Is Credit a Driver for Agricultural Growth? An Iranian Provincial Analysis

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ABSTRACT

Lack of adequate credit is among the major obstacles that Iranian agriculture, like many other developing countries, is facing. This study aimed at exploring the effect of formal credit on agricultural growth in Iran, using a unique provincial panel data set during 2000-2013. Different panel data econometrics techniques were applied. The main results indicated, on average, positive association between the sector growth and formal credit provided by the Agricultural Bank. The same relation was found for labor force. Meanwhile, public investment showed an indirect impact on the sector growth, though the size of effect differed among provinces. Redistribution of credits based on agricultural potentials of provinces is recommended as a key factor for increasing growth-related impact of credit.

Keywords: Agricultural Bank, Econometric model, Labor force, Panel data, Public investment.

INTRODUCTION

Bank credit plays a key role in economic growth, particularly in developing territories, by financing production, consumption, and capital formation which, in turn, stimulates the economic growth. Most of the previous studies on the credit-growth link have relied on macro (nationwide) data (Ang, 2008; Brezigar Mastena *et al.*, 2008; Barajas *et al.*, 2013) and little has been done at sector and, especially, provincial (state) levels.

The question on the role of credit in agricultural output has been a subject of vast debate in recent decades (Sharmeen and Chowdhury, 2013; Das *et al.*, 2009; Iqbal *et al.*, 2003). At the core of these debates is the impact of institutional credit on growth in agricultural output. When farmer faces a credit shortage, additional credit supply can raise output through two different mechanisms. Firstly, by promoting input use and investment, that is called liquidity effect of credit. Secondly, by smoothing out consumption and, therefore, increasing the willingness of risk-averse farmers to take risk of involving in a risky activity like agricultural production and make investments. This is the consumption smoothing effect of credit (Das *et al.*, 2009).

Many researchers have reported the positive effect of bank credit on output growth (King and Levine, 1993; Gregorio and Guidotti ,1995; Rajan and Zingales,1998; Das and Maiti,1998; Levine *et al.*, 2000; Hassan *et al.*, 2011; Lahura, 2011; Coricelli, 2015; Bhar and Hamori, 2015: Nkurunziza, 2010., and Banerjee, 2012). In the context of agriculture, Saboor *et al.* (2009) showed that credit could lead to poverty reduction in rural families of Pakistan whose main source of livelihood was agriculture. Sharmeen and Chowdhury (2013) found that agriculture is directly related to poverty

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alleviation in Bangladesh and credit has the capacity to get farmers into the efficiency cycle. Nwosu *et al.* (2010) reviewed the Agricultural Credit Guarantee Scheme Fund (ACGSF) in Nigeria. They concluded that since credit is needed for enhanced productivity and agricultural development, the three tiers of government in Nigeria should give the scheme the necessary support and publicity so that farmers (particularly small farmers) can benefit from its laudable objectives. Ananzeh (2016) examined the relationship between bank credit and economic growth in Jordan at different sectors for the period spanning from 1993 to 2014 using Vector Error Correction Model (VECM) and Granger causality test. Results confirmed a causal relationship going from economic growth to bank credit in agriculture and construction sectors in Jordanian economy. Sidhu *et al.* (2008) state that credit in agriculture acts like a two-edged weapon which could result in productivity enhancement if used productively and may lead to the problem of indebtedness if applied irrationally on unproductive activities. Positive and significant impact of credit on agricultural output is also seen in Nigeria (Udoka *et al.*, 2016; Anthony, 2010). Sial and Carter (1996) have estimated the shadow price of capital in Pakistani Punjab's agriculture using endogenous switching regressions techniques. Results indicate that an individual selected at random from the population of small farmers would experience a 200 per cent rate of return on the first rupee borrowed from the small farm credit program, indicating a high shadow price of capital and a prima facie case for small farm credit programs. Sial *et al.* (2011) tried to explore the role of institutional credit in agricultural production using the time series data in the context of Pakistani agriculture. Results show that agricultural credit, availability of water, cropping intensity, and agricultural labor force are positively significantly related to agricultural production

Agriculture is an important sector in the Iranian economy. It accounts for about 10 percent of national gross domestic product and provides 20 percent of the country's employment. Its contribution to non-oil export and food supply is estimated at 20 and 80 percent, respectively (Central Bank of the Islamic Republic of Iran, 2016). Iran Agricultural

Bank (IAB) as the only specialized bank involved with the agriculture sector, has had the responsibility to finance those engaged in the sector for more than eight decades and undoubtedly is central in meeting farmers' credit needs. In other words, IAB has allocated more than 95% of its resources to the sector through various types of credits. Based on the available data, the total volume of IAB credits soared from Rial (Iranian national currency which is, roughly) 16 trillion in 2011 to Rial 210 trillion in 2013, indicating a 1,200 percent growth (Sharifat *et al.*, 2015).

