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Islamic Agricultural Finance and Growth

Kazem Sadr
Mohammad-Ali Kafaie
Bahram Haidari*

Abstract

The objective of this study is to model and estimate the effect of financial services in the agricultural sector of Iran on the value added of this sector. Moreover, since as of 1984, the Interest Free Banking law was implemented, the effect of this change on the value added of the sector will be studied as the second objective. The model of the study consists of three tions. The volume of real investment in the first tion is assumed to be the function of value added, flow of finance, and last year's capital stock. The second tion consists of a capital accumulation identity, and the third tion formulates value added as function of capital stock and labor force in the agricultural sector. The three tions are estimated simultaneously with co integration method and both long run and short run estimation of coefficients exhibit a positive and significant effect of credit on both the capital stock and output. Further, the results show application of Islamic tools of finance also contributes to the increase of agricultural sector's value added significantly. These results reinforce the arguments of Islamic economists that Islamic finance is growth promoting.

Keywords: Islamic Finance, Agricultural Credit, Agricultural Finance, Agricultural Bank of Iran

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*- K. Sadr (Corresponding Author) and M. A. Kafaie are Professor and Assistant Professor, respectively at Shahid Beheshi University, and B. Haidari is a researcher.

Introduction

Islamic economists have shown in many research studies how Islamic financial system promotes economic growth. They have already put forth many hypotheses regarding promotion of investment [11], incentives for savings [10], prudent monetary policy and rapid adjustment of an economy to external economic shocks [7]. Mirakhor has summarized progress and achievements of Islamic economists during the past three decades [9,4].

Despite this wealth of literature, few of the formulated hypotheses set forth by Islamic economists have been empirically tested and turned into economic theories. This is particularly true with macroeconomic models, for verification of which, an economic environment is required in which Islamic rules have already been applied comprehensively. Iran, Pakistan and Sudan's economy provide valuable opportunity for Islamic economists to test their propositions.

In fact, some economists have already benefited from this opportunity and have used data from Iranian economy to do empirical research. Mohsin Khan's Proposition that Islamic banks absorb and rapidly adjust to external shocks was tested first by Darrat [2] to show stability of demand for money. Following him, Kavand [6], completed a study in which the stability of all measures of money, that is M1, M2, and M2-M1 which carry no interest were examined and verified. Darrat [3] repeated his study for the Iranian and Pakistani economy and supported the former conclusion.

How the Islamic banks overcome the asymmetric information problem when they apply equity financial tools, have been studies, too, in Iran [16, 17]. To substantiate this argument that supervision of the financier over the performance of investor partner is itself an investment activity which creates new information that will be utilized in further allocation of financial resources among new demanders, regions, and projects and that the benefit of this endeavor will exceed the cost of monitoring incurred by the financier to overcome the asymmetric informational problem, a research project designed to explore the answer was carried out in the Agricultural Bank of Iran [16]. The results of this study show that this bank selects among the alternative modes of finance a portfolio which seeks to maximize its expected profit. The other finding of the study was that the supply of financial facilities to

farmers by this bank was positively related to the rate of return and negatively to the risk of various modes of finance [16].

Saving behavior of private sector in addition to aggregate private and public savings was studied in Iran by Laleh [8] using an interest frees saving behavior model. The ratio of private savings to GNP was found to be a positive function of per capita income and its rate of growth, and a negative function of inflation rate and the ratio of net real value of private sector wealth to GNP [8]. Further, the Islamic financing system has been shown to contribute to reduction of growth disparity among different regions in Iran. Toutounchian indicates in his study that banking financial resources have been distributed among the provinces such that their comparative degree of deprivation has been reduced [19].

What all the above reported studies, in addition to those reviewed by Mirakhor, propose is that Islamic financial system contributes to economic growth by increasing investment and savings opportunities, provide a stabilizing and rapidly adjusting monetary and financial system, which also copes adtely with risk and asymmetric information in the economy [16,17]. In short, they argue that Islamic finance will promote growth. To substantiate further this proposition and verify it with facts, a research project studying the effect of agricultural finance on the supply of this sector's output was carried out, and will be reported here, as follows.

