec-13	4.27	5.34	5340	5450	-110	4605	4700	-95
Jun-14	4.51	6.18	6181	5450	731	5172	4560	612
Dec-14	4.69	6.16	6156	5450	706	4996	4423	573
Jun-15	4.97	7.49	7494	5450	2044	5864	4264	1600
	Total		49759	54500	-4742	43546	48622	-5077

The present values of floating and fixed cash flows are also given with their difference. If the on the run yield rates are stable without any change in future semi-annual periods the cash flows in the table one will accrue. While the fixed cash flows stay at RM5,450 floating cash flows start with RM3,130 and gradually increases to RM 7,494. During the first seven semi-annual periods the float payer will receive net cash. After eight semiannual the fixed payer receives net cash for three semi-annual periods. The net cash flows are not symmetrical. When the cash flow changes course, there is ample chance and motivation to the float payer to default. The present values of floating cash flow show an increasing trend from RM3,082 to RM5,864, but the fixed rate cash flows show a decreasing trend because the discounting rate is fixed. Sizeable present values are favorable to the fixed payer than the float payer in the beginning. As per the payback principle the fixed payer

will be in an advantageous position initially than the float payer of the swap. The difference between the total present values is the swap value which is RM5,077 in this case. This amount is favorable to the float payer and therefore he should compensate the other party by an upfront payment of RM 5,077. This amount will equalize both the parties in terms of present values. The yield rate and the value of financial assets are inversely related. The implied yield profit rates and the implied forward profit rates computed may not accrue in real time. Hence we tried to simulate the yield rates up and down each time by 50 basis points[1] (bps) to highlight the sensitivity of the swap value. First we increase the on the run yield rate by 50 bps at a time four times till it reached 200 bps. Our intension is to highlight whether the present values move linear or curvilinear to every increase of 50 bps in yield rates.

Table 2: Real IIBOR increases by 50 bps from implied Zero profit rates

Semi annuals	Implied ZR	Implied FR	VRCF	FRCF	Net CF	Float PV	Fixed PV	Diff PV
Dec-10	3.63	3.63	3630	5450	-1820	3565	5353	-1788
Jun-11	3.75	3.87	3873	5450	-1577	3732	5252	-1520
Dec-11	3.95	4.36	4358	5450	-1092	4109	5139	-1030
Jun-12	4.11	4.57	4574	5450	-876	4217	5025	-807
Dec-12	4.36	5.35	5349	5450	-101	4802	4893	-91
Jun-13	4.6	5.82	5822	5450	372	5080	4756	324
Dec-13	4.78	5.85	5849	5450	399	4958	4619	338
Jun-14	5.02	6.7	6699	5450	1249	5495	4471	1024
Dec-14	5.2	6.67	6673	5450	1223	5297	4326	971
Jun-15	5.48	8.03	8028	5450	2578	6128	4160	1968
	Total		54855	54500	355	47383	47994	-611

The results of 50 bps increase in yield rates are given in the above table. These results show balanced symmetric net cash flows. The floating cash flows are now show some evenness. One could observe the net negative cash flows are approximately equal to the net positive cash flows, which indicates that the value of the swap is fair at these yield rates. The present value of floating cash flows increase from RM3,565 to RM6,128 while the fixed cash flows present values decrease from RM5,353 to RM4,160. The break even occurs exactly at the middle of the swap contract i.e. in Dec 2009, the price of the swap also at the peak at this point of time. These imply that the risk premium could be 50 bps (0.5%) for this swap contract. A closer observation will reveal that still the default risk is persisting and it is favorable to the float payer initially and favourable to fixed payer later. The float payer still faces counter party default risk, because in the initial stages the fixed payer will pay net cash to the float payer. At the end of the swap horizon the float payer may default. The final swap value comes to RM611 to be paid upfront by float payer to fixed payer.

The results of 100 bps increase in yield rates are given in the following table.

[1] One hundredth of a percentage is a basis point. In terms of ordinary number it is one in ten thousand. (1 bp = 0.01% or 0.0001). 1% is 100 basis points, 2% is 200 basis points and so on.