Iranian literature on credit-output relation in agriculture is poor. Although the economy-wide effect of credit on agricultural output is studied in some cases (Sharifi Renani *et al.*, 2014; Azimi, 2013), there is no evidence on regional impacts while, from policy making point of view, it's very important to know whether there is any province-specific impact of credits allocated. Therefore, the main aim of this study was to provide some reliable information regarding the type and size of IAB's credit impacts on agricultural output at provincial level. After providing a brief review of problem statement and literature, next section introduces materials and methods applied to meet study goals. Results obtained from estimated model are discussed in third section and last part of the paper concludes.

MATERIALS AND METHODS

Econometric Model

Following Udoka *et al.*, (2016), Chisasa and Makina (2015), and Das *et al.*, (2009), considering the diverse nature of agricultural activities and IAB credit distribution across the country, the dynamic panel data model (which is a typical aggregate production function) at provincial level was chosen as the most suitable regression specification. Dynamic panel data models contain one or more lagged dependent variables, allowing for the modeling of a partial adjustment mechanism. Dynamic panel data approach is based on the notion that the traditional instrumental variables method does not exploit all of the information available in the sample data. Equation (1) presents our log-log specified econometric model:

$$Va_{it} = \alpha + \beta_1 Cr_{it} + \beta_2 Lf_{it} + \beta_3 Ra_{it} + \beta_4 In_{it} + \beta_5 Va_{i,t-1} + \varepsilon_{it} \quad (1)$$

Here, α is intercept (constant of the regression) β's are slope parameters representing the average rate of change in left hand side variable as a result of one unit change in right hand side factors and ε is error term capturing effect of all influential factors not explicitly included in the regression. Description of variables is shown in Table 1. As discussed in introduction, we expect a direct relationship between credit and agricultural output. Based on economic theories, more labor force should lead to more output, but some believe that, in developing countries, agricultural activities are over-populated and a negative impact on output could be expected (Guo *et al.*, 2015). Due to a large share of dry farming in Iranian agriculture, the coefficient of rainfall is hypothesized positive. Finally, agricultural investment (mechanization, modern irrigation technologies, etc.) could result in more productive use of scarce inputs and, hence, higher production. After checking for stationarity of variables and possible co-integration relationships, Equation (1) was estimated using Generalized Method of Moments (GMM) which is suggested as a proper method of estimation for dynamic panel models (Arellano and Bond, 1991). By using Generalized Method of Moments (GMM), we may construct more efficient estimates of the dynamic panel data model.

Data

In order to provide estimates on credit-output relation, a unique panel data set consisting of annual provincial information for the period spanning from 2000 to 2013 (chosen based on availability of data) was used. All the required data was obtained from Central Bank of the Islamic Republic of Iran (CBI), IAB, and Statistical Center of Iran (SCI) official documents.

RESULTS AND DISCUSSION

Table 2 provides some descriptive statistics of variables. As can be seen, Mazandaran and Qom have the highest and lowest value-added and contribute the most and the least to national agricultural output, respectively. Tehran (Iran's capital) the seventh ranked province in terms of value added has absorbed greatest share of IAB credits (about 15 percent). On the other hand, the southern province of Fars, with over 366,000 agricultural labor force, ranks first in terms of job creation, while Qom provides the least agricultural job opportunities. Gilan, at northern part of the country, and central province of Yazd are rainiest and driest provinces with almost 1,120 and 70 millimeter annual precipitation, respectively. Finally, the highest share of public investment in agriculture belongs to southeastern province of Khoozestan with a little more than 12 percent of total public agricultural investment in the period, while Qom again captures the lowest ranking. The last two columns of Table 2 contain very informative data for policy makers. They show the average credit allocated by IAB per unit value-added created and person involved in the sector for different provinces. Here,

