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THE IMPACT OF PUBLIC EXPENDITURE ON PRIVATE INVESTMENT IN AGRICULTURE: CROWDING IN OR CROWDING OUT? EVIDENCE FROM AZERBAIJAN

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ABSTRACT

This paper aims to conduct an empirical enquiry into determining the impact of public expenditure on private investment in agriculture to discover as to whether the former casts a crowding-in or crowding-out effect on the latter, simultaneously controlling for the oil-related factors which are oil price and oil production in the case of Azerbaijan. The Autoregressive Distributed Lag Bounds Testing (ARDLBT) approach to cointegration has been applied by means of employing the quarterly data for the period 2001Q4–2017Q3. The results manifest that public expenditure crowds in private investment to agriculture in the long-run, demonstrating both strong statistical and economic significance. The empirical findings obtained herein are beneficial for the policy-making purposes, and the meagreness of the related literature concerning Azerbaijan makes us deduce that further empirical research should be implemented.

Key words: Public Expenditure, Private Investment, Agