

**Undisclosed Potential of Zakat Payment Deficit**  
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**Abstract**

**PURPOSE** - The purpose of this paper is to scrutinize the potential deficit in the zakat payment of any Muslim business when it is applying a non-shariah accounting system that is based on the Gregorian calendar. As the Gregorian calendar is about 11.5 days longer than the Islamic calendar, the potential deficit is accumulating into one year of unpaid zakat for every thirty-year operation of the business. **DESIGN/METHODOLOGY/APPROACH** - The study starts with an overview of scientific and shariah analyses of the astronomical phenomena in defining a lunar month in the Islamic calendar. The most current case study and data are provided. This is to stimulate a critical thinking and show that unless Muslims accept astronomical calculation as a sole method, an Islamic calendar will never exist. The study then develops a robust analytical model for the estimation of the zakat deficit when Muslims do not apply an Islamic calendar for their accounting system. Three different datasets are used for the empirical study to bridge the hypothetical assumption, theoretical model, and the empirical findings. **FINDINGS** - Finally, the paper confirms the hypothetical assumption to find that the zakat loss for the possession of the above assets can be at the tune of US\$ 9 million. This robust estimation procedure can be applied to rectify any inadvertent past mistakes and transform them into a shariah compliant payable zakat for Muslims' business in the future. **RESEARCH LIMITATION/IMPLICATION** – The research has not used financial statements of Muslims businesses as input; however, this can be easily accommodated once they are available. It is imperative that Muslims construct a reliable Islamic calendar and swiftly reformulate their accounting system based on it; otherwise, the zakat deficit is snowballing and will be burdened by the next generation. **ORIGINALITY/VALUE** – This is an original and funded research work.

**Keywords:** Islamic calendar, zakat payment deficit, Muslims' civilization debt, flawless shariah economy

**1 Introduction**

Islamic finance is developing quite rapidly and has grown to manage some US\$1.5 trillion worth assets in 2000 from mere £5 billion in 1985. The world witnesses it to further grow in a faster rate in the coming years. In addition to that, Islamic banking and finance have gained confidence as alternative financial vehicle for creditors and borrowers internationally. Currently there are more than 250 Islamic banks with the growth rate of 15%-20% per annum (Adel, 2010) (2010f). These Islamic banks are operating in 75 countries worldwide to include some 100 Islamic equity funds managing total assets of more than US\$ 5 billion (2010f). In the mean time, in 2005, Muslim population had reached some 1.5 billion which accounts for about 24% of the 6.3 billion of world's total population. This population growth has consequently created higher awareness for better investment means that complies with Islamic principles (shariah). This leads to the growth of innovative and lucrative Muslim's business and the development of assets ownership by

Muslims at global scale. This has in return demanded variety of investment sectors which has created Islamic Capital Market (ICM) development.

What makes ICM differs from the western one is the fact that the former's activities should comply with the shariah principles (e.g. Islamic laws). An interest-free transaction which leads to minimizing risks due to speculative financial activities is actually the keyword to the success of an Islamic finance development. Rather than interest-based economic development that are strongly prohibited in Islam, the Islamic finance transaction is constructed based on the risk and profit sharing which in return provides trustworthiness due to transparent and disclosures in its transaction.

Notwithstanding the encouraging development of innovative alteration of originally conventional (i.e. non-shariah) business into shariah compliant business models, however, the development of ICM has so far been too deeply bound by classical issues namely *riba* (usury), *maysir* (gambling), *gharar* (ambiguity), and *nisab*. In other words, regarding ICM Muslim scholars are normally too deeply framed by issue that ICM should only deal with business entities whose transactions must be free from the abovementioned prohibited elements. Among others, these four favorite issues are discussed in (Adel, 2010), (Isa, 2005), (Khatkhatay, 2008). What has likely been neglected is the issue of the maturity (*haul*) of an asset upon which *zakat* should be paid. Even an article that sound to focus on the mechanism of shariah standards (Elgari, 2008) and an article that emphasizes on shariah audit for Islamic financial services (Rahman, 2008), seem to have neglected *haul* issue although the current practice of our shariah economy is now using non-Islamic accounting system.

## **2 Neglected Islamic calendar and haul issue in zakat calculation**

The interests and admiration of modern western scientists to the Muslim economic and fiscal systems actually can be traced back as early as mid 1970s. Letters from Lord Vivian Bowden to editors of prominent British newspapers Guardian and Times, and his speech before the House of Lords demonstrate this. Lord Bowden's letter to Guardian's editor was dated 5<sup>th</sup> June 1975 and was quoted: *"No one seems to realize that we have introduced something astonishingly like the ancient Muslim system called zakat in which units of value are defined in terms of the actual commodity which is being dealt with...."* In the following paragraph, he further quoted as saying: *"At the end of the fasting month of Ramadan, all Muslims flock to their mosques. They pay the dues for the poor in cash, but the amount they pay have been computed in every town at the appropriate time, so that the purchasing power of the tax revenue will be guaranteed. Someone will have found out how much a loaf of bread costs, and the taxes will be determined accordingly. Here is the indexation in the purest form, and it has been in use for 1,400 years."* (1976).

Meanwhile, Bowden's letter to Time's editor dated on 17<sup>th</sup> November 1976 whereby he mentioned also specifically the strength of Islamic financial system is quoted as saying: *"Throughout most of the third century of our era, prices in the Roman Empire rose at about 12 per cent per annum – as they are raising here today. After 100 years the price of wheat had risen than a hundred thousand times, trade and commerce were in ruins and the government demanded the payment of taxes in kind. For this reason, the Muslims abandoned the use of money as a standard of value in the long term, and they insisted that loans and debts be repaid in such a way as to preserve their purchasing power."* (1976).

Later that year, Lord Bowden speech before a parliamentary debate and said: *".....Noble Lords may regard this as a somewhat frivolous operation in elementary mathematics, but it so happens that it is almost precisely the rate of inflation which destroyed the Roman Empire.....; the price of wheat increased 100,000 times in about 100 years.....It was first enunciated in some details in the desert of Arabia about 1,500 years ago and it is described in some detail in the Koran. It is*

*prescribed therein that if a debt is incurred it shall not be repaid in money but in equivalent purchasing power. A man must repay a debt-gold for gold, camels for camels.....This means that the purchasing power is retained.” (1976)*

From his letters and speech texts, one is able to see two clear indications. Firstly, the original text he quoted should have demonstrated that in their early civilization, Muslims actually paid their zakat during Ramadan. The calculation of the zakat was therefore based on the Islamic fiscal year and calendar. Secondly, the repayment of loans and debts is always indexed into the current market price as the price of money often deteriorated over time.

### **3 Effect of neglecting the Islamic calendar**

What has been hardly touched by Muslims researchers is the issue of haul or the minimum period of assets ownership that is zakatable (entitled to pay zakat). The last issue is somewhat forgotten although Lord Bowden has demonstrated that in the early development of Muslim’s civilization, the haul was always be calculated based on the Islamic accounting system. Majority of Muslims seem to have forgotten the fact that almost all Islamic business are actually practicing their business based on the Gregorian calendar, not the Islamic calendar. One will easily obtained financial statements of listed Islamic banks that are all based on the Gregorian calendar. Seventeen Islamic banks listed in Bursa Malaysia (2007a), (2009a), (2009c), (2006a), (2007c), (2007d), (2006c), (2007e), (2010a), (2010c), (2006b), (2007b), (2010e), (2010g), (2010h), (2006d), (2010i), five Islamic banks listed in Jakarta Stock Exchange (2005), (2009d), (2009e), (2010d), (2010b), one Islamic bank in Bahrain (2008), one Islamic bank in United Arab Emirate (2009f), one Islamic bank in Pakistan (2004), and one Islamic bank in UK (2009b) all are using the Gregorian calendar as the basis of their accounting system. It should be born in mind that bank operation is closely networked with fiscal and monetary authorities of each country and they are all interconnected through global network of central banks. In addition, as players in financial industry sector, they are also connected with other players (insurance and reinsurance, capital market, industry sectors, etc). The operation of abovementioned Islamic banks therefore most likely validates an important notion that Islamic calendar has actually been forgotten by Islamic banks and Islamic business completely.

Peculiarly though, one can hardly find a comprehensive discussion on haul issue regardless of the fact that the Gregorian calendar is actually about 11.5 days longer than the Islamic calendar. Therefore, a Muslim business that is operating its accounting system that is based on the Gregorian calendar will preserve a potential deficit in the payment of its zakat both in corporate as well as in stakeholders’ levels. The deficit will be even worse as it accumulates into about one year zakat payment deficit for every thirty year of its business operation. If this practice is collectively committed by all Muslim businesses that have been going on maybe for hundreds of years, then the potential zakat deficit must be unimaginably huge. The only paper that briefly mentions that an Islamic calendar should be used to calculate the payable zakat is (Isa, 2005) on page 18, and it is herewith quoted: *“When using the lunar year to calculate zakat, payment should be at a rate of 2.5 percent. For a solar year, the rate would be 2.577% in consideration of the fact that the lunar calendar has a fewer number of days per year. It would also be acceptable to use the rate of 2.5 percent for both calendars considering that the number of extra days of the solar calendar will enter into the zakat of the next year.”* The above quoted text therefore indicates two important notions:

1. There is a potential of zakat payment loss if a Muslim’s business prepares its financial statement based on the Gregorian calendar;
2. The loss is accumulating over the years if it is not rectified immediately in the following years;

However, although his statement is quite specific, there seems no Islamic scholar who is interested in studying this effect in depth in spite of the fact that all Islamic banks are currently practicing pseudo (e.g. non-shariah) accounting system. Due to the accumulating effect, two important issues demand an in-depth investigation: Firstly, when were actually Muslims started taking a pragmatic approach in using the Gregorian calendar for the non-existence of a reliable Islamic calendar for the basis of their accounting system? This question is of paramount importance as it potentially generates unconscious Muslims' civilization debt. Secondly, is it possible to develop a robust synchronization model to rectify an inadvertent miscalculation of the zakat in the Muslim's business? Such a model must be sufficiently flexible to accommodate the financial statements of a Muslim business that has been carried out mistakenly for tens or even hundreds of years. Should Muslims be able to answer these two questions, the potential civilization debt can be accurately calculated and further actions can be undertaken to rectify the past mistakes. This paper however, only tries to investigate the second part of the research question owing to the fact that the first research question requires much longer time to accomplish.

#### **4 What makes Islamic calendar is uncertain?**

It is estimated that for more than 1,000 years of their civilization, Muslims are experiencing conflict among Muslim clerics (jurists) in implementing shariah (Islamic law) in their daily lives. One group of jurists is persistent in the literal letter of the Qur'an and Hadith while the other group tries to adopt the spirit of the text and implement modern science and technology that complies with the text. Should there be a transition from the former to the latter, one really needs a special endurance to witness it. A few examples are given herewith.

For five daily prayers, for example, traditional jurists took the Prophetic words (hadith) literally by using a pole to monitor its shadow as a representation of the movements of the sun. They prohibited the use of prayer timings by astronomically calculated clock. Even for timings of subuh (dawn prayer) when there is no sunlight to monitor the pole's shadow, traditional Muslim clerics was persistent in the literal text of the Qur'an by differentiating the appearance of black and white threads at dawn. More modern jurists allowed the use of clock for determining the timings of the prayer which is now becomes an accepted norm by Muslims throughout the world.

However, an attempt to fully embrace astronomical calculation to determine the onset of Islamic calendar remains a latent conflict nowadays. A reliable Islamic calendar therefore never exists. As a contingency action to narrow down the problems, Muslims all over the world then use the Islamic calendar only for spiritual purposes. In lieu of the Islamic calendar, they then adopted the use of the Gregorian calendar for worldly life e.g. education, banking, trading and so forth.

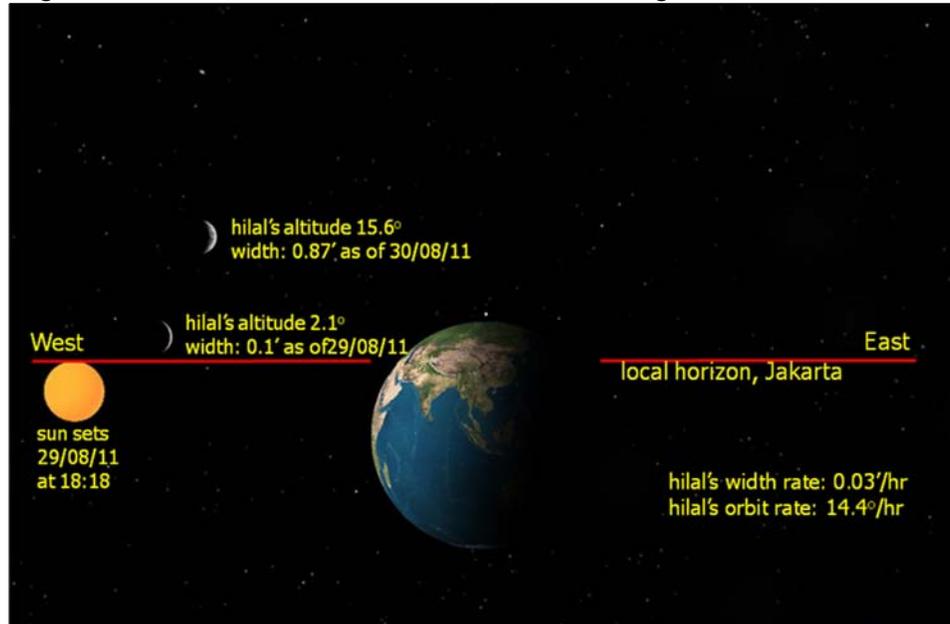
#### ***4.1 The latest dispute in concluding Ramadan fast of 1432-H***