Table 1. Description of variables and expected sign of parameters.

variable	Symbol	Unit of measurement	Expected effect on dependent variable
Agricultural value-added	*Va*	Billion Rial at constant prices	-
Credits	*Cr*	Billion Rial	Positive
Labor force	*Lf*	thousand person	Positive/Negative
Rainfall	*Ra*	Millimeter	Positive
Agricultural investment	*In*	Billion Rial at constant prices	Positive
Lagged agricultural value added	$Va_{i,t-1}$	Billion Rial at constant prices	Positive

Source: Udoka *et al.* (2016); Chisasa and Makina (2015); Das *et al.*, (2009) and authors' additions.

Table 2. Descriptive statistics (average over 2000-2013).

Variable province	Va	Cr	Lf	Ra	In	Cr/Va	Cr/Lf
E-Aze	23063.23	2810.07	235.75	277.72	128.82	113.42	12.13
W-Aze	23788.63	2198.05	197.76	384.27	144.03	88.19	11.21
Ardabil	14119.05	1332.68	105.66	434.18	109.32	90.06	12.77
Esfahan	23441.51	4372.28	196.93	186.32	189.06	179.38	22.35
Ilam	4549.60	1464.86	54.35	407.45	103.32	296.34	27.36
Booshehr	7440.95	855.87	45.70	226.21	221.84	99.46	19.08
Tehran	23707.07	8914.03	77.06	325.09	179.49	371.21	136.03
C&B	8933.00	1095.94	63.82	335.48	109.06	119.58	17.34
Khoozestan	28856.92	3496.38	184.20	282.53	538.65	111.28	19.20
Zanjan	9617.03	1295.90	81.69	295.54	83.58	115.44	16.25
Semnan	7090.22	1441.66	37.46	131.65	78.61	187.74	38.65
S&B	11779.24	1077.41	164.19	85.17	318.21	78.61	6.75
Fars	43677.19	4576.66	366.16	262.60	353.26	98.31	12.67
Qazvin	11896.35	1310.31	77.81	330.57	104.68	99.54	17.19
Qom	3973.72	812.43	16.12	158.04	74.82	186.54	51.44
Kordestan	9132.64	1476.48	106.95	469.13	122.75	144.18	13.99
Kerman	34748.30	3550.87	250.21	114.95	212.80	89.96	14.38
Kermanshah	12302.94	1467.54	134.85	409.16	190.45	114.28	11.12
K&B	4897.72	642.56	57.49	554.50	128.58	121.11	11.44
Golestan	17269.34	2118.05	132.71	491.36	178.31	120.44	16.14
Gilan	16617.55	1745.47	303.01	1128.03	111.37	100.36	5.82
Lorestan	13171.71	1615.72	125.00	439.08	139.50	112.90	13.09
Mazandaran	44517.22	4128.85	225.28	752.97	128.78	84.08	18.48
Markazi	11462.11	1804.61	88.44	252.51	102.72	145.21	20.79
Hormozgan	10435.76	1035.79	92.95	115.96	195.09	91.21	11.33
Hamedan	17563.29	1608.80	137.78	332.30	129.20	86.24	11.79
Yazd	8566.68	1671.32	81.95	70.03	127.91	161.65	20.85
Average	16541.44	2219.28	134.86	342.70	166.82	133.58	21.84
Max	44517.22	8914.03	366.16	1128.03	538.65	371.21	136.03
Min	3973.72	642.56	16.12	70.03	74.82	78.61	5.82

Source: CBI, IAB, SCI and authors' calculations.

Tehran captures top ranking in terms of the two above- mentioned indices, while it has no position better than 7th and 20th with respect to *Va* and *Lf*. This finding clearly suggests that the criteria and procedures applied by IAB in distribution of credits at provincial level should be revised. In other words, the more value-added and job creator province should be rewarded by more credits allocated. Here, the lowest credit allocated per unit value added belongs to Sistan and Balouchestan province of Sistan and Balouchestan (S&B). Also Gilan, a major rice producing region, ranks the lowest position in terms of credit per unit labor force engaged. This should be attributed to labor-intensive nature of rice production in Iran.

