Can Islamic Banking Survive?
A Micro-evolutionary Perspective

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Abstract

Islamic banking is a growing phenomenon which came into existence to satisfy the financial needs of devout Muslims who observe the prohibition of interest-based transactions. Many economists have studied the macroeconomic properties of this institution in the framework of an isolated and ideal Islamic economy. In this age of integrated global financial markets, the instantaneous transformation of an entire financial sector to profit-and-loss sharing is very unlikely. I present an evolutionary game-theoretic model in which devout Muslims, regular interest-based banks, and "weak" (hybrid) muslims/banks interact. The third type of agents is intended to represent the behavior of current Islamic banking, which is commonly criticized for mimicking interest-based systems. It is shown in this model that a critical initial mass of the "weak" types is necessary for the survival of the devout agents in a heterogeneous environment. Moreover, it is shown that the survival of the devout agents is predicated on the islamically-"weak" agents acting among themselves in an Islamic way. When the islamically-"weak" agents act in an Islamic way among themselves, it is shown that their existence is necessary and sufficient for Islamic banking to survive!

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1 Introduction

The Twentieth Century has witnessed a resurgence in the observance of fundamental Islamic practices around the world. The Islamization of the financial sectors of many Muslim countries was a natural consequence of this resurgence, and the degree of Islamization varied dramatically across countries with Muslim populations. The Islamic Republic of Iran and Pakistan are at one extreme, where the entire financial sector has been made officially "Islamic".[1] Malaysia, Saudi Arabia, and some other Arab countries have developed a hybrid financial system where Islamic banks coexist with regular financial institutions, and both types of financial institutions are regulated by the monetary authorities of those countries.

This increase in the practice of Islamic banking transformed "Islamic Economics" from a sub-field of فقه (Islamic jurisprudence) and comparative systems into one which interacts positively with mainstream economic theory.[2] The large ensuing literature since the mid-1970s (significantly assisted by the inception of a number of journals devoted to the subject) has helped dispelling a number of the myths that surrounded the field in earlier decades. In particular, it is no longer held that by abolishing interest, Islam denies the legitimacy of time preference and/or rates of return for capital (see, for instance the papers in Khan (1995) on this issue).

Moreover, it has been noted by Khan (1986) that the abolition of interest-based transactions is not a subject alien to "western" economic thought. For instance, Fisher (1945), Simons (1948), Friedman (1969), and others, have argued that the current (one-sided liability) interest-based financial system is fundamentally unstable. This view was made more popular in recent years due to the epidemic of Savings and Loans bankruptcies in the U.S., as well as the financial crises in Latin America (instigated by the ambiguity of the financial positions held by banks seeking higher interest rates on foreign currency denominated bonds). Zarqa (1983), Khan (1986), and a number of papers that followed, have illustrated the macroeconomic stability of a profit and loss sharing (henceforth PLS) system, which would replace interest-based transactions in an Islamic economy.

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[1] See Bank-Markazi-Jomhouri-Islami-Iran (1983) and Pakistan (1984).

[2] The earliest well known source on Islamic economics is Ahmad (1952). For a recent survey of the major figures in the field of Islamic Economics, see Haneef (1995).

This paper attempts to add to the existing literature in two directions. First, I consider the stability of the institution of Islamic banking from a micro-economic point of view, where the survival of this institution depends on its ability to maintain sound financial positions for its customers (devout Muslims, and others). Second, I do not limit my attention – as has been the tradition in the literature – to an idealistic Islamic economy which is isolated from the rest of the world; i.e. where all interest-based transactions are impossible, (e.g. Naqvi (1982) and others). Instead, I present an evolutionary game-theoretic model of the dynamics of Islamic banking in the existence of other interest-based financial institutions. This model is a closer representation of the current situation, where Islamic banks operate in most countries (including the U.S.) side-by-side with traditional banking institutions.

At the micro-level, I replace the assumption of a population of homogeneous *homo-Islamicus* (Haneef (1995)) agents in the economy, with one comprised of three types of agents: (1) pious Muslims who never engage in interest-based transactions; (2) traditional banks and economic agents who lend and borrow with interest; and (3) economic agents who deal symmetrically with both the pious Muslims (in which case they have PLS transactions), as well as regular economic agents (in which case they have interest-based transactions). This last type will be labelled "weak" muslims to follow the Islamic economics literature which severely criticizes the behavior of Islamic banks which mimic interest. Perhaps the strongest condemnation in the literature is that in Ahmad (1992):

> "The sad reality is that though every one concedes that Islam prohibits interest, there is not a single Muslim country which is running its financial institutions without resorting to interest. The fact is that no one knows how to do it, and when political pressure mounts, they can only resort to some kind of subterfuge" (p.16)

Later, Ahmad (1992) criticizes the Islamic banks under subsections titled "And we claim, we have abolished interest!", and "Current posture of Islamic Economics":

> "It is not clear whom we are cheating..." (p.47)

> "The worst part of the story is that Islamic economists, as a body in their International Monetary and Fiscal Conference held in Islamabad in 1981, gave their unreserved approval to this arrangement. So far this is the best that Islamic economics has to offer, viz., change the name of interest and you have abolished interest". (p.48)