Quite recently, Muslims all over the world have just experienced unnecessary split in concluding their Ramadan fasting. Some ended the Ramadan fasting on the 29<sup>th</sup> August 2011 and therefore performed Iedul Fitri prayer on the morning of 30<sup>th</sup> August. The other groups still refrained from eating and drinking and concluded the Ramadan fasting one day later, on the 30<sup>th</sup> August. The latter then performed Iedul Fitri prayer on the morning of 31<sup>st</sup> August, instead. This split has happened in quite number of times in this decade alone. The latent dispute that recently happened in concluding Ramadan of 1432-H needs an in depth look in an attempt to analyze it from shariah as well as scientific point of views. Sources of astronomical data and calculation used in the following sections are taken from (Odeh, 2011) based on the previous evaluation (Saksono, 2007). In order to accurately show detailed information needed for the analysis, Jakarta the capital city of Indonesia is used as the basis of astronomical calculation and a case study.

##### **4.1.1 Astronomical analysis**

On the 29<sup>th</sup> August 2011, astronomical calculation reveals that the sun set at local horizon of Jakarta, Indonesia at 17:53 LT (local time) whilst the moon set at 18:02 LT. Nine minutes time

difference will geometrically locate the hilal (crescent) at an altitude of about  $2.1^{\circ}$  when the sun set. However, none of hundreds of moonsighting team spread in some 90 different locations across the country witness to have seen the crescent. Although some prominent jurists confessed to have seen the crescent in two locations in Java, their confession were refused by the Indonesian authority as the latter were not officially designated moonsighting team. The Indonesian government then decided that there was no physical evidence to conclude that the early eve of 29<sup>th</sup> August as an official timing of the first day of Syawwal 1432-H. It then proclaimed that Indonesian Muslims were asked to remain fasting on the 30<sup>th</sup> August 2011, and officially performed Iedul Fitri prayer on the morning of 31<sup>st</sup> August 2011. Astronomical data showing the characteristics of the hilal and the sun on two consecutive days 29<sup>th</sup> and 30<sup>th</sup> August 2011 are given in Figure 3. The detail of the related astronomical data is given in Table 1.



**Figure 3: Characteristics of the sun and the moon (hilal) on 29th and 30th August 2011 in Jakarta**

DATE	SUNSET	MOONSET	HILAL ALTITUDE (angular degree)	HILAL WIDTH (angular minute)
<b>29 August 2011</b>	17:53	18:02	+2.10 westward	0.10
<b>30 August 2011</b>	17:53	18:58	+15.6 westward	0.87
<b>30 August 2011</b>			-37.70 eastward	0.40
<b>30 August 2011</b>			+34.50 eastward	0.58

**Table 1: Characteristics of hilal on 29<sup>th</sup> and 30<sup>th</sup> August 2011**

Based on the detailed astronomical data in Table 1, one will be able to summarize that the hilal's width grew at a pace of 0.03' (angular minutes) per hour, whilst the moon was orbiting the earth at a rate of  $14.44^{\circ}$  (angular degrees) per hour. Therefore, ten hours after the sunset of the 29<sup>th</sup> August 2011, the hilal will be at an altitude of  $-37.70$  eastward of Jakarta's eastern local horizon, whilst the hilal's width will be 0.4 angular minutes (i.e. 400% as wide as when the sun set on 29<sup>th</sup> August 2011) – see rows 3 and 4 in Table 1. Of course, notwithstanding a better potential to be

visible for being 300% wider than it was on the sunset of 29<sup>th</sup> August, the hilal will be in different side of the hemisphere from hilal observers in Jakarta. It was therefore physically impossible to see the hilal virtually from the whole Indonesian territory. However, at sunset in Santiago, Chile, the same hilal at that particular moment should have been easily visible at an altitude of 11.2 degrees and width of 0.34 minutes (see Figure 4).

Likewise, fifteen hours after the sunset of 29<sup>th</sup> August in Jakarta, the hilal will be at an altitude of 34.5<sup>o</sup> eastward of Jakarta's eastern local horizon with 0.58' wide. It was therefore almost 500% wider than hilal's width when the sun set on 29<sup>th</sup> August. At that time, in San Diego (California), the sun set at 18:18 on 29<sup>th</sup> August local time. Being 15 hours ahead of San Diego, Jakarta's local time was actually 09:18 on 30<sup>th</sup> August 2011. Again, in spite of the fact that the hilal was 500% wider than it was at sunset of 29<sup>th</sup> August in Jakarta, the hilal was not visible either due to the strong intensity of the sunlight at 09:18. Time synchronization between Santiago, San Diego and Jakarta including the characteristics of the hilal is summarized in Table 2.



