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Preliminaries to an Investigation of Reduced Product Set Finance

J.A. Bergstra and C.A. Middelburg
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Introduction

This note is motivated by the paper of J.A. Bergstra and C.A. Middelburg: "Preliminaries to an Investigation of Reduced Product Set Finance," published in this volume of *KAU Journal of Islamic Economics.* I shall first summarize the main arguments of the authors then present some comments and suggestions.

The authors argue that Islamic finance can be presented as conventional finance restricted by prohibition of interest and *gharar,* along with a few other restrictions. Accordingly, financial products can be constructed by synthesis from a few primitive financial transactions. The authors call this kind of design "reduced product set finance," and note that this design as such is appealing regardless of the ethical motivations behind it.

Based on this view the authors claim that product synthesis can be performed by means of techniques developed in computer science. A contract can be compared with control code or an instruction sequence. Multiple contracts with different agents can be captured by multi-threading for which the authors have developed some formalization.

The authors accordingly raise some important questions:

- What are the valid principles of product synthesis?
- Can judgment about legality of financial products be automated?
- Is it possible to design a large space of potential products closed under certain principles of synthesis that contain both legal and illegal products?

The authors note that the possibility of synthesizing a loan with interest (or a saving account, which is also a loan, with interest) from a set of legitimate financial products raises important issues. They ask whether it is possible to design a reduced set of products that can be proven to prevent the synthesis of a loan with interest? The authors conclude that investigation of these issues is feasible, but the outcome is open.

Overall, the paper opens new frontiers, raises interesting questions, and suggests potentially promising applications of computer science in financial contracting. Below are some comments that hopefully improve the likelihood of achieving these objectives.

Discussion

Islamic vs. Conventional Finance

The authors argue that Islamic finance is a subset of conventional finance. This is difficult to accept if by "conventional finance" we mean what conventional banks do: mainly lending and borrowing. Only in theory conventional finance can be considered as unrestricted set of transactions. In reality, however, it is very narrow and limited in scope.

A main principle of *Shari'ah* is the principle of permissibility: all transactions are acceptable unless otherwise stated by *Shari'ah*. This means that all conceivable transactions are permissible unless they involve *riba* or other restricted transactions. But for a conventional bank, it is the other way around: *only* money for money transactions are involved. Thus we can restate the relationship between the two systems more accurately as follows: Islamic finance is the set of all possible transactions excluding the set of conventional (i.e. *riba* based) finance. From this perspective, it is conventional finance that is a reduced set relative to Islamic finance.

The authors' argument can be valid by comparing Islamic finance with the set of *all* possible transactions. Starting from the set of all possible transactions, *Shari'ah* restrictions produce Islamic finance. In this sense, Islamic finance can be described as a reduced set of finance.

Role of Restrictions

The authors rightly point out that restrictions might actually make the system better off:

> So rather than asking what is lost by the prohibition of interest, one may ask what is gained by permitting interest from a situation where it is not being used. In other words, a reduced product set finance may lead to an effective system for which the addition of some feature may be less advantageous than expected by those who take the feature for granted. (p. 10.)

While this seems against mainstream thinking in economics, it is well known that various forms of constrains are necessary for optimal behavior. For dynamic decision-making, inter-temporal budget constraint (IBC) is necessary to avoid explosion of debt or Ponzi financing. This constraint can be viewed as a reflection of prohibition of usury or *riba*, since the IBC restricts borrowing to available resources, which is the essence of Islamic restrictions of financial transactions (Al-Suwailem, 2008).

The point the authors make in the following paragraph is particularly insightful:

> Moreover, obtaining an advantage from imposing design space restrictions is a phenomenon known from computing. In computer architecture, the limitation of instruction sets has been a significant help for developing faster machines using RISC (Reduced Instruction Set Computing) architectures. Fast programming, as opposed to fast execution of programs, is often done by means of scripting languages which lack the expressive power of full-blown program notations. Replacing predicate logic by propositional calculus has made many formalizations decidable and for that reason implementable and the resulting computational complexity has been proved to be manageable in practice on many occasions. New banking regulations in conventional finance resulting from the financial crisis of 2008/2009 have similar characteristics. By making the financial system less expressive, it may become more stable and on the long run more effective. Indeed, it seems to be intrinsic to conventional finance that seemingly artificial restrictions are a necessity for its proper functioning. The development of these restrictions is propelled by the drastic innovations of the financial industry rather than by ethical constraints of a principled kind. (p. 5.)