In the model I shall present, it will be shown, rather surprisingly, that it is exactly this type of economic agents that are needed in the interim to ensure the economic survival of pious Muslim agents. The assumptions of the model will be motivated by religious and theoretical considerations, as well as some empirical evidence. Though highly stylized, this dynamic microeconomic approach may serve as a seed for further theoretical and empirical investigations of the necessary transition from interest-based to PLS systems. Section 2 reviews the religious prohibition of interest in the قُرآن (the Muslim

Holy-Book, revealed to the Prophet Muhammad (pbuh)) and the حَدِيث (sayings of the Prophet (pbuh)), as well as the فقه (juridical) inferences and extensions based on those prohibitions. In Section 3, I will briefly discuss the major forms of economic transactions approved in Islam, and the extant empirical evidence on their implementation. In Section 4, I shall discuss some of the general theoretical assumptions of the model which are motivated by the religious, theoretical, and empirical findings. Section 5 presents the model and the analysis of its dynamics, and Section 6 concludes the paper.

2 The Islamic Prohibition of Interest

The prohibition in the قُرآن and the حَدِيث (sayings of the Prophet (pbuh)) refers to رِبَا. The etymology of the term رِبَا leads back to the arabic verb رَبَا (literally = "increase").[3] The official definition of رِبَا according to the consensus of the four major jurist schools is:[4]

> "Trading two goods of the same kind in different quantities, where the increase is not a *proper compensation*".

"زِيَادَة أَحَد الْبَدَلَين الْمُتَجَانِسَين مِن غَيرِ أَن يُقَابِل هَذِهِ الزِيَادَة عِوَض."

There are two main types of رِبَا recognized by all the scholars:[5]

1. رِبَا النَسِيئَه: (also sometimes called رِبَا القُرآن, the riba of the Qur'an). The etymology of the term نَسِيئَه refers to the verb نَسِيَ, which means to defer (also to forget). Therefore, this type of رِبَا refers to deferred payments in excess of the lent principal; i.e. recognizes a time-value for money. This type of رِبَا is strictly prohibited in the Qur'an, as will be discussed below, and it is considered one of the major sins (اَلكَبَائِر).

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2. الفَضل رِبَا: (also sometimes called رِبَا السُّنَّة, the riba of the Prophet's tradition). It is defined explicitly in a حَدِيث (saying) of the Prophet Muhammad (pbuh) prohibiting the (possibly simultaneous) trading of wheat for wheat, barley for barley, gold for gold, silver for silver, dates for dates, or salt for salt, in different quantities. It is a consensus amongst the jurists that those six commodities were given by the Prophet (pbuh) only as examples, and that the prohibition extends to all other goods.[6] Some modern scholars have been more lenient on this form of رِبَا since one of the early companions of the Prophet (pbuh), including the famous companion and scholar عَبدُ اللَّه إِبن عَبَّاس, allowed it (though they later abolished it). It is the consensus that this type of رِبَا is abolished since it justifies the more serious رِبَا النَّسِيئَه, and may lead to it.

The prohibition of رِبَا (interest or usury) in the Qur'an was not an innovation in what the Muslims view as the one true religion revealed by God through all the Prophets (pbut).[7] In the Old Testament (King James Version), we find:

Exodus, Chapter 22, verse 25:

If you lend money to any of my people that is poor by thee, thou shalt not be to him as an usurer, neither shalt thou lay upon him usury.

Also:

Leviticus, Chapter 25, verses 34-46:

And if thy brother be waxen poor, and fallen in decay with thee; then thou shalt relieve him: yea though he be a stranger, or a sojourner, that he may live with thee.

Take thou no usury of him, or increase: but fear thy God; that thy brother may live with thee.

Further, in the New Testament, we find:

Luke, Chapter 6, verses 34-35:

And if ye lend them of whom ye hope to receive, what thank have ye? for sinners also lend to sinners, to receive as much again.

But love ye your enemies, and do good, and lend, hoping for nothing again; and your reward shall be great, and ye shall be the children of the Highest: for He is kind unto the unthankful and to the evil.

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[6]   Technically, the Prophet (pbuh) has thus prohibited any بَيعَتَينِ فِي بَيعَة (two sales in one).

[7]   Muslims use the acronym (pbuh) following any mention of the Prophet Muhammad. It stands for "peace (from God) be upon him". When mentioning multiple Prophets, (pbut) stands for "peace be upon them".

It is not surprising in light of this clear prohibition of interest in Judaism and Christianity to learn that the first interest free bank in documented history was established prior to the life of Prophet Muhammad (pbuh). The first interest-free (Islamic?) bank *Agibi Bank* was established circa 700 B.C. in Babylonia, and functioned exclusively on an equity basis.[8]

It is important for the assumptions and objectives of our modeling technology in this paper to understand the manner in which the prohibition of رِبا was introduced and then established in a heterogeneous economic environment. The first verse in the Qur'an mentioning رِبا was revealed in Mecca, and it did not abolish the practice, but echoed the essence of the New Testament quote that it does not please God, and that true increase with God cannot be attained through interest (all translations of meaning here follow those of A. Yusuf Ali):

أَلرُّوم (30), verse 39:

وَ مَا آتَيْتُمْ مِن رِبًا لِيَرْبُوا فِي أَمْوَالِ النَّاسِ فَلَا يَرْبُوا عِندَ اللَّه

وَ مَا آتَيْتُمْ مِن زَكَاة تُرِيدُونَ وَجْهَ اللَّهِ فَأُولَئِكَ هُمُ الْمُضْعِفُون

That which ye lay out for increase [riba] through the property of (other) people will have no increase with God; but that which ye lay out for charity seeking the countenance of God (will increase): it is these who will get a recompense multiplied.