**Figure 4: Characteristics of hilal in Santiago, Chile and San Diego, CA on the sunsets of 29<sup>th</sup> August 2011 local times**

It is therefore obvious that visibility is a rather vague prerequisite in light of the fact that since the separation between the sun and the moon following conjunction, the hilal is actually growing wider and wider, regardless whether or not it is visible to human eyes. This confirms the Prophet's hadith in saying that visibility prerequisites are only compatible with unlettered people like his companions during his time. For people living in modern age like us, rather than spreading hundreds of people to 90 different locations randomly, the Indonesian authority should have sent just several moonsighting teams to Santiago and San Diego. With the advent of telecommunication system, the team will then be able to send an email or short message to the authority in Jakarta who will then be able to order Indonesian Muslims to refrain from fasting on the 30<sup>th</sup> August. Either way however, the maximum duration of the Islamic calendar will be exactly one month because it has to be verified by moonsighting technique. This confirms that a prerequisite to physically see the crescent will never produce a reliable Islamic calendar.

Cities in American Continent	Local Date	Sunset (LT)	Moons et (LT)	Hilal Characteristics	Jakarta 30/08/2011
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				Altitude ( <sup>o</sup> West)	Width ( <sup>o</sup> )	Local Time	Hilal Altitude ( <sup>o</sup> East)
<b>Santiago, Chile</b>	29/08/1 1	18:14	19:19	+11.2	0.34	04:24	-37.7
<b>San Diego, CA</b>	29/08/1 1	18:18	18:30	+2.6	0.51	09:18	+34.5

**Table 2: Characteristics of hilal in Santiago, Chile and San Diego, CA on the sunsets of 29<sup>th</sup> August 2011 local times and corresponding characteristics in Jakarta**

This paper comes along with a dynamic animation program of the formation of the moon-phase for different geographical positions of an observer on the surface of the earth. The above technical explanation of hilal's visibility can be graphically rendered using the software. The program and its brief user guide are downloadable free of charge.

#### 4.1.2 The white days as benchmark

In addition to the above analysis, Muslim clerics should also look closer to sophisticated astronomical message of hadith about *ayyami al-biydh* (the white days). The hadith encourages Muslims fast on the 13<sup>th</sup>, 14<sup>th</sup>, and 15<sup>th</sup> days of any Islamic month unless otherwise prohibited. It is quite interesting that this hadith quite specifically mentions about dates and the associated astronomical prerequisites, and therefore Muslims should be able to use them as important benchmarks in constructing an Islamic calendar. Apparently, these three days are termed as *white days* because people in certain parts of the globe will not experience the darkness of the night because momentarily before the sun sets in the western horizon, the full moons of the 13<sup>th</sup>, 14<sup>th</sup>, and 15<sup>th</sup> days will rise in the eastern horizon. As such, the portion of the hemisphere will be bright all the way through. Therefore, this hadith should have conveyed a very sophisticated astronomical message.

Table 3 lists the sunset and moonrise timings between 29 August and 14 September 2011. The table accurately demonstrates the behavior of the sun and the moon that is consistent with the white-days philosophy of the above hadith. If one takes a closer look into the highlighted rows in the table, he/she should be able confirm that in these three consecutive days, the moon rises before the sun sets, and that is exactly the conveyance of astronomical message of the hadith regarding *the white days* (*ayyami al-biydh*). Should the first day of Syawwal be coincident with the timing of the sunset on 30<sup>th</sup> August, the 15<sup>th</sup> day of Syawwal would fall on the 13<sup>th</sup> September 2011. However, the table shows that on that day, the full moon rose at 6:28PM, whilst the sun already set at 5:51PM. This 37-minutes time lag will keep the hemisphere surrounding Jakarta being in the dark period for at least 27 minutes, and therefore 13<sup>th</sup> September was not one of the white-days as indicated by the hadith. In other words, the white-days are actually the 10<sup>th</sup>, 11<sup>th</sup>, and 12<sup>th</sup> September (see the highlighted part of the table). Therefore, one should easily backwardly calculate and conclude that the first day of Syawwal should have been coincident with the 29<sup>th</sup> day of August (sunset), and therefore, Iedul Fitri prayer should be performed on 30<sup>th</sup> September 2011.