First of all, the importance of agricultural credit for various agricultural activities will be shortly described. Second, the methods that researchers have used to measure this role will be reported and then the conceptual model of this study will be presented. After describing data collection and its estimation, the findings of the study will be reported.

A- The Importance of Agricultural Finance

Agricultural credit contributes to the development of agricultural sector in alternative ways; three of which are summarized below.

1- Agricultural production process is seasonal

Farmers need to pay for all production inputs such as seed, fertilizer, land preparation and machinery at the outset of farming season; but are only able to produce the output at the end of the season. The lag between the

time that they have to pay for their expenses and when they receive output revenues requires them to have access to liquidity.

Availability of agricultural credit enables farmers to use enough inputs and engage in farm investments in order to produce optimal level of output and gain profits. Thus, agricultural finance helps farmers to expand their production activity and earn their living; in the absence of which both their output supply and their welfare would decline.

2- Credit Rationing

Due to asymmetric information between the suppliers of finance and their customers, on one hand, and intervention of governments to put ceiling on the rate of return of financial tools, credit supply will be rationed among farmers and many cannot receive what they need at the market rate. This imperfection in the credit Market may limit the farmers' production budget and cause suboptimal use of production inputs. Adte supply of credit, on the other hand, along with measures that resolve the asymmetry of information helps farmers to enhance their production efficiency.

3- Inadte Farm Savings

In many developing counties farm units are small and peasants can hardly save for their production expenses. Availability of agricultural credit makes up for the shortage of savings and enables them to allocate their farm budget effectively.

Overall, agricultural finance contributes to an efficient use of production factors and farm investment in the agricultural sector and thus promotes the value added of this sector. The important policy aspects that have been emphasized in the literature is the coverage and sustainability of credit disbursement [13, 14]. Rather than controlling financial rate of return, governments are recommended to help build up a competitive, complete and not segmented market environment. Subsidized credits are no more recommended to be offered, but to target groups of farmers.

B- Agricultural Credit in Iran

Formal agricultural credit has been supplied in Iran for the past seventy years by many public agencies. But as of 1980, all public institutions were

consolidated into Agricultural Bank of Iran. In 1984, the Interest Free Banking Law was passed and implemented.

As of this date, the loan market was eliminated from the Iranian economy and all banks reformed to financial intermediaries or investors in the financial and capital market, respectively. Evidently, all monetary, fiscal and financial policies were taken according to the Interest Free Banking Law, since then.

C- Measuring the Contribution of Agricultural Credit

Although the effect of agricultural credit upon the agricultural output has been measured in different ways in the literature, but they can be categorized into four major groups:

1. Considering credit as an input in a production function and assuming its estimated coefficient to measure the contribution of credit to farm output [15]. Truly, farm credit complements the farm budget, which is allocated to alternative inputs. However, it is not a physical input; its use in the production function renders double counting of inputs effect.

2. Dividing farmers according to their access to credits and referring their differences in their productivity to this factor [21]. Clearly, these farmers differ in their managerial capabilities, and wealth endowments, in addition to the credit amounts received. Therefore, their productivity differentials cannot be solely contributed to their access to credit.

3. Assuming all forms of credit will be invested and then accumulated as capital stock [18]. The effect of the latter in an estimated production function is assumed to reveal the credit contribution. It is clear that short term credits are often used to finance operating cost and not for investment activities.

4. Formulating the aggregate agricultural demand and supply functions and then defining the input level in the supply tion as a function of credit [1]. The reduced form of the above tions is assumed to measure the effect of credit on the output.

According to derived demand theory, prices of inputs and output, among other factors, will affect the demand for input level and the latter cannot depend solely on credit level.