Then came the prohibition early in the Madinah, but it was ambiguous whether all interest was prohibited or only exorbitant and/or compounded interest:

آلِ عِمْرَان (3): verse 130

يَأَيُّهَا الَّذِينَ آمَنُوا لَا تَأْكُلُوا الرِّبَوا أَضْعَافًا مُضَاعَفَة وَ اتَّقُوا اللَّهَ لَعَلَّكُمْ تُفْلِحُون

O ye who believe! Devour not usury [ribA] doubled and multiplied [compounded?]; but fear God; that ye may (truly) prosper.

Then, among the very last verses revealed in the Qur'an, came the unequivocal and strong prohibition:

أَلْبَقَرَة (2): verses 275–279

الَّذِينَ يَأْكُلُونَ الرِّبَوا لَا يَقُومُونَ إِلَّا كَمَا يَقُومُ الَّذَى

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8   See Baron (1952).

يَتَخَبَّطُهُ الشَّيْطَانُ مِنَ المَسِّ ذَلِكَ بِأَنَّهُم قَالُوا إِنَّمَا

اَلبَيعُ مِثلُ الرِّبَوا، وَ أَحَلَّ اللَّهُ البَيعَ وَ حَرَّمَ الرِّبَوا،

فَمَن جَاءَهُ مَوعِظَةٌ مِن رَبِّهِ فَانتَهَى فَلَهُ مَا سَلَفَ وَ أَمرُهُ إِلَى

اَللَّهِ، وَ مَن عَادَ فَأُولَئِكَ أَصحَابُ النَّارِ هُم فِيهَا خَالِدُونَ.

Those who devour usury [riba] will not stand except as stands one whom the evil one by his touch hath drive to madness. That is because they say: "Trade is like usury [riba]". But God hath permitted trade and forbidden usury [riba]. Those who after receiving direction from their Lord desist shall be pardoned for the past; their case is for God (to judge); but those who repeat (the offense) are companions of the fire. They will abide therein (forever).

يَمحَقُ اللَّهُ الرِّبَوا وَ يُربِي الصَّدَقَاتِ وَ اللَّهُ لَا يُحِبُّ كُلَّ كَفَّارٍ أَثِيمٍ.

God will deprive usury of all blessing, and He will give increase for deeds of charity. For He loveth not creatures ungrateful and wicked.

يَأَيُّهَا الَّذِينَ آمَنُوا اتَّقُوا اللَّهَ وَ ذَرُوا مَا بَقِيَ مِنَ الرِّبُوا إِن كُنتُم مُؤمِنِينَ.

O ye who belive! Fear God, and give up what remains of your demand for usury [riba] if ye are indeed believers.

فَإِن لَم تَفعَلُوا فَأَذَنُوا بِحَربٍ مِنَ اللَّهِ وَ رَسُولِهِ وَ إِن

تُبتُم فَلَكُم رُؤُوسُ أَموَالِكُم، لَا تَظلِمُونَ وَ لَا تُظلَمُونَ.

If ye do not [give up riba], take notice of a war from God and His Apostle; but if ye turn back ye shall have your capital sums. Deal ye not unjustly, and ye shall not be dealt with unjustly.

From this gradual progression of the prohibition of رِبَا, and the explanations of the reasons behind its prohibition given in the above verses, we can learn a number of points:

1. Individuals, if left to themselves, will practice رِبَا. They will do so due to its similarity with other forms of profitable trade. In economic terms, as discussed below, total abandonment of interest is *not a Nash equilibrium*; it pays some individuals to deviate from this arrangement and borrow or lend at a fixed interest rate.

2. The prohibition is always accompanied by a statement that if all interest-payments were abandoned, it will be for the good of everyone. In economic terms, whether we interpret the improvement in people's condition in material or other terms, this tells us that the prohibition of interest will be *Pareto efficient*.

3. Indeed, one may argue, it is precisely in those situations (where it pays individuals to deviate, but mass deviation can lead to exploitation and other social and economic maladies), that religious prohibition is a viable and useful enforcement mechanism to achieve the Pareto efficient outcome.

4. An instantaneous transformation from رِبا based to PLS-based financing cannot be expected (or warranted?). The system needs to evolve from the current state to the desired one in a steady manner.

3 Islamically Admissible Financing Options

There are hundreds of financial instruments devised by Islamic banks and financial institutions to meet the diverse needs of investors and entrepreneurs. However, all of those instruments derive from six main methods of financing that are well documented in the juridical literature. Those arrangements are:

1. مُضَارَبَة, or silent partnership. Under this system, one party (the investor, or رَبّ الْمَال) provides the capital, and the other (the entrepreneur) provides his time and effort. Profits are shared according to a pre-negotiated rule, but financial losses are all born by the investor.

2. مُشَارَكَة, or partnership, is a standard corporation-like arrangement, where all losses and profits are shared according to pre-negotiated rules. Partners in a مُشَارَكَة have the right to co-manage all projects, unlike مُضَارَبَة, where the entrepreneur has sole control of the enterprise's management.

3. بَيْع الْمُرَابَحَة, also called بَيْع بِثَمَن آجِل, or sale against deferred payment. The sale price typically exceeds the spot price of the good by some fixed mark-up which is negotiated prior to the transaction.