In order to provide proper estimates of the parameters in Equation (1) and avoid encountering problem of spurious regression, stationarity of variables is tested and reported in Table 3. In order to test the existence of both common and individual unit roots, two different and widely used tests including Levin-Lin-Chu (2002) and Im-Pesaran-Shin (2003) are applied. The null hypothesis of both tests is defined as presence of unit root (non-stationary variable).

It's obvious that three out of five variables (Lf, Ra and In) are stationary (have no unit root) while the other two variables (Va and Cr) are not stationary (have unit root). By ignoring different order of integration of variables, Kao residual cointegration test was applied to investigate existence of long run equilibrium relationship

Table 3. Unit root tests results.[a]

Test variable	LLC level	First difference	IPS Level	First difference	Result
Va	3.11	-8.80***	2.80	-3.80***	I(1)
Cr	6.45	-14.22***	8.97	-7.45***	I(1)
Lf	-13.96***	-	-9.25***	-	I(0)
Ra	-12.32***	-	-6.07***	-	I(0)
In	-8.74***	-	-4.99***	-	I(0)

[a] LLC stands for Levin, Lin and Chu; IPS stands for Im, Pesaran and Shin. Three asterisks denote significance at one percent level; all variables are in natural logarithm.

among variables. The calculated t-statistic (2.72**) confirmed existence of such relation implying no concern about spurious regression. Furthermore, we can state that all variables considered followed the same path through time and the effect of any shock transmitted to the model would gradually disappear. So, Equation (1) was estimated properly using GMM method that provides reliable estimates in dynamic panel models. Table 4 portrays results. The variable of interest (Cr) shows a positive and significant impact, as expected, on agricultural growth, which is in line with Sharifi Renani *et al*. (2014) and Azimi (2013). Since all variables are in natural logarithms, estimated coefficients should be interpreted as elasticities. Therefore, we expect that one percent increase in credits allocated by IAB lead approximately to 0.06 percent rise in sector value-added. Of course, the size of effect seems small. It could be regarded as an indicator of inefficiency in credit allocation mechanism or misuse of distributed credits.

Same effect, but a little stronger, was found for labor force, which is expectable due to labor-intensive nature of agricultural activities in Iran. To be more specific, one percent increase in agricultural labor force results, on average, in 0.06 percent more value-added. Two other variables, namely, *Ra* and *In*, indirectly relate to agricultural growth, though coefficient on rainfall is insignificant. The reverse impact of public investment could be attributed to lack of efficient training programs on the ways that farmers should benefit from huge public budget spent on development of modern irrigation systems. This is a reality in many regions where inappropriate irrigation systems are installed and farmers are not effectively equipped with knowledge of how to use it. This finding is critical to both agricultural policy makers and IAB that aimed at rapid development of modern (under-pressure) irrigation systems in the last two decades as a best choice for water use efficiency enhancement in agriculture. The insignificance of rainfall estimated coefficient might be attributed to the change in timing and spatial pattern of precipitation due to climate change, which is in fact one of the main challenges Iranian agriculture is facing since a few years ago. The lagged value added [Va(-1)] posses a high value of estimated parameter implying existence of high dependence in dependent variable data. In other words, the higher (lower) is agricultural growth in current year, the higher (lower) would be sector growth in upcoming year. All the three diagnostic

Table 4. Panel GMM estimates of the parameters.[a]

Variable	Coefficient	*std*-Error	*t*-Stat	Prob
Constant	-0.1254	0.0681	-1.8409	0.0665
Cr	0.0609	0.0132	4.5994	< 0.0001
Lf	0.0640	0.0232	2.7531	0.0062
Ra	-0.0156	0.0116	-1.3405	0.1810
In	-0.0323	0.0112	-2.8863	0.0041
Va(-1)	0.8917	0.0298	29.9344	< 0.0001
R-squared = 0.9658	*J*-stat= 3.83×10^{-22}	*BG*-stat= 12.48	*obs*= 351	

[a] All variables are in natural logarithm.

criteria, reported at ending row of the table, confirm adequacy of the estimated model. The calculated R-squared shows high explanatory power of the estimated model as all the variables included explain more than 96 percent of dependent variable variations and only four percent of variations relates to the excluded variables. The very small value of *J*-stat suggests that the model fits the data well. Finally, the calculated value of Breusch-Godfrey test statistic (BG-stat) (Maddala and Lahiri (2009)) rejects existence of any autocorrelation in error terms. This test is used to assess the validity of some of the modeling assumptions inherent in applying regression models to observed data series. In particular, it tests for the presence of serial correlation that has not been included in a proposed model structure and , if present, would mean that incorrect conclusions would be drawn from other tests, or that sub-optimal estimates of model parameters are obtained if it is not taken into account. The regression models to which the test can be applied include cases where lagged values of the dependent variables are used as independent variables in the model's representation for later observations. Also, total number of observations used in estimation of Equation (1) was 351 (=27×13).