D- The Model

Our model building starts from the basic and usual definition of gross investment, $I_{t,}$ as the sum of net investment, I_{nt}; (the difference between the capital stock at the end of two successive periods) plus replacement investment $I_{rt;}$ (the depreciation of last period's capital stock);

$$I_t = I_{nt} + I_{rt} = (K_t - K_{t-1}) + \delta K_{t-1}$$

$$= K_t + (\delta\text{-}1)\, K_{t-1} \qquad (1)$$

where, K_t is the capital stock at the end of period t, and δ is the depreciation rate. It is assumed that all agricultural firms plan to obtain a desired stock of capital in the long run, K_t^e, but they do so, by adjusting their current capital stock proportionately ($0 < \alpha < 1$) to the gap between the desired and actual capital stock (α is also called adjustment coefficient and its higher values indicate higher speed of adjustment for the firm);

$$K_t - K_{t-1} = \alpha\,(K_t^e - K_{t-1}) \qquad (2)$$

There are many factors affecting the speed of firm's adjustment. One of the most important factors is the ability to earn credit, as illustrated at the outset of this section. Therefore, we hypothesize that the supply of agricultural credit can substantially alter the investment decisions of the firms, through the whole adjustment process. Following Tun Wai and Wong [20] we define adjustment coefficient α as follows:

$$\alpha = \beta_0 + \frac{1}{K_t^e - K_{t-1}}\,(\beta_1\, CR_t) \qquad (3)$$

Note that in this definition the capital stock gap ($K_t^e - K_t$) is inversely related to the adjustment factor, α and total credits received by all farm units, CR_t, has a positive effect on α. By substituting (3) in (2);

$$K_t - K_{t-1} = \beta_0\,(K_t^e - K_{t-1}) + \beta_1\, CR_t \qquad (4)$$

and the resultant in (1), we obtain:

$$I_t = \beta_0 (K_t^e - K_{t-1}) + \beta_1 CR_t + \delta K_{t-1} \quad (5)$$

We also assume that the desired capital stock of the agricultural sector is a linear function of its net output level:

$$K_t^e = m_0 + m_1 y_t \quad (6)$$

With inserting tion (6) in (5) we get;

$$I_t = \beta_0 (m_0 + m_1 y_t - K_{t-1}) + \beta_1 CR_t + \delta K_{t-1}$$

or

$$I_t = \theta_0 + \theta_1 y_t + \theta_2 CR_t + \theta_3 \delta K_{t-1} \quad (7)$$

where,

$\theta_0 = \beta_0 m_1$

$\theta_1 = \beta_0 \gamma_1$

$\theta_2 = \beta_1$

$\theta_3 = (\delta - \beta_0)$

that is, aggregate investment in the agricultural sector is dependent on the sector's aggregate net output (or its value added), total agricultural credits, and capital stock in the preceding period. Finally, it is assumed that the gross output of this sector is a function of four inputs, namely, capital stock, K_t, labor, L_t, raw material, N_t and the state of technology, A_t, therefore,

$$Q_t = Z (K_t, L_t, N_t, A_t) \quad (8)$$

Assuming that N_t is weakly separable from other inputs, we can rewrite (8) as

$$Q_t = R [(g (K_t, L_t, A_t), N_t]$$

If we assume further that K_t and L_t are independent from technology A_t, we can rewrite the sector's production function as;

$$Q_t = Q [h(A_t) f (L_t, K_t), N_t] \quad (9)$$

in which $f(L_t, K_t)$ is in fact the value added of the agricultural sector and will be shown by y_t:

$$y_t = f (K_t, L_t) \quad (10)$$

Let's assume a Cobb-Douglas technology, then tion (10) can be specified as

$$\ell n\, y_t = \lambda_0 + \lambda_1\, \ell n\, L_t + \lambda_2\, \ell n\, K_t + u_t \quad (11)$$

Evidently, the model of this study consists of three tions, two of which are behavioral (a production function and an investment function) and one definitional (capital accumulation identity), i.e. tions (7), (1) and (11), which would be estimated simultaneously.

This model allows us to analyze the effect of credits on the promotion of investment demand, and its contribution to capital accumulation in the agricultural sector. Also the effect of capital stock on agricultural output could be measured through production function. Simultaneous estimation of these three tions makes it possible to trace back the effect of credit supply on the output in the agricultural sector.

E- Data Collection

The data for this study are obtained from the time series published by Central Bank of Iran, Statistical Center of Iran, and the Management and Planning Organization for the years 1961-1996, (1340 to 1375 Iranian calendar). The data for capital stock in the agricultural sector has been taken from Noferesti [12] for the years 1961 to 1991, and the rest have been calculated using his method.