4. إِجَارَه is a simple leasing arrangement, where - again - the payments by the lessee exceed the (change in the) price of the leased commodity by some negotiated mark-up.

5. بَيْع السَّلَم is an arrangement whereby a producer can get finances against the sale of a product (typically a crop) before its production, with the quantity and the price being pre-specified.

6. قَرْض حَسَن literally means "good (interest-free) loan", but in practice, a fixed service charge is added to the loan.

It is often noted that the first two arrangements in this list have a strict risk, profit, and loss sharing rule, whereas the other four can easily accommodate a hidden interest rate. Indeed, "Islamic banks" commonly use an "accounting interest rate" for book-keeping those transactions. It is this practice of "renaming interest" that is so strongly criticized by Ahmad (1992), as quoted in the introduction. Many Islamic banks attempt early in their operations to conduct مُشَارَكَة and مُضَارَبَة, but eventually converge to using

مُرَابَحَـة (MRBH), بَيع بِثَمَن آجِل (BBA), and leasing as the main modes of operation. Those practices are commonly favored due to the elimination of the risks of enterprise failure, moral hazard, and adverse selection.

One of the largest Islamic banks in the world is Bank Islam Malaysia Berhad (BIMB), which started operation under the Islamic Banking Act of 1983 in Malaysia (Bank-Negara-Malaysia (1994)). In 1983, 49.1% of the bank's outgoing funds went to BBA, 37.2% to MRBH, and 9.3% to leasing, leaving 4.4% for the less suspicious practices. By 1991, 73.7% of the bank's financing were devoted to BBA, 13.2% to MRBH, and 13% to leasing, leaving only 0.1% to the more acceptable مُشَارَكَة and مُضَارَبَة (see BIMB (1994), and Bank-Negara-Malaysia (1994)).

4   Assumptions of the Model

We take as fundamental the fact that interest rates payment and receipt are forbidden for all Muslims. Moreover, we recognize that the economy contains pious Muslims who never engage in any transactions involving interest payments, as well as regular economic agents and institutions which routinely pay and receive interest. This hybrid economic system is likely to continue for some time, and it would be idle philosophy to contemplate how a purely Muslim economy would perform without knowing whether such a system can be sustainable in the presence of interest paying and receiving agents and institutions.

A recently conducted survey of depositors of an Islamic bank (Abdel-Kader (1995)) showed that in addition to agents who never deal in interest and those who always do, there is a large contingency of agents who participate in both systems. In particular, she found that for the depositors of BIMB in 1991, 64% of depositors had accounts with other (interest paying) banks. Moreover, the transactions of Islamic banks are themselves not purely Islamic:

- Whereas demand deposits do not pay any interest, savings deposits which remain with the bank for a significant period (e.g. 12 months) are rewarded with a "gift", which typically has a high correlation with market interest rates, although they tend to be lower than the market rates (BIMB (1994), Bank-Negara-Malaysia (1994)).

- Most مُضَارَبَه arrangements carry in their contracts a clause that if the rate of return to the bank or investor is less than some percentage (usually written in the contract as an absolute monetary value of the "profit share"), the bank or investor has the

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right to audit the entrepreneur's operations. To avoid such an audit, entrepreneurs typically pay that threshold rate regardless of the actual profit or loss, which makes that rate functionally equivalent to an interest rate (Khan (1983)).

This empirical reality motivates our assumption that there are three types of economic agents in our evolutionary game model:

1. Pious people (denoted $P^\star$, for always using PLS financial instruments instead of interest-rate based instruments).

2. Regular banks and economic agents (denoted $I^\star$, for always choosing the interest-based instrument).

3. "Weak" muslims (denoted W), who interact symmetrically with all agents; i.e. when making a transaction with a $P^\star$ agent, they follow PLS rules; and when making a transaction with an $I^\star$ agent, they use the market interest rates. Those agents will be interpreted as an approximation to the current "Islamic banks" which offer the opportunity for $P^\star$ agents to get funds for their projects or to invest their savings and collect a profit, but they also offer instruments that mimic interest rates, and in some cases even have separate divisions which function as a regular bank.

Our model is an evolutionary game wherein the three types of agents are pairwise randomly matched in each period to play a two-person, two-move game (interpreted as an economic transaction). The two moves available to each agent are P (do not use interest rates), and I (use interest rates). Pious Muslims – due to the religious prohibition – never choose I, and hence their lifetime strategy is $P^\star$. Traditional economic agents are accustomed to interest rates, and believe that it is always better due to their risk aversion (it is argued below, based on the "equity premium puzzle", that this belief is empirically unjustified). Therefore, they always choose I, taking the borrower or lender side depending on which is more advantageous at the given interest rate.

We shall construct the normal form of the stage game as a prisoner's dilemma:

	P	I
P	(a,a)	$(0,b)$
I	$(b,0)$	(c,c)

where we shall assume that $b > a > c > 0$. This makes the standard banking practice (I, I) the unique Nash equilibrium for the stage game, but it is Pareto inferior to the Islamic outcome (P, P).