Table 3: Real IIBOR increases by 100 bps from implied Zero profit rates

Semi annuals	Implied ZR	Implied FR	VRCF	FRCF	Net CF	Float PV	Fixed PV	Diff PV
Dec-10	4.13	4.13	4130	5450	-1320	4046	5340	-1294
Jun-11	4.25	4.37	4373	5450	-1077	4194	5226	-1033
Dec-11	4.46	4.86	4860	5450	-590	4549	5101	-553
Jun-12	4.61	5.08	5077	5450	-373	4635	4976	-341
Dec-12	4.86	5.86	5855	5450	405	5193	4833	359
Jun-13	5.1	6.33	6331	5450	881	5444	4686	758
Dec-13	5.28	6.36	6359	5450	909	5298	4541	757
Jun-14	5.52	7.22	7216	5450	1766	5804	4384	1421
Dec-14	5.71	7.19	7191	5450	1741	5582	4231	1352
Jun-15	5.99	8.56	8563	5450	3113	6376	4058	2318
	Total		59955	54500	5455	51121	47376	3744

While the fixed payer of the swap pays a constant amount of RM 5,450 the float payer pays floating cash flows. The total for the fixed payer is RM54,500 whereas for the float payer it is RM 59,955 an excess of RM 5,455. The total present value for the fixed payer comes to RM47,376 but for the float payer it is RM51,121 and results in a difference of RM3,744, which is the swap price. The fixed payer should pay the float payer this amount upfront. The default risk is significant at the end to the fixed payer because the float payer has to bear higher amounts.

Table 4: Real IIBOR increases by 150 bps from implied Zero profit rates

Semi annuals	Implied ZR	Implied FR	VRCF	FRCF	Net CF	Float PV	Fixed PV	Diff PV
Dec-10	4.63	4.63	4630	5450	-820	4525	5327	-802
Jun-11	4.75	4.87	4874	5450	-576	4651	5201	-550
Dec-11	4.96	5.36	5361	5450	-89	4981	5064	-82
Jun-12	5.11	5.58	5579	5450	129	5044	4928	117
Dec-12	5.36	6.36	6362	5450	912	5573	4774	799
Jun-13	5.61	6.84	6841	5450	1391	5796	4618	1178
Dec-13	5.79	6.87	6869	5450	1419	5625	4463	1162
Jun-14	6.03	7.73	7734	5450	2284	6100	4298	1801
Dec-14	6.21	7.71	7709	5450	2259	5853	4138	1715
Jun-15	6.5	9.1	9098	5450	3648	6609	3959	2650
	Total		65057	54500	10557	54757	46770	7988

When the yield moves further up to 150 bps in real time, the swap value also increases. The fixed payer has to compensate the float payer more. The value of the swap is roughly around RM8,000. The float payer pays a higher amount totally to the tune of RM10,557. The default risk in the initial stages is significant to the float payer and vice versa.

Table 5: Real IIBOR increases by 200 bps from implied Zero profit rates

Semi annuals	Implied ZR	Implied FR	VRCF	FRCF	Net CF	Float PV	Fixed PV	Diff PV
Dec-10	5.13	5.13	5130	5450	-320	5001	5314	-312
Jun-11	5.25	5.37	5374	5450	-76	5103	5175	-72
Dec-11	5.46	5.86	5863	5450	413	5408	5027	381
Jun-12	5.61	6.08	6081	5450	631	5445	4880	565
Dec-12	5.86	6.87	6868	5450	1418	5944	4716	1227
Jun-13	6.11	7.35	7350	5450	1900	6137	4551	1587
Dec-13	6.29	7.38	7379	5450	1929	5940	4387	1553
Jun-14	6.53	8.25	8252	5450	2802	6382	4215	2167
Dec-14	6.72	8.23	8228	5450	2778	6110	4047	2063
Jun-15	7.01	9.63	9633	5450	4183	6827	3863	2965
	Total		70158	54500	15658	58297	46175	12124