This topic is worth further exploration and analysis. The work of Arora et al. (2010) might lend additional support to this argument.

Principles of Synthesis

The fact that legitimate (sale) transactions can be combined in a manner to produce a loan with interest has been known since the time of the Prophet (peace be upon him). The *hadith* prohibiting *einah* clearly shows that *Shari'ah* does not allow for such synthesis. However, some scholars were unaware of this *hadith* and thus did not explicitly prohibit *einah*.

In addition, the Prophet prohibited combining "two sales in one" and combining "sale and loan." Scholars understood that these combinations are mostly used to circumvent prohibition of *riba* or other restrictions.

Furthermore, the Prophet prohibited making "profits without being liable" of the underlying object (good or service). This means that if person *A* buys a good *g* from *B* and then sells it to *C* for a profit, i.e. a higher price, then *A* must be bear risks associated with *g*. Without bearing these risks, the two transactions transform into paying a price *p* to *B* then collecting *p+r* from *C*. Effectively, it becomes a *riba* transaction from *A*'s perspective: money for more money without bearing the ownership risk of the good in between.

The more we examine and study Islamic rules of exchange, the more we find a consistent and complete set of legitimate transactions serving the objectives of Islamic economics.

Overall, the authors open new frontiers in Islamic finance (and finance in general) by suggesting a computer-science framework for modeling contracting and financial transactions. But it seems that the authors went too far in specifying the attributes of transactions. It seems that modeling could be done in a much simpler manner.

Coding Islamic Financial Products

It is probably feasible to design a formal system (e.g. Hofstadter, 1999) representing economic and financial transactions. *Shari'ah* requirements then can be imposed on the system. The behavior of the system with and without these requirements can be analyzed. But the design of the system is built with *Shari'ah* rules in mind in advance.

Once a system is in place, statements (theorems) can be systematically generated. In this system, a theorem is simply a financial product, so there will

be a systematic way to generate new products. We can then use rules of *Shari'ah* to evaluate the acceptability of such products. Building such a formal system requires a team of experts from several disciplines. The discussion below can be considered as a "brain storming," immature start for this worthwhile project.

Exchange

Consider a spot transaction, i.e. trading a quantity of a certain good *g* by agent *A* for a quantity of money *m* by *B*. We can write this as:

A	*B*
$g_t^0 \rightleftharpoons m_t^0$	

The term g_t^0 means a certain quantity of a physically specified good (as indicated by the superscript zero) delivered at time *t*, i.e. spot. The same is true for money *m*. The symbol $\rightleftharpoons$ is indicates exchange, i.e. each counter-value is transferred to the other party. Alternatively, we may write the exchange as:

$$A(g_t^0) \rightleftharpoons B(m_t^0)$$

This means that *A* agrees to exchange *g* for price *m* from *B*. In general, $A(g)$ indicates that *A* is legally responsible for the delivery of *g*, and the same is true for *B* with respect to *m*. We may simply write the exchange as $g_t^0 \rightleftharpoons m_t^0$ whenever it is obvious that the first party (left) is *A* and the second is *B*.

Salam

A *salam* contract can be modeled as:

A	*B*
$g_{t+n} \rightleftharpoons$	m_t^0

In this contract the good is to be delivered in the future ($t+n$) and thus is not physically specified at the time of the contract, hence no superscript appears. (The difference between g_t^0 and g_t is similar to the difference between an object and a class in object-oriented programming, so g_t^0 is an instant of g_t.)

The distinction between g_t^0 and g_t is important, since exchange of a physically specified good at a future date, g_{t+n}^0, is not acceptable in *Shari'ah*. A good delivered in the (distant) future must be physically unspecified to give the seller sufficient room of flexibility to choose a suitable instant to fulfill his or her obligation.

Credit Sale

A credit sale can be modeled as:

A	B
g_t^0	$\rightleftharpoons$ m_{t+n}

If the price is to be paid in installments, we can write the price as $\Sigma_1^n m_{t+i}$.

Leasing or *Ijarah*

A leasing contract is to exchange a utility of a certain good, $s(g)$. Hence we write:

A	B
$s_t(g_t^0)$	$\rightleftharpoons$ m_t

Agent *A* is the lessor while *B* is the lessee. We assume that g is durable. To distinguish durable from perishable goods, we may indicate the latter with a dot: $\dot{g}$.