The fact that (P, P) is not a Nash equilibrium (i.e. $b > a$) follows immediately from the impossiblity of finding a profit-sharing rule which, for a generic profile of risk aversion in the population and distribution of potential profits, will make the certainty equivalent of the profit share greater than or equal to the interest rate times principal. Moreover, if an $I^\star$ agent is matched with a $P^\star$ agent, since the $I^\star$ type is always willing to take

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either the borrower or the lender side, and since the $P^\star$ agent has the option of holding their money and paying 2.5% زكاة المال or giving an interest free loan,[9] the outcome is an interest free loan from the $P^\star$ agent to the $I^\star$ agent. We normalize the service fees or other nominal fixed return to the lender in such a transaction at zero, and the $I^\star$ agent can then invest the funds, or collect unshared interest on them, hence justifying $b > a$.

The fact that the unique Nash equilibrium (I, I) is Pareto inferior to the Islamic outcome (P, P) (i.e. $a > c$) is justified on theoretical as well as empirical grounds. On the theoretical side, one may name: (i) the stability of an Islamic financial sector in the face of macroeconomic shocks (Simons (1948), Zarqa (1983), Khan (1986)); (ii) the more efficient allocation of resources, up to a lower marginal productivity of investment (Iqbal and Mirakhor (1987)); (iii) the reduction of "effort aversion" which would cause poorer choice of investment projects (Khan (1995)); (iv) the potential undertaking of riskier projects with a higher expected profit; and, above all (v) obedience to God which is believed to lead to success in this life and the next. Those theoretical considerations support the assumption that $a > c$.

On the empirical side, an argument that $a > c$, even allowing for risk aversion, can easily be formulated based on the famous "Equity-Premium Puzzle" (Mehra and Prescott (1985)). Mehra and Prescott noted that the premium of the return on the S&P over the riskless rate (commercial paper) for the period 1889–1984 had a mean of 6% and a standard deviation of 18%. This large "premium" can only be explained by extreme rates of risk aversion in the economy. However, Weil (1989) has shown that if such a rate of risk aversion is assumed, we get a reverse puzzle, "the risk-free rate puzzle". Namely, if we assume a rate of risk aversion which justifies the equity-premium, then the rate of time preference which justifies the risk-free rate must be negative. Since a negative rate of time preference defeats some of the most fundamental justifications for interest rates, it would seem that risk aversion cannot explain why PLS (equity-based) systems yield returns so much higher than riskless rates. A number of other unsuccessful explanations have been proposed in recent years, but the "puzzle" remains an unexplained empirical regularity which justifies our assumption that $a > c$.

5 The Model

We study the stage game discussed in the previous section, which shows that whenever any two agents are matched at any point in time, they play a prisoner's dilemma:

	P	I
P	(a, a)	$(0, b)$
I	$(b, 0)$	(c, c)

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[9]   Any funds that remain unused for a year are subject to this form of wealth tax of 2.5% per annum. Interpreting the time period in our model as a year, the $P^\star$ agent would – from a purely financial point of view – rather lend the money with no interest than hord it and pay 2.5% of its total sum.

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with $b > a > c > 0$. We further assume, following the discussion and motivation in the previous section, that there are three types of strategies agents use in the repeated game: $P^\star$ (always choose P), $I^\star$ (always choose I), and W (choose P if matched with a $P^\star$-type, and choose I if matched with $I^\star$). The only remaining degree of freedom is how W acts when matched with another W. The assumption we make for such encounters is crucial for the analysis to follow. We shall consider the two extreme cases:

Case I: $WW = PP$ where the "Weak" types mimic the pious types when they interact amongst themselves.

Case II: $WW = II$ where the weak types mimic the interest-using types amongst themselves.

Time is assumed discrete. In each period, all the agents (in a very large, but finite, population) are matched pairwise, and they get to play the game for this period. The appropriately normalized payoffs in any period of the repeated game given the three strategies is:

	$P^\star$	$I^\star$	W
$P^\star$	(a,a)	$(0,b)$	(a,a)
$I^\star$	$(b,0)$	(c,c)	(c,c)
W	(a,a)	(c,c)	(d,d)

where $(d,d) = (a,a)$ in CASE I, and $(d,d) = (b,b)$ in CASE II.

It directly follows that the expected payoffs for each type at any given period are a simple function of the proportion of agents using $P^\star$ (we call that proportion x_t), and the proportion using $I^\star$ (we call that proportion y_t, and - trivially - the proportion using W is $(1 - x_t - y_t)$). Those expected payoffs are:

$$\Pi(P^\star; x_t, y_t) = a - ay_t,$$

$$\Pi(I^\star; x_t, y_t) = c + (b - c)x_t,$$

$$\Pi(W; x_t, y_t) = \begin{cases} a + (c - a)y_t & \text{Case I (WW=PP)}, \\ c + (a - c)x_t & \text{Case II (WW=II)}. \end{cases}$$

Which results in a population-wide payoff at time t of:

$$\Pi(x_t, y_t) = x_t\Pi(P^\star; x_t, y_t) + y_t\Pi(I^\star; x_t, y_t) + (1 - x_t - y_t)\Pi(W; x_t, y_t).$$

Now, we assume that the agents making more money will have a stronger presence in the market in the following period, and vice versa. This can be interpreted as the rich having more progeny/followers, or simply as being larger economic entities which subdivide into more "agents", whereas those getting poorer get smaller and fewer. The particular dynamic model chosen here is the famous "replicator dynamics" model which