CONCLUSIONS

Considering high relevance of credit to economic growth at one hand and outstanding role of agriculture in Iranian economy as a source of employment, food security, and rural families' well-being, the present study aimed at identifying growth-related impact of credits allocated by Iran Agricultural Bank. This paper contributes to the literature on output-credit relationship in agriculture by using (for the first time in Iranian relevant literature) data on a panel of 27 provinces spanning from 2000 to 2013. After checking for some prerequisites on working with panel data (data stationarity, cointegration relationship, decision on pool or panel structure of data) a type of dynamic aggregate production function was estimated using generalized method of moments approach. Main results confirmed our hypothesis on direct association between IAB credits allocated and agricultural output, which has never been

reported at regional level previously. Our estimates reveal a positive and weak impact of IAB credits allocated on sector growth. It's expected that one percent increase in credits provided by IAB causes a 0.06 percent rise in agricultural growth. This impact should be reinforced by scrutinizing the ways credits are used. Moreover, labor force relates positively and significantly to sector output highlighting the vital role of human labor in Iranian agriculture. We expect that one percent more labor force engaged in agriculture would result in almost 0.06 percent higher sector growth. This should be kept in mind when pursuing higher mechanization rate in agriculture. In other words, development of mechanization in regions with low impact of labor force is recommended. The only theoretically unexpected finding goes to public investment which has a negative coefficient in the estimated model. This contradiction can be explained by examining government policy on development of modern pressurized irrigation systems as a major public investment in Iranian agriculture, which has absorbed considerable share of allocated subsidized (with low interest rate) credits by IAB in recent decades. In other words, inconsistency between farmers' needs and type of installed irrigation systems in some regions, in one hand, and lack of proper training programs on using installed systems, on the other hand, resulted in reverse impact of public investment on agricultural output. Strong and significant lagged dependence between agricultural growths in two successive years implies that a favorable performance of agriculture in current year is expected to be followed by a more productive agriculture in the next year and vice versa. It's another important point for policy makers. An unfavorable year for agriculture (due to incidence of drought, for instance) means that government should get ready for bridging the gap between domestic production and demand in the following year which, in turn, needs allocation of the required budget. Empowering IAB financial resources and rearrangement of government policy on development of modern irrigation systems with special emphasis on exploring farmers' needs and knowledge are recommended. Moreover, this study strongly recommends allocation of IAB's credits based on growth experiences and potentials at provincial

level. In other words, IAB's authorities should provide more credit to those provinces with higher productivity of credit (higher output resulting from one additional credit allocated) and more growth potential.

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آیا اعتبارات عاملی برای رشد کشاورزی است؟ تجزیه و تحلیل استانی در ایران

س. پروا، و ر.مقدسی

چکیده

کمبود اعتبارات از جمله مهمترین موانع پیش روی کشاورزی ایران، همانند سایر کشورهای در حال توسعه، می باشد. مطالعه حاضر به دنبال برآورد اثر اعتبارات رسمی توزیع شده توسط بانک کشاورزی بر رشد کشاورزی به کمک داده های پانل استانی برای دوره ۱۳۹۲- ۱۳۷۹ بوده و برای این منظور تکنیک های اقتصاد سنجی اطلاعات پانل را بکار گرفته است. مهمترین یافته های حاصل بر وجود ارتباط مثبت میان اعتبارات بانک کشاورزی و رشد کشاورزی دلالت دارد. اثر مشابه در خصوص نیروی کار نیز مشاهده شد. در ضمن یک ارتباط معکوس بین سرمایه گذاری های دولتی و رشد بخش تخمین زده شد اگرچه بزرگی این اثر در استان های مختلف متفاوت می باشد. بازتوزیع اعتبارات بر مبنای ظرفیت های کشاورزی استان ها به عنوان عاملی مهم در ارتقاء اثر اعتبارات بر رشد بخش پیشنهاد شده است.