A further increase in yield rate shows the same pattern of cash flows and present values, but a higher amount. The default risk also shows similar pattern like earlier, favorable to the float payer initially and favorable to the fixed payer later. When yield rate slopes upward from the computed yield rate the float payer suffers by higher payments. But the fixed payer faces enormous credit risk or default risk. The value of the swap increases by a fixed amount approximately equal to RM4,000 at each 50 bps increase. First 50 bps increase registers a value increase of RM4,466 the second 50 bps increase shows RM4, 356 as value increase, similarly the 150bps increase and 200bps increase show value addition of RM4,243 and RM4,136 respectively. The value of the swap increases when the yield rate slopes upward but at a marginally declining rate.

XII. When Yield Rates Decrease in Real Time

When yield rate drops from the expected yield rates the float payer is placed in an advantageous position. The fixed payer pays a higher amount than the float payer in total. But he receives an upfront payment from the float payer.

Table 6: Real IIBOR decreases by 50 bps from implied Zero profit rates

Semi annuals	Implied ZR	Implied FR	VRCF	FRCF	Net CF	Float PV	Fixed PV	Diff PV
Dec-10	2.63	2.63	2630	5450	-2820	2596	5379	-2784
Jun-11	2.75	2.87	2872	5450	-2578	2795	5304	-2508
Dec-11	2.95	3.36	3355	5450	-2095	3211	5215	-2005
Jun-12	3.11	3.57	3570	5450	-1880	3356	5125	-1768
Dec-12	3.35	4.34	4337	5450	-1114	3990	5015	-1025
Jun-13	3.59	4.80	4803	5450	-647	4317	4898	-581
Dec-13	3.77	4.83	4830	5450	-620	4238	4782	-544
Jun-14	4.00	5.66	5664	5450	214	4834	4651	182
Dec-14	4.19	5.64	5638	5450	188	4679	4523	156
Jun-15	4.46	6.96	6961	5450	1511	5584	4372	1212
	Total		44660	54500	-9841	39600	49264	-9665

The float payer pays RM44,660 but the fixed payer pays RM54,500 an excess payment of RM9,841 by the fixed payer. To compensate this excess payment the float payer must pay RM9,665, which is the difference in present value, to the fixed payer. The counter party credit risk is more for the fixed payer than the float payer of the swap contract at the end of swap contract. In the beginning, the credit risk is more for the float payer because the fixed payer has to pay a net amount.

Table 7: Real IIBOR decreases by 100 bps from implied Zero profit rates

Semi annuals	Implied ZR	Implied FR	VRCF	FRCF	Net CF	Float PV	Fixed PV	Diff PV
Dec-10	2.13	2.13	2130	5450	-3320	2108	5393	-3285
Jun-11	2.25	2.37	2372	5450	-3078	2320	5330	-3010
Dec-11	2.45	2.85	2854	5450	-2596	2751	5254	-2503
Jun-12	2.61	3.07	3067	5450	-2383	2913	5175	-2263
Dec-12	2.85	3.83	3830	5450	-1620	3568	5077	-1509
Jun-13	3.09	4.29	4294	5450	-1156	3917	4972	-1055
Dec-13	3.27	4.32	4320	5450	-1130	3857	4866	-1009
Jun-14	3.5	5.15	5147	5450	-303	4480	4745	-264
Dec-14	3.68	5.12	5121	5450	-329	4346	4625	-279
Jun-15	3.95	6.43	6428	5450	978	5286	4482	804
	Total		39563	54500	-14937	35546	49919	-14373

When yield rate further drops by another 50 bps the advantage for the float payer increases and the fixed payer suffers. A total amount of RM 14,937 the fixed payer pays more than the float payer. This is to be compensated by an upfront payment of RM 14,373 by the float payer to the fixed payer. Here this figure highlights the benefits enjoyed by the float payer in the case of a drop in the future yield rate.