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is borrowed from Biology. This model has become the main paradigm for evolutionary game theory:[10]

$$x_{t+1} = \frac{x_t \times \Pi(P^\star; x_t, y_t)}{\Pi(x_t, y_t)},$$

$$y_{t+1} = \frac{y_t \times \Pi(I^\star; x_t, y_t)}{\Pi(x_t, y_t)}.$$

The dynamics of this model are strikingly different for CASE I and CASE II. A schematic sketch of the phase diagrams for the model with $b > a > c > 0$ in CASE I and CASE II are shown in Figure 1 and 2, respectively. In Figures 1 and 2, lines and points in boldface represent fixed points, and arrows in the interior represent the dynamic trajectories. Figures 3 and 4 show the phase diagram and 400 numerical trajectories each for the case $b = 3, a = 2, c = 1$, however, the phase diagram is qualitatively the same for any $b > a > c > 0$, although the exact turning points depend on the numerical values of those parameters. Notice that x_t's average payoff is monotonically decreasing in y_t, and that y_t's payoff is montonically increasing in x_t; i.e. the $I^\star$ types are predators and the $P^\star$ types are prey. The interaction of those two types with W in cases I and II produces interesting dynamics. It is straight-forward to verify the main analytical properties of our phase diagrams:

In CASE I $WW = PP$:

- All the points on the x-axis ($y_t = 0$) are fixed points, where the $P^\star$'s survive forever, and the W's survive forever acting like $P^\star$'s.

- There is an isolated fixed point at $y_t = 1$.

- All the points with $(1 - x_t - y_t) = 0$ (i.e., the diagonal, with no W's), converge to the isolated fixed point, where all the $P^\star$'s vanish.

- In an neighborhood of the diagonal defined by $(1 - x_t - y_t) < \epsilon(a, b, c)$, we get montonic decline of x_t to zero, followed by a monotonic decline of y_t to zero. In the limit, only W's survive, and they act in CASE I like $P^\star$'s.

- With sufficient W types $(1 - x_t - y_t) > \epsilon(a, b, c)$, the $P^\star$ types survive forever, with $\lim_{t\uparrow\infty} y_t = 0$, and the W's in the limit act like $P^\star$'s.

- There is no scenario in which both $\lim_{t\uparrow\infty} x_t$ and $\lim_{t\uparrow\infty} y_t$ are both positive. In other words, the pious and the interest-using cannot co-exist forever!

- In order for Islamic banking to survive in a heterogeneous environment, it is necessary that $WW = PP$ (see CASE II below), and that there is some mass of W types (the larger the mass, the higher the chance of $P^\star$'s surviving, and the faster that interest-based dealings perish).

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[10] For a recent treatment and survey of the literature in Evolutionary Game Theory, see Vega-Redondo (1996).

In CASE II $WW = II$:

- The only manifold on which any Islamic banking can survive is defined by the x-axis $y_t = 0$. All of the points on that axis converge to the isolated fixed point at $x_t = 1$, i.e. where at time $t = 0$, only P^*-types exist.

- All points with $x_t = 0$ (on the y-axis) are fixed points, where the interest-using agents survive forever, and the W types mimic them and survive as interest-users.

- Starting from any point other than $x_t = 1$ (an idealistic, isolated, Islamic economy), $\lim_{t \uparrow \infty} x_t = 0$.

- There is no scenario in which both $\lim_{t \uparrow \infty} x_t$ and $\lim_{t \uparrow \infty} y_t$ are both positive. In other words, the pious and the interest-using cannot co-exist forever!

Of course, if we take intermediate cases where the W types sometimes use PP and sometimes use II when dealing amongst themselves, we may still get the survival of Islamic banking provided that the proportion of W's is above a critical level, and that they use PP amongst themselves sufficiently often. Figures 5 and 6 illustrate two of the more interesting scenarios under Cases II and I, respectively. Figure 5 shows that if $WW = II$, we may get a short period of increase in P^*, but such a resurgence of Islamic banking will be short-lived, and eventually self-defeating. Indeed, as we know from the above analysis of the phase diagram, the only scenario under CASE II in which Islamic banking (the P strategy) survives (is used in the limit), is for all agents to use P at time 0. This corresponds to the traditional view of Islamic economists that all interest must be abolished instantly, otherwise the Islamic practice cannot be sustained. Indeed, in both cases I and II, this point $x_t = 1$ is trivially a fixed point, and this justifies the statement that if the economy were to convert to Islamic practice at once, such practice can survive regardless of the environment.

However, this intuition is not useful in a complex world where interest-using agents coexist with Islamic practice. In this environment ($x_t < 1$), it is not true that a sufficiently large x_0 (contingency of pious agents), can guarantee the survival of Islamic banking. This is obvious in CASE II, where all pious agents will perish if faced with a heterogeneous population. It is interesting to see in Figure 6 a scenario under CASE I where x_0 is large at the expense of $(1 - x_0 - y_0)$, i.e. there are not enough W type agents in the economy. In this case, the P^* types will still be easy prey for the I^*, and will be doomed to extinction. After all the P^* types have vanished ($x_t = 0$), the W agents continue to outperform the interest-taking types, and eventually become the only survivors ($\lim_{t \uparrow \infty}(1 - x_t - y_t) = 1$). This limiting result has Islamic banking surviving in the limit, but for economic rather than religious reasons, since the truly pious types are the first to perish. Indeed, the Islamically-"weak" agents are the strongest economically. In both cases I and II, they can survive in the face of the interest-users. In CASE I, they can play an additional role (provided there are enough of them) of helping the pious agents survive in the long-run.