Gregorian Date	Syawwal (at sunset)	Sunset (LT)	Moonrise (LT)
29/08/2011	1	5:53:00 PM	5:41:00 AM
30/08/2011	2	5:53:00 PM	6:31:00 AM
31/08/2011	3	5:53:00 PM	7:22:00 AM
01/09/2011	4	5:53:00 PM	8:13:00 AM
2/9/2011	5	5:53:00 PM	9:07:00 AM
3/9/2011	6	5:53:00 PM	10:02:00 AM
4/9/2011	7	5:52:00 PM	10:59:00 AM

5/9/2011	8	5:52:00 PM	11:56:00 AM
6/9/2011	9	5:52:00 PM	12:53:00 PM
7/9/2011	10	5:52:00 PM	1:47:00 PM
8/9/2011	11	5:52:00 PM	2:39:00 PM
9/9/2011	12	5:52:00 PM	3:28:00 PM
<b>10/9/2011</b>	<b>13</b>	<b>5:51:00 PM</b>	<b>4:15:00 PM</b>
<b>11/9/2011</b>	<b>14</b>	<b>5:51:00 PM</b>	<b>5:00:00 PM</b>
<b>12/9/2011</b>	<b>15</b>	<b>5:51:00 PM</b>	<b>5:44:00 PM</b>
13/9/2011	16	5:51:00 PM	6:28:00 PM
14/9/2011	17	5:51:00 PM	7:12:00 PM

**Table 3: The sun and the moon characteristics between 29/8/2011 and 14/9/2011**

### **5 Zakat payment loss in the current accounting system**

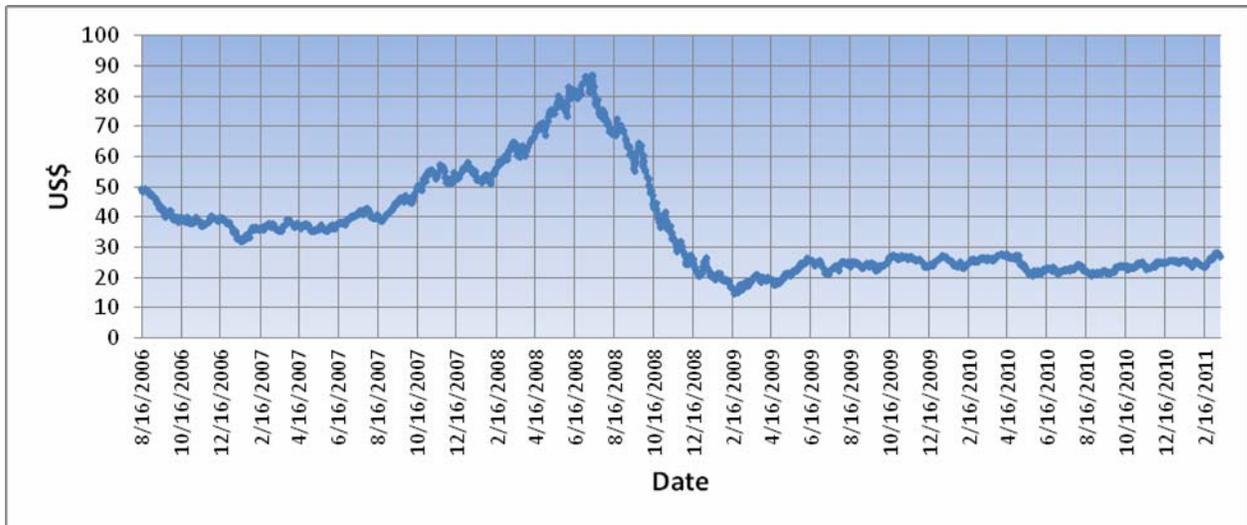
In order to be able significantly show the deficit in the zakat payment due to the use of the Gregorian calendar one needs financial statements of any Muslim business for a long period of time (at least ten consecutive years) as the annual difference is only 11.53 days (about 3.15%). Unfortunately, such data is not available. Although some of the abovementioned Islamic banks (see **3 Effect of neglecting the Islamic calendar**) provide their financial statements; however, their annual financial statements are just too coarse. To develop a robust estimation model, finer data series such as monthly financial statements should be used. For these reasons, three simulated possession of assets from an open capital market for other research project are used (Saksono, 2011), and is given in Table 4.