If the lease contract is for several periods, and the rent is paid at each period, then we can write:

$$A(\Sigma_0^n s_{t+i}(g_t^0)) \rightleftharpoons B(\Sigma_0^n m_{t+i}).$$

If the good is not physically specified at the time of the contract, it becomes a future obligation on *A*. So we write:

$$A(s_{t+n}(g_{t+n})) \rightleftharpoons B(m_t^0).$$

This is called *ijarah fi themmah* or forward lease. This is not to be confused with "subsequent lease" or "*ijarah mudhafah*". In the latter contract, we have:

$$A(s_{t+n}(g_t^0)) \rightleftharpoons B(m_t^0).$$

That is, a tangible asset physically specified at t is to be leased starting from $t+n$, although the contract is signed at t. The difference between forward lease and subsequent lease is that, in the latter case, the asset is physically specified at contract time. Thus, if for any reason the asset g does not survive until $t+n$, the contract is nullified. In forward lease, the asset itself is a future obligation upon *A*. Further, given that the future good is a debt obligation upon *A*, the price or rent must be paid in advance to avoid having an exchange of "debt for debt", which is prohibited by *Shri'ah*.

Labor contract

A labor contract can be written as:

$$A(w_t^0) \rightleftharpoons B(m_t^0),$$

where *w* indicates work done by *A*. If work is done over several periods but price is paid in the first period, then we have:

$$A(\Sigma_0^n w_{t+i}^0) \rightleftharpoons B(m_t^0).$$

If work is unspecified (i.e. without the superscript 0), this means that *A* does not have to do the work by himself; rather, he can hire anyone to perform the required work. Hence we have:

$$A(w_{t+n}) \rightleftharpoons B(m_t^0).$$

It becomes a future obligation on *A*.

Conditionality

So far we presented different objects (*g*, *s*, *w*) to be exchanged for money *m*. Each can be physically specified or a future obligation. We need to extend the structure to include conditions.

For example, we assumed that a future obligation to deliver a good is a debt obligation. As we shall see, not all future obligations are debt obligations. To make it explicit, we may write it as: $A(g_{t+n} \mid L)$. *L* indicates that agent *A* is fully liable to deliver *g* at *t+n*, i.e. the obligation to deliver is fully guaranteed by *A*.

Collateral and Guarantee

If there is collateral, we can write it as: $A(g_{t+n} \mid L(z))$, where *z* is collateral. If instead *A* presents a guarantee by agent *C* to deliver *g*, we can write: $A(g_{t+n} \mid L(C(g_{t+n})))$. For simplicity, however, we assume that any future obligation is a debt obligation unless otherwise specified.

Istisna

A different kind of future obligation is present in *istisna*. In *istisna* contract, a good is manufactured by *A* and delivered at a future date. Hence we write:

$$A(g_{t+n} \mid w_t^0) \rightleftharpoons B(m_{t+n}).$$

The term $A(g_{t+n} \mid w_t^0)$ indicates a good to be delivered at $t+n$ produced by work w done by A. Agent A is using material h to produce the good, so we may write $(g_{t+n} \mid w_t^0(h))$, but we drop it for simplicity.

Note the difference between *istisna* and *salam*: it is the conditioning of future good on work. Without this condition, it effectively becomes a *salam* contract, in which the price must be paid in advance and not to be delayed, to avoid exchange of "debt for debt."

Sale of *Salam* Debt

After a *salam* contract is concluded, the buyer has a claim on a future good to be delivered by A. Hence we represent the position of B after concluding the contract as: $B(g_{t+n} \mid A(g_{t+n}))$. That is, B is entitled to g conditional on A fulfilling his obligation of delivering the same future good. If B wants to resell the *salam* future good, we have:

$$B(g_{t+n} \mid A(g_{t+n})) \rightleftharpoons C(m_t^0).$$

Since A is effectively is the one responsible for delivery of g, it becomes a kind of selling something without being responsible for it. The majority of scholars do not allow this exchange because B does not possess g and is not liable for it; rather, it is A who is liable for it. They all agree, however, that if the price is not spot, it becomes an exchange of "debt for debt" which is unanimously prohibited.