Interpreting the W agents as the modern Islamic banks with some Islamic dealings and some transactions that either mimic interest, or are explicitly interest based, our results suggest that the severe criticism of those institutions in the literature may be misguided. It would be ideal to instantaneously obtain universal Islamic behavior $x_t = 1$. However, since this is not a likely scenario, the "weakly-Islamic-banks" type seems necessary to ensure the survival of Islamic economic practice in a heterogeneous economy of Islamic and interest-using agents. If we further accept the limiting result $(1 - x_t - y_t) = 1$ as a form of Islamic banking survival (despite the fact that the truly pious agents would have perished), then the existence of W agents has been shown to be sufficient for Islamic banking to dominate the economy in the limit. Moreover, the larger the contingency of W agents, the faster an economy can rid itself of the interest-using types, provided that we are in CASE I, where the W types behave among themselves in the Islamic manner.

6   Concluding Remarks

Islamic economists, and Muslims in general, diverge in their view of the modern phenomenon of Islamic banking. Some view the practices of Islamic banks which mimic interest as practical short-run alternatives, and hope that they will gradually be replaced with practices that agree with the spirit as well as the letter of the Islamic law (Khan (1995)). Others are angered with what they view as an outrageous form of religious hypocrisy, and wish to transform the economy instantaneously to be in accordance with Islamic law (Ahmad (1992)).

In the highly stylized model presented in this paper, it has been shown that each of these divergent views is correct in a special case. The determining factor in this model is the manner in which Islamic banks deal among themselves. It is shown that the necessary and sufficient condition for Islamic banking to survive in the long run is the existence of agents who are willing to interact symmetrically with the Islamic and the interest-based parts of the economy, and that those agents deal amongst themselves in an Islamic way. It is interesting to note that the Malaysian Islamic banking system (which is the most advanced hybrid financial system where Islamic and regular banks coexist) has recently adopted an Islamic check-clearing system which would facilitate the Islamic interaction amongst the Islamic banks (Bank-Negara-Malaysia (1994)). This suggests that our model can serve as a seed for future empirical, theoretical, and policy research on transition from regular interest-based banking to Islamic banking.

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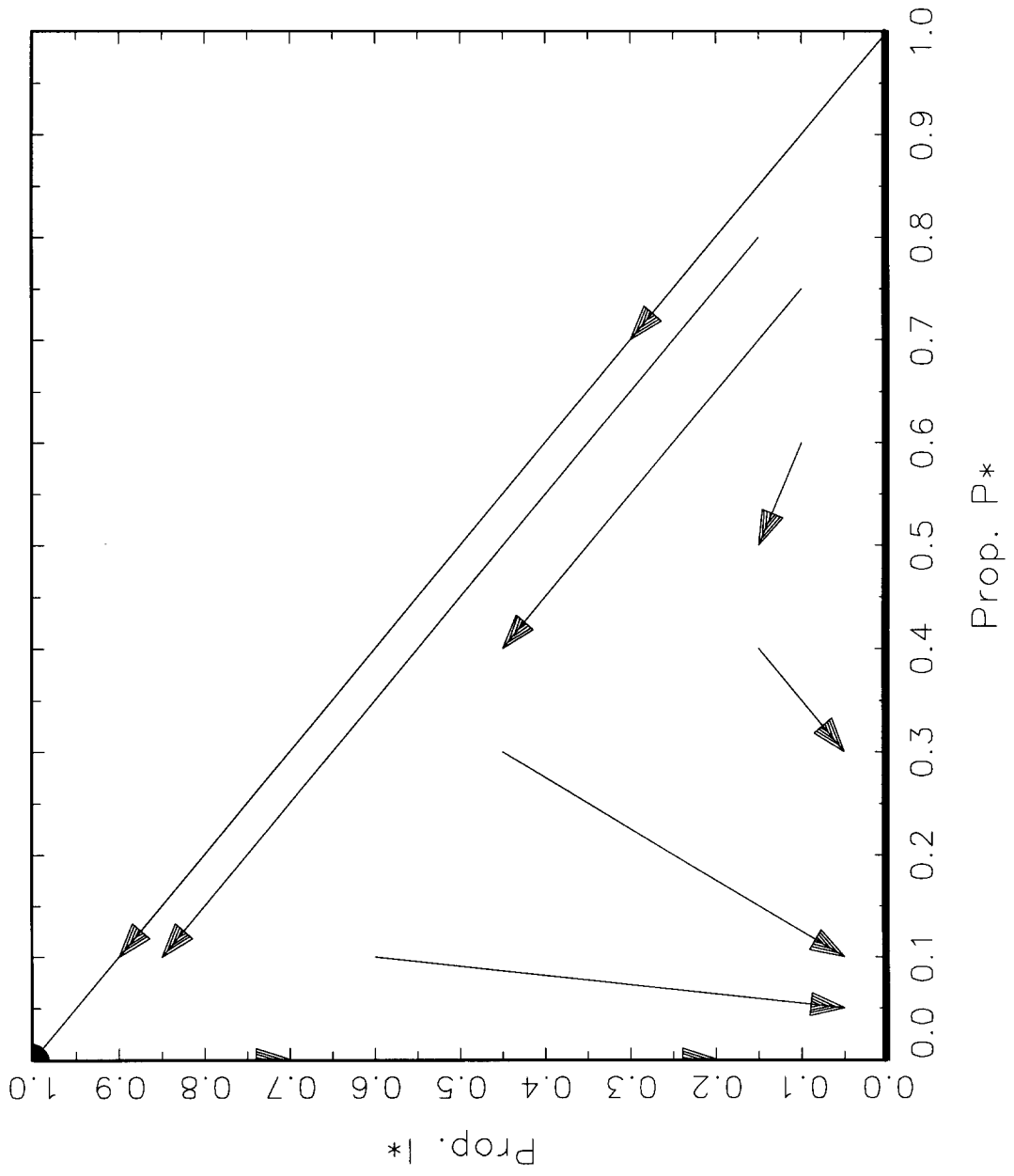
Figure 1.