Table 8 : Real IIBOR decreases by 150 bps from implied Zero profit rates

Semi annuals	Implied ZR	Implied FR	VRCF	FRCF	Net CF	Float PV	Fixed PV	Diff PV
Dec-10	1.63	1.63	1630	5450	-3820	1617	5406	-3789
Jun-11	1.75	1.87	1872	5450	-3578	1840	5356	-3517
Dec-11	1.95	2.35	2352	5450	-3098	2285	5293	-3009
Jun-12	2.1	2.57	2565	5450	-2885	2460	5227	-2767
Dec-12	2.35	3.32	3324	5450	-2126	3135	5141	-2005
Jun-13	2.59	3.78	3785	5450	-1665	3504	5046	-1542
Dec-13	2.76	3.81	3811	5450	-1639	3462	4951	-1489
Jun-14	2.99	4.63	4630	5450	-820	4111	4840	-729
Dec-14	3.17	4.6	4604	5450	-846	3996	4730	-734
Jun-15	3.44	5.9	5895	5450	445	4971	4596	376
	Total		34468	54500	-20032	31381	50586	-19205

Another 50 bps drop in the real yield rate in real time than expected yield rate will give an added advantage to the float payer. The net excess payment made by the fixed payer is RM 20,032 whose present value is RM 19,205 which is enjoyed by the float payer. The default risk for the fixed payer is almost zero but for float payer it is significant. The fixed payer may default because of higher amount payable all through the contract.

Table 9: Real IIBOR decreases by 200 bps from implied Zero profit rates

Semi annuals	Implied ZR	Implied FR	VRCF	FRCF	Net CF	Float PV	Fixed PV	Diff PV
Dec-10	1.13	1.13	1130	5450	-4320	1124	5419	-4296
Jun-11	1.25	1.37	1372	5450	-4079	1355	5383	-4028
Dec-11	1.45	1.85	1851	5450	-3599	1811	5333	-3522
Jun-12	1.6	2.06	2063	5450	-3387	1998	5279	-3281
Dec-12	1.85	2.82	2818	5450	-2632	2691	5205	-2514
Jun-13	2.08	3.28	3276	5450	-2174	3079	5122	-2043
Dec-13	2.26	3.3	3301	5450	-2149	3052	5038	-1986
Jun-14	2.49	4.11	4113	5450	-1337	3726	4937	-1211
Dec-14	2.67	4.09	4087	5450	-1363	3628	4838	-1210
Jun-15	2.93	5.36	5363	5450	-87	4637	4712	-75
	Total		29374	54500	-25127	27101	51266	-24166

Yet another drop of 50bps in yield rate further pushes the fixed payer to the corner. The fixed payer pays an excess amount of RM 25,127 which is almost equal to half of the total amount. The float payer pays RM29,374 while the fixed payer pays RM 54,500. The net present value enjoyed by the float payer of the swap is around RM24,000 which is the value of swap. The counterparty default risk for the fixed payer is almost zero, while for the float payer it is significant. The value of the swap decreases by RM4,586, RM4,708, RM4,833 and RM4,961 respectively for every 50 bps increase. The increase in swap value is negative meaning that the float payer is placed in a favourable position.