F- Research Method

In order to avoid estimation of a spurious regression in this time series analysis, all variables were tested for unit roots (in logs), using the Augmented Dickey-Fuller test (ADF). The test results indicate that the null hypothesis of having a unit root for all the variables under consideration (in levels) can not be rejected, but not for their first differences. So all variables are I(1) in levels, but I(0) in their first differences. See tables 1 and 2 for the summary of the test results.

For determining the order of vector autoregressive (VAR) model, The Schwartz-Bayesian criterion was used, and decided that a VAR model with intercept and no trend is appropriate for both production function and investment demand tion.

Table 1: Test results for unit Roots Based on ADF Tests (levels)

Variables	ℓn y (0,0)		ℓn K (1,1)		ℓn L(1,1)		ℓn CRD1(1,0)	
Cases	Statistic	Critical value	Statistic	Critical value	Statistic	Critical value	Statistic	Critical value
With Intercept	-0.62	-2.94	-1.1	-2.95	-1.88	-2.95	-1.27	-2.97
with Intercept and trend	-2.45	-3.55	-3.01	-3.54	-2.24	-3.55	-3.2	-3.57
Variables	I (0,0)		CRD (0,0)		ℓn CRD2 (0,0)			
Cases	Statistic	Critical value	Statistic	Critical value	Statistic	Critical value		
with Intercept	-1.78	-2.95	-1.29	-2.95	-1.72	-2.97		
with Intercept and trend	-1.6	-3.55	-2.36	-3.56	-1.48	-3.57		

Table 2: Test Results for unit Roots Based on ADF Tests (First Differences)

Variables	Δ ℓn y (0,0)		Δ ℓn K (1,1)		Δ ℓn L(1,1)		Δ ℓn CRD1(0,0)	
Cases	Statistic	Critical value	Statistic	Critical value	Statistic	Critical value	Statistic	Critical value
with Intercept	-6.15	-2.95	-3.62	-2.95	-4.52	-2.95	-8.2	-2.97
with Intercept and trend	-2.45	-3.55	-4.01	-3.54	-2.24	-3.55	-3.2	-3.57

Variables	Δ I (0,0)		Δ CRD (0,0)		Δ ℓn CRD2 (0,0)	
Cases	Statistic	Critical value	Statistic	Critical value	Statistic	Critical value
with Intercept	-5.13	-2.95	-6.82	-2.96	-4.34	-2.98
with Intercept and trend	-5.11	-3.55	-6.7	-3.57	-4.4	-3.58

To investigate the existence of the possible stable long-run relationships, we followed multivariate Johansen-Juselieus approach (1992), and the result of trace test, with null hypothesis of less than or l to co-integrating sectors, are reported in tables 3 & 4.

Table 3: Co-integration LR Test Based on Trace of Stochastic Matrix (n=36) (Production Function)

Null hypothesis	**Alternative hypothesis**	**Statistic**	**95% Critical value**	**90% Critical value**
$r = 0$	$r \geq 1$	44.66	34.87	31.93
$r \leq 1$	$r \geq 2$	17.04	20.18	17.88
$r \leq 2$	$r \geq 3$	6.81	9.16	7.53

order of VAR = 2 , n = 36 , intercept with no trends

Table 4: Co-integration LR Test Based on Trace of Stochastic Matrix (Investment Function)

Null hypothesis	Alternative hypothesis	Statistic	95% Critical value	90% Critical value
$r = 0$	$r \geq 1$	235.04	48.88	45.7
$r \leq 1$	$r \geq 2$	24.34	31.54	28.78
$r \leq 2$	$r \geq 3$	9.62	17.86	15.75
$r \leq 3$	R=4	0.44	8.07	6.5

order of VAR = 1 , n = 34 , intercept with no trends

The number of co-integrating vectors is determined by starting at the top of table and move down until H_o cannot be rejected. Since the trace test statistics for H_o of no co-integration (44.66) for production function, and 235.04 for investment function exceeds the 95% critical value, (34.87 & 48.88 respectively), but this is not the case for the null hypothesis of $r \leq 1$, it appears that there is evidence for one co-integrating production function and one co-integrating investment function. The normalized co-integrating coefficients for both the production and Investment functions are shown in table 5.