A related transaction takes place if B purchases a physically specified g from A but resells it before possessing it, and thus before becoming fully liable for it. Hence we have two transactions:

$$A(g_t^0) \rightleftharpoons B(m_t^0),$$

$$B(g_t^0 \mid A(g_t^0)) \rightleftharpoons C(\hat{m}_t^0).$$

That is, B sells a good g that is still in the possession of A and thus A is the one responsible for its delivery. Again, the majority of scholars will not allow this transaction because it "sale before possession" that is not allowed by *Shari'ah*. Some scholars would allow such transactions only on non-profit basis, i.e. B is not allowed to sell g for a price higher than the purchase price, so that $m_t^0 \leq \hat{m}_t^0$.

Options or Khiyar

A *khiyar* is the right to cancel the contract and reverse the exchange. We present it as follows:

$$A(g_t^0) \overset{A}{\longleftrightarrow} B(m_t^0)$$

This means that the transaction is reversible with the permission of *A*. Alternatively, we may write an exchange in a compact form. An exchange $A(g_t^0) \rightleftharpoons B(m_t^0)$ can be written as $E(A(g_t^0), B(m_t^0))$, or even more compactly as $E(g_t^0, m_t^0)$, whereby it is understood that the first argument is the counter-value of *A*, while the second is that of *B*. Now a contract with the right to cancel or *khiyar* by *A* can be written as:

$$E(g_t^0, m_t^0 \,|\, A).$$

That is, the exchange is conditional on *A*'s approval. If the option lasts until *t+n*, we can write:

$$E(g_t^0, m_t^0 \,|_{t+n}\, A).$$

In general, therefore, we can use conditionality for contracts just we use them for counter-values. We shall see later how this would make product coding much more dynamic and innovative.

<u>*Mudhrabah*</u>

In a *mudharabah* contract, *B* provides money capital m_t^0 to *A*, who manages it to produce profits, which will be shared on an agreed upon ratio. Let profits be $\pi = m_{t+n} - m_t^0$, where m_{t+n} is realized revenues at *t+n*, and let the manager's (or *mudharib*'s) share of profits be θ, which is a positive fraction for positive profits, and zero otherwise. Then the contract can be written as:

$$A(w_t^0) \rightleftharpoons B(\theta\pi \,|\, A(w_t^0)).$$

The agent *A* exchanges labor services for a share of profits generated by his work. If profits are negative, then *A* does not share the losses. Crop-sharing or *muzara'ah* can be written in a similar fashion.

<u>*Ja'alah*</u>

Ja'alah is a conditional labor contract: If *A* succeeds or achieves the desired outcome, he is rewarded a certain amount of money; else he gets nothing. For example, if *A* is an oil company and is hired to explore oil in a given land, then if it finds oil it is rewarded *m*; else it is rewarded nothing. Hence we can write:

$$A(w_t^0) \rightleftharpoons B(m_{t+1} \,|\, \lambda(A(w_t^0)) = 1),$$

where *w* indicates exploration for oil by *A*, $\lambda = 1$ indicates success if oil is found, $\lambda = 0$ indicates failure if not. Note that λ is a function of *w*, so payoff is dependent on *A*'s efforts.

Gharar

The most obvious form of *gharar* is gambling. Gambling is a zero-sum game whereby *A* wins only if *B* loses, and vice versa. As an example, consider the case in which *A* pays *B* an amount of money *m*, in return for a higher reward, say *m*+*r*, if another tsunami hits Japan within a certain period, or zero otherwise. Hence we have:

$$A(m_t) \rightleftharpoons \{B(m_{t+n} + r_{t+n}) \text{ if } j = 1; 0 \text{ if } j = 0\}$$

where *j*=1 indicates that a tsunami hits Japan, or else *j*=0. So if *j*=1, *A* wins *r* at the expense of *B*. If *j*=0, *B* wins *m* at the expense of *A*. The transaction therefore decomposes into two mutually exclusive transactions:

1. If *j*=1 $A \leftarrow B(r)$
2. If *j*=0 $A(m) \rightarrow B$

In either case, one gains while the other loses. This is not the case in *ja'alah*, for example, or any other legitimate transaction. *Ja'alah* decomposes into two transactions:

1. If $\lambda = 1$ $A(w_t^0) \rightleftharpoons B(m_{t+1})$
2. If $\lambda = 0$ $A(w_t^0) \rightarrow B$

Hence only if $\lambda = 0$ that *B* might possibly win at the expense of *A*. This is a possibility because not any type of work by *A* would be a gain for *B*. But even if this is the case, as long as success is more likely, and it is the objective of the transaction, so the payoff in case of success is preferable to both parties, then the failure case is considered as "minor *gharar*" or tolerated *gharar*. If however failure is more likely, or is more preferable by the winner, then it cannot be tolerated, and thus it becomes "excessive *gharar*" (Al-Suwailem, 2006).