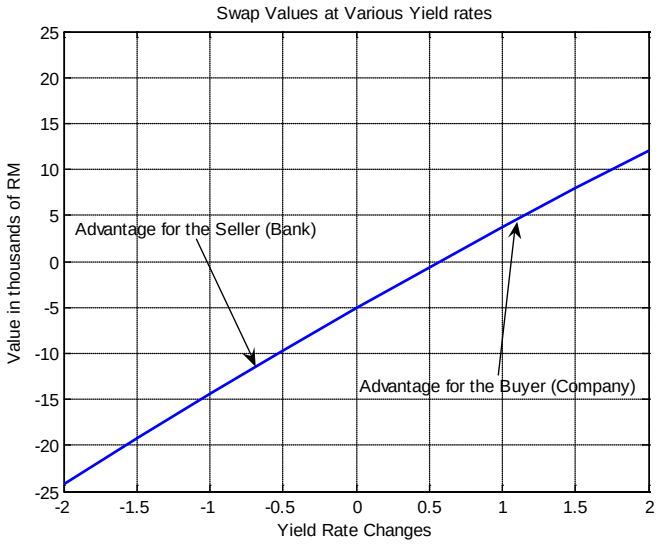

Figure 1: Swap values for every 50 basis points change in yield rates

The figure above shows the swap values at different yield rates. At the computed forward profit rate the value is RM 5,000 approximately favorable to the float payer. At the lower yield rates the advantage to the float payer is significant. It even touches RM 25,000 at drop of 2% in real yield rate. When profit rate increases by the same percentage the disadvantage to the float payer is not proportionate. The maximum disadvantage is around RM12,000 approximately. Since the fixed payer of the swap is paying a fixed amount, which has no uncertainty or risk his advantage is smaller and disadvantage is significant.

XIII. Conclusion

The Government bond yield rate maturing close to the start date and relevant rates from IIBOR were used to compute spot yield profit rates and forwards profit rates to determine an Islamic swap value. A hypothetical swap value of RM 100,000 was tested with the computed profit rates and the following facts emerge.

- The float payer charges a risk premium of 0.5% approximately on fixed paper for the default risk he faces. This is due to the volatility in floating rates, and the risk is borne by the float payer naturally the rate is not equal.
- If the fixed rate is reduced by 50 bps, the floating NPVs and fixed NPVs are equal, provided if the forward yield rates are constant. Many theories and research studies proved that the future yield rates are dynamic and follow random walk.
- The counterparty credit risk is favorable to the fixed payer in higher yield rates, but favorable to the float payer in lower yield rates.
- When yield rate rises the value of swap turns out to be favorable to the fixed payer and vice versa. But the amount of increase and decrease are not proportional. In all cases it is somewhat favorable to the float payer of the swap.
- For an increase of 200 bps of yield rate the value of the swap touches RM 24,000 favorable to the float payer, while for the same rate decrease it reaches only RM12,000 unfavorable to the float payer.

The Islamic swap float payer is placed in a favorable position when compared to the swap fixed payer, if given yield rates and other assumptions hold. Relaxing these assumptions could be a matter for discussion.

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Matlab program

```
close all
clear all
clc
format short
crate1=[.0313; .0325; .0345; .0360; .0384; .0407;
.0424; .0446; .0463;.0488];                          %Treasury bond par yield rates
settle=datenum('07-01-2010');                        % Day of swap contract
maturity=datenum(['12-31-2010';'06-30-2011';'12-31-2011';'06-30-2012'; '12-31-2012';'06-30-2013';'12-31-
2013';'06-30-2014';'12-31-2014'; ;'12-31-2015']);    %Profit dates
price=[100;100;100;100;100;100;100;100;100;100];     % face values
a1=[]; a2=[]; a3=[];

%If expected forward rates and actual forward rates are same
for i=1:5
zerorates1=zbtprice([maturity crate1], price, settle);          % Backward iteration
forwardrates1=zero2fwd(zerorates1,maturity,settle);             %forward iteration
dfs1=zero2disc(zerorates1,maturity,settle);                     %discounting factors of zero rates
notional=1e5;                                                   %Notional swap price
cffloat1=notional*forwardrates1;                                % Floating cash flows
cffixed1=notional*.0545;                                        % fixed cash flows
cffixed1=(ones(length(cffloat1),1))*cffixed1;                   %Create one column of fixed cash flow
dif1=cffloat1-cffixed1;                                         %find difference
a1=[a1;[zerorates1 forwardrates1 cffloat1 cffixed1 dif1]];      % Table of cash flows
floatnpv1=cffloat1.*dfs1;                                       %Present values of floating cash flows
fixednpv1=cffixed1.*dfs1;                                       %Present values of fixed cash flows
sp1=floatnpv1-fixednpv1;                                        % Swap price in RM
a2=[a2;[floatnpv1 fixednpv1 sp1 cumsum(sp1)]];                  % Table of cash flows
a3=[a3;(sum(fixednpv1-floatnpv1))]                              % Cumulative difference in NPVs
crate1=crate1+.005;                                             % Increase the yield rates by 0.5%
end
```