Table 5: Normalized Co-integrating Coefficients Vectors

Investment function		Production function	
Variable	Normalized coefficient	Variable	Normalized coefficient
I_t	-1	$\ell n\, y_t$	-1
Y_t	.00049	$\ell n\, K_t$	1.108
K_t	.016	$\ell n\, L_t$	2.49
CRD_t	.042	C	-21.08

In order to find short-run coefficients, the error correction term for each of the 2 tions is calculated and after including them in their respected tions, the whole system is estimated simultaneously by 3SLS.

G - Results

The long run estimated coefficients of the simultaneous system for the investment and production functions are presented in table 5. It can be said that one Billion rials increase in the flow of agricultural credit will increase that of investment by 0.042 Billion or 42 Million rials in real terms. This table also shows that during the period of study, one percent increase in this sector's capital stock will increase the value added of agriculture sector by 1.108 percent in the long run. Similarly, one percent increase in the labor force will increase the value added by 2.49 percent.

From the estimated results in table 5, the long run effect of agricultural finance on the value added of this sector can be calculated as:

$$\frac{\partial \ell \text{ny}}{\partial \ell \text{n CRD}} = \frac{\partial \ell \text{ny}}{\partial \ell \text{nK}} \frac{\partial \ell \text{nK}}{\partial \ell \text{n CRD}} = \frac{\partial \ell \text{ny}}{\partial \ell \text{nK}} \frac{\partial \text{K}}{\partial \text{CRD}} \frac{\text{CRD}}{\text{K}} \qquad (12)$$

Since the average ratio of annual credit to the capital stock in this sector over the period of study is 0.066, therefore, we can say that in the long run, one percent increase in the supply of agricultural credit will increase the value added of this sector by 0.003 percent, i.e.

$$\frac{\partial \ell \text{ny}}{\partial \ell \text{n CRD}} = (1.108) \times (0.042) \times (0.066) = 0.003 \qquad (13)$$

On the other hand, the average ratio of credit flow to that of value added of the sector, over the period of study is 0.0731. Therefore, each one billion rials addition of finance allocated to the agricultural sector will increase its value added by 41.1 million rials.

$$\left.\begin{aligned} \frac{\partial \ell \text{ny}}{\partial \text{l } \ell \text{nCRD}} &= \frac{\partial \text{y}}{\partial \text{CRD}} \frac{\text{CRD}}{\text{y}} = 0.003 \\ \frac{\partial \text{y}}{\partial \text{CRD}} &= \frac{0.003 \times 1}{0.0731} = 0.0411 \end{aligned}\right\} \qquad (14)$$

Clearly, the results indicate that credit supply has a significant and positive effect on the value added of agricultural sector. Despite all the environmental changes, such as draught, flood, and frost damages, and all the

economic shocks that hit the economic system of Iran after the Islamic revolution, such as war and sanctions, agricultural finance exhibited lasting and determining effects on the sector's output.

To obtain the short run coefficients estimates, an error correction term introduced as an exogenous variable in every tion. Then all the tions are simultaneously estimated by 3SLS method. The estimated tions are presented below:

A) The production function

$$\Delta\ \ell n\ y = 1.21\ \Delta\ \ell n\, K + 0.36\ \Delta\ \ell n\, L - 0.04\ ECM_{-1}$$

B) The investment function

$$I = \Delta K = 0.147\ \Delta y + 2.039\ \Delta K_{-1} + 0.28\ \Delta CRD - 548.3\ ECM'_{-1}$$

C) Error correction terms

$$ECM = 45.22 + 2.144\ \ell n\, y - 2.38\ \ell n\, K - 5.34\ \ell n\, L$$

$$ECM' = 0.0024\ I - 0.1152E^{-5}\ y - 0.3771E^{-4}\ K_{-1} - 0.989E^{-4}\ CRD$$

The above estimated coefficients indicate that in the short run, one percent change in the real stock of capital will change the value added by 1.21 percent. Similarly, one Billion rials change in the flow of value added in real terms, will change the real capital stock - or flow of real investment - by 0.147 Billion rials; while one Billion rials change in agricultural credit will change capital stock - or investment flow - by 0.28 Billion rials; all in real terms.