ASSETS	VOLUME	PERIOD OF OWNERSHIP	
		From - to	months
General Electric	10 million shares	5/1/2000 - 16/6/2009	115
Gold	1,000,000 ounces	2/1/1990 - 5/6/2009	236
Crude oil	10 million barrels	16/8/2006 - 24/2/2011	55

**Table 4: List of assets used for simulating zakat payment loss in the current accounting system**

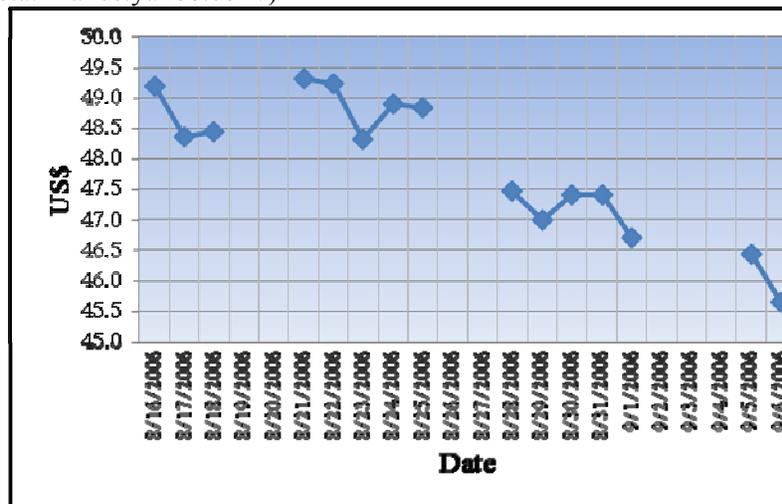
#### **5.1 The development of a robust estimation model**

Stock price data is very volatile in nature. Its fluctuation is shown in the history of crude oil prices for five consecutive years from 2006 to 2011 as shown in Figure 5. Several preliminary investigations show that a local modeling within a limited local window is far more advantageous than the global modeling for the whole data in Figure 5. Breaking down the estimation process into local window will only give consequences that the assessment of the zakatable assets is carried out on a monthly basis. Accordingly, the zakat is then calculated proportionally on a monthly basis too. In addition, a robust modeling for such a volatile data can be decomposed into two stages in lower and higher frequency domain (Saksono, 2011). The first stage modeling takes care of astronomical transformation from the solar to lunar calendar systems (Odeh, 2010). One of the results in one particular window is given in Table 5 (see the highlighted row wherein one needs to conduct the estimation). The corresponding plot of the data in Table 5 shows the fluctuated data within the window of fifteen observations.



**Figure 5: History of crude oil price between 18 August 2006 and 11 March 2011**  
 (source: Yahoo Finance <http://beta.finance.yahoo.com/>)

DATE	MARKET PRICE (US\$)
8/16/2006	49.19
8/17/2006	48.36
8/18/2006	48.44
8/19/2006	
8/20/2006	
8/21/2006	49.32
8/22/2006	49.23
8/23/2006	48.33
8/24/2006	48.90
8/25/2006	48.84
<b>8/26/2006</b>	<b>1 Sya'ban 1427</b>
8/27/2006	
8/28/2006	47.48
8/29/2006	46.99
8/30/2006	47.42



8/31/2006	47.41
9/1/2006	46.70
9/2/2006	
9/3/2006	
9/4/2006	
9/5/2006	46.44
9/6/2006	45.64

**Table 5: Transformation result from the Gregorian to Islamic calendars (left)**

**Figure 6: Graphical plot of data in Table 5 (right)**

**5.2 Estimation model in the higher frequency domain**

Transaction in the capital market is carried out during the working days, and there is no transaction during weekend or public holidays. The highlighted row in Table 5 shows the need for an estimated price at a particular date as there is no transaction on those days. In order to mathematically model the volatile data in Figure 6, a higher degree polynomial has proved to be a versatile model (Saksono, 2011). A brief technical description of the model is given herewith.

$$y_i = p_0 + p_1x_i + p_2x_i^2 + p_3x_i^3 + \dots + p_nx_i^n \quad (1)$$

Where:

$y_i$  = stock price at  $i^{\text{th}}$  day;

$x_i$  =  $i^{\text{th}}$  transaction day;

$p_0, p_1, \dots, p_n$  = unknown parameters of the polynomial to be determined.

Least square principles allow the introduction of small random error  $v_i$  in  $y_i$ . They are then rewritten in a matrix form:

$$v + y = Ap \quad (2)$$

or

$$v = Ap - y \quad (3)$$

Where:

$v$  = a vector of residual error of the observation (stock price);

$A$  = a coefficient matrix (design matrix);

$p_{l(l=0,n)}$  = a vector of parameters of  $n^{\text{th}}$  degree of the polynomial to be determined;

$y_{j(j=1,i)}$  = a vector of recorded (observed) stock price.