Einah

Einah is a combination of credit and spot sales to reproduce or synthesize a loan with interest. It is a good application of the equation-nature of exchange. Consider the following transactions:

	A	*B*
1. Credit sale	$g_t^0 \rightleftharpoons \hat{m}_{t+n}$	
2. Spot sale	$m_t^0 \rightleftharpoons g_t^0$	
Total	$m_t^0 + g_t^0 \rightleftharpoons \hat{m}_{t+n} + g_t^0$	
Net	$m_t^0 \rightleftharpoons \hat{m}_{t+n}$	

In the first transaction, *A* sells a spot good to *B* for a deferred price $\hat{m}_{t+n}$. Then, since *B* now owns the good *g*, *B* sells the good to *A* for spot price $m_t^0 < \hat{m}_{t+n}$. Combining the two transactions, and cancelling *g* since it appears on both sides, we end up with money now for more money later, which is a loan with interest. The majority of scholars prohibit *einah* even if the two transactions are not explicitly conditioned on each other.

Mudd Ajwa

Another application of the equation-nature of exchange is called *mudd ajwa*. This applies when we have money on both sides of the exchange, but with a good on one side, all spot:

$$m_t^0 + g_t^0 \rightleftharpoons \hat{m}_t^0$$

We know from rules of *riba* that money for money of the same currency must be spot and equal. But if we have a good on one side, then we need to look at the amount of money on either side. *Mudd ajwa* rule simply states that the common quantity of money on either side must be cancelled. Then if we end up with a normal exchange it becomes acceptable, otherwise it is not.

Suppose that $\hat{m}_t^0 = m_t^0 + b,\ b > 0$. Then the net transaction becomes $g_t^0 \rightleftharpoons b$ which is a legitimate trade assuming *b* to be a reasonable price for *g*. If however, $m_t^0 = \hat{m}_t^0 + b$, we end up with $g_t^0 + b \to 0$ which is a win-lose outcome, thus not acceptable. If $m_t^0 = \hat{m}_t^0$ we still end up with a win-lose transaction. If we have two goods on the two sides, the net value of goods shall be equivalent to the net of money, or else it becomes a win-lose transaction.

Thus it is clear from this rule as well as from *einah* that exchanges are considered as types of equations, and this can be used to facilitate the evaluation of the validity of the transaction.

Contracts as Objects

A contract might be treated as an object or counter-value. For example, in reciprocal (interest-free) loans (*quroudh mutabadalah*), agent *A* lends *B* in currency *x* in exchange for *B* lending *A* in currency *y*. Or *A* might lend *B* now in exchange for *B* lending *A* for an equivalent period later on. Further, a sale transaction can be exchanged for a loan. For example, *A* might lend *B* an amount of money *m* in exchange for *B* buying (or selling) a good *g* from (or to) *A*. The objective of this exchange is to derive an implicit interest on the loan through the sale transaction. This is the combination of sale and loan prohibited by the Prophet (peace be upon him).

But not all combinations are questionable; only those that result in *riba* (money for money) or *gharar* (zero-sum game) that such combination will be objectionable. For example, *A* might sell a share (50% say) of a good or asset *g* to *B*, in exchange for a nominal price by *B* plus *B* marketing and selling the whole asset. The selling price will be shared after deducting the nominal price of *B*'s share. So we end up with an exchange of a credit sale for *mudharabah*. This formula has been approved by *Maliki* scholars, and it does not result in either *riba* or *gharar* (Al-Suwailem, 2006).

Treating contracts or products as objects opens an unlimited space for product innovation. Products can be exchanged just like objects, allowing for new and creative products, given that they do not violate rules of *Shari'ah.* It is hoped that, if the coding program is implemented properly, it would be a very supportive tool for Islamic product development.

Conclusion

There is great potential for representing Islamic financial products using symbolic and computer-science techniques. This will be very useful for product development and evaluation. I hope that the initiative by Bergstra and Middelburg can be further developed and enriched to achieve these objectives.

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