To measure specifically the contribution of agricultural credit to the value added of this sector we derive:

$$\frac{\partial \ell n y^*}{\partial \ell n CRD^*} = \frac{\partial \ell n y^*}{\partial \ell n K^*} \frac{\partial \ell n K^*}{\partial \ell n CRD^*} = \frac{\partial \ell n y^*}{\partial \ell n K^*} \frac{\partial K^*}{\partial CRD^*} \frac{CRD^*}{K^*} \qquad (15)$$

(in which * means change in a variable; $K^* = \Delta K$) Since, the average of change in the credit-change in the capital stock ratio over the period of study is l to 0.136, therefore,

$$\frac{\partial \ell ny^*}{\partial \ell nCRD^*} = (1.21) \times (0.28) \times (0.136) = 0.046 \qquad (16)$$

In the short run, one percent change in the availability of credit will change the value added by 0.046 percent. These results reinforce the findings of the long run estimations. Therefore, one can conclude that the supply of agricultural credit has had a positive and significant effect on the increase of agricultural sector's value added in Iran during the period 1961-1996.

H- The Role of Islamic Financial System

To verify the effect of Islamic financial system upon economic growth in the agricultural sector of Iran, the reduced form of the structural tions model was estimated again, using co-integration methodology of estimation like before, except for entering a dummy variable as of 1984, to identify the starting point of Islamic Banking operation. The results are presented in table 6.

CRD1 and CRD2 are credits for the working capital and long run investment, respectively. It is noticed that the latter has a greater role in increasing the value added than the former

Table 6: Co-integrated and Normalized Vector

$\ell n\ y$	-1
$\ell n\ K_{-1}$	0.6
$\ell n\ L$	0.27
$\ell n\ CRD_1$	0.059
$\ell n\ CRD_2$	0.093
DUMMY	0.26

Our findings show an impressive, but expected positive effect of Islamic Free Banking Law on the value added of agricultural sector. As indicated before, we introduced a dummy variable to measure the effect of this change in the financial system. Its coefficient is estimated to be a positive and significant effect of this change in the financial system (from an interest based to an interest free system). This result is obtained after

controlling for the contribution of capital stock, labor force and the value of short and long run credit. Therefore a one percent increase in each one of these will increase the output by 0.6, 0.27, 0.059 and 0.093 percent, respectively, but, the effect of change in the financial system (from an old interest based to a new Islamic financial system) increased the value added by 0.26 percent; almost as much as the contributions of the all labor force. This finding verifies the growth promotion hypothesis of Islamic economists and provides empirical evidence for the arguments that they have been put forth.

I- Conclusion

The objective of this study was two folded. On one hand it was intended to build a model for estimating the effect of financial services in the agricultural sector of Iran on the value added of this sector. On the other hand, the effect of drastic change in the financial and banking system of Iran in 1984 (1363 in Iranian calendar) – from an interest based system to an Interest Free Banking system and the obligation of carrying all the economic activities and policies according to Islamic rules- on the value added of the agricultural sector was the other goal we sought.. Based on our expectations (and also as suggested in the Islamic economic literature) we proposed that the abolition of interest rate from all kinds of credit and financial services would boost the economic activities and therefore increase the growth rate of production, here, in the agriculture sector.

In proceeding these two goals and based on the theoretical and of course empirical literature, we formulated a three tion system as our analytic model. The first tion was written to show that in the agricultural sector the flow of real investment is a function of its value added, the flow of financial credits, and last year's capital stock. The second tion was a capital accumulation identity, and the third tion indicated that in the agricultural sector the value added is a function of capital stock and labor. By estimating simultaneously this system of tions with co-integration method, we find that both long run and short run estimates of coefficients exhibit positive and significant effects of credit on both the capital stock and output. Furthermore, we showed that the full application of Islamic financial rules and tools of finance has also played a major and significant role in the increase of value added of

agriculture sector. Our findings in this study showed that the sheer change of banking and financial system from an interest based system to an Islamic interest free system has promoted the growth of agriculture sector almost as much as the contribution of labor force in this sector. These results reinforce the arguments of Islamic economists, as Mirakhor has summarized them, that the Islamic finance system does promote the production growth substantially.

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