Under Null Hypothesis ( $H_0$ ), the distributions of  $\hat{p}$ ,  $v$  and  $y$  are defined as:

$$\hat{p} \sim N(p, \sigma_0^2 Q_{pp}) \quad \hat{p} \text{ is normally distributed with expected value } p \text{ and precision } \sigma_0^2 Q_{pp}, \text{ and } Q_{pp} = (A^T P A)^{-1}. q_{pp} \text{ is the corresponding diagonal element of the variance-covariance matrix of } p, \text{ and } \sigma_0^2 \text{ is the a-priori variance.} \quad (4-a)$$

$$v \sim N(0, \sigma_0^2 Q_{vv}) \quad v \text{ is normally distributed with expected value 0 (zero) and precision } \sigma_0^2 Q_{vv}. q_{vv} \text{ is the corresponding diagonal element of the variance-covariance matrix of } v. \quad (4-b)$$

$$y \sim N(Ap, \sigma_0^2 W^{-1}) \quad y \text{ is normally distributed with expected value } Ap \text{ and precision } \sigma_0^2 W^{-1}. W \text{ is the weight matrix that is, for practical reason, kept as an identity matrix.} \quad (4-c)$$

Least square principles require that the sum of the squared residuals  $v_i$  be constrained minimum. This leads to the construction of a normal equation for the solution of the estimated parameters  $\hat{p}_i$  and the precision estimate of the estimation model with respect to the observed data.

$$p = (A^T A)^{-1} A^T y \quad (5)$$

In simpler form, one writes the above normal equation as:

$$p = N^{-1}K \quad (6)$$

Substituting back  $p$  from (5) to (3) will yield  $v$ . The standard deviation ( $\sigma$ ) is an important statistical measure to express how good one's estimate is. It is defined as:

$$\sigma = \sqrt{\frac{\sum_{j=1}^i v_j^2}{\{i - (n + 1)\}}} \quad (7)$$

For three data sets used in the research, the standardized  $\sigma$  obtained is about 0.50% of the average stock price in a window. Therefore, it is only about US\$ 0.50 for an average stock price of US\$ 100 (Saksono, 2011). It is of strong belief that such accuracy is an optimum that an analytical model can achieve.

## 6 Results

By applying the developed robust estimation model as explain in the previous sections, three assets as listed in Table 4 are used to calculate the potential of zakat deficit (i.e. the difference between payable zakat of two calendar systems). When transaction is available on dates required to estimate the assets and its corresponding zakat, the assets is calculated based on that market value. Only if there is no transaction on the dates whereby assets estimation is required, then the above estimation algorithm is applied. Payable zakat is calculated proportionally on a monthly basis based on 2.5% prescribed annual zakat for Muslims in two accounting systems (i.e. the Gregorian and Islamic calendars). The results are listed in Table 6.

Empirical study using the collective possession of assets as shown in Table 6 consistently confirms three important findings:

1. If Muslims are using the Gregorian calendar as the basis of its accounting system, the potential of zakat payment loss is quite huge. That is in the order of US\$ 9 million, or it is equivalent to some 2.727% of the asset value;
2. This robust calculation rectifies that a rough estimate of the zakat payment at 2.577% of the assets value as suggested by (Isa, 2005) still preserves miscalculation in the zakat calculation;
3. This robust calculation is required in order to accurately model the fluctuated price especially for the asset value owned through stock market.

ASSETS	VOLUME	PERIOD		ZAKAT (Gregorian calendar US\$)	ZAKAT (Islamic calendar US\$)	Zakat deficit (US\$)
		From - to	months			
General Electric	10 million shares	5/Jan/2000 - 16/Jun/2009	115	81,583,329	83,968,940	2,385,611
Gold	1,000,000 ounces	2/Jan/1990 - 5/Jun/2009	236	206,622,239	212,048,171	5,425,932
Crude oil	10 million barrels	16/Aug/2006 - 24/Feb/2011	55	41,781,151	42,970,881	1,189,730
<b>TOTAL:</b>				329, 986,719	338,987,992	9,001,273

**Table 6: Total zakat deficit of three assets available from open market**

Subject to availability of a proper financial statement, the estimation model can be applied to rectify the potential loss of zakat payment of any Muslim business that inadvertently prepared the financial statements based on the Gregorian calendar.

## 7 Conclusions

The study shows that it is imperative that Muslims construct a reliable Islamic calendar even for a hundred years to come, and use it as the basis of Islamic business including shariah banking.

Failure in so doing will only put Muslims further deep in the Dark Age without Islamic calendar, which consequently put us in more serious civilization debt. This will only be possible if Muslims accept astronomical calculation as the sole technique to construct the Islamic calendar with the *ayyami al-biydh* philosophy used as a versatile astronomical benchmark in the construction of a reliable Islamic calendar. Only then Muslims will have a flawless Islamic economy system that is based on the shariah compliant accounting system. Meanwhile, moonsighting technique will only provide an Islamic calendar with limited duration of one month. Muslim jurists should be able to oversee the future Muslim generations that will burden the snowballing effect of the civilization debt because we use the Gregorian calendar as the basis of our accounting system.

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