Sketch of Phase Diagram; CASE I WW=PP; b>a>c

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Figure 2.

Sketch of Phase Diagram; CASE II WW=II; b>a>c

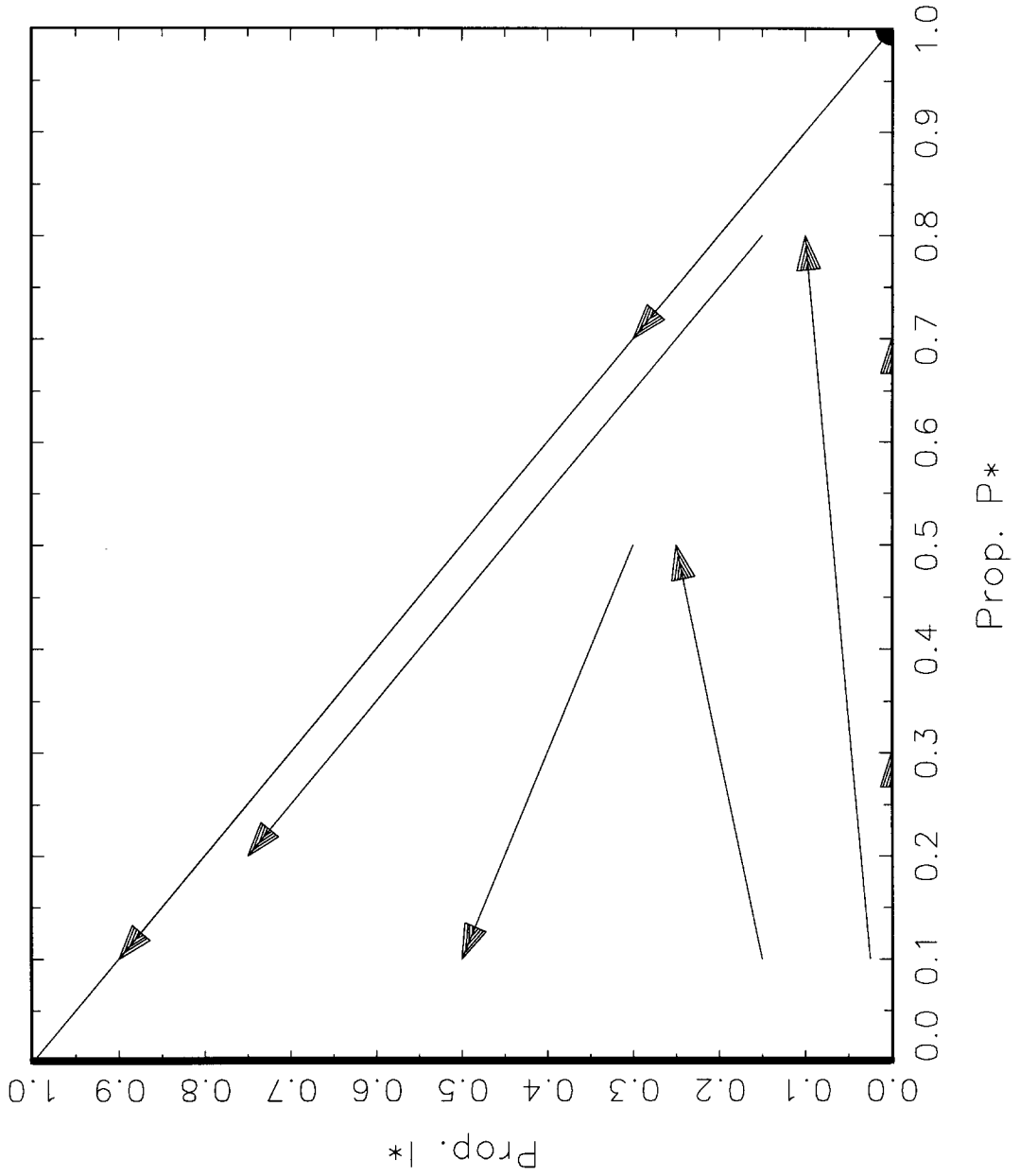GAUSS   Fri Feb 21 10:45:37 1997

Figure 3.

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Phase Diagram; CASE I WW=PP; b=3, a=2, c=1

Figure 4.

Phase Diagram; CASE II WW=II; b=3, a=2, c=1

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Figure 5.

Evolution of P*, I* and W players; CASE II WW=II

GAUSS   Tue Feb 18 14:55:32 1997

Figure 6.

Evolution of P*, I* and W players; CASE I WW=PP

GAUSS   Tue Feb 18 14:50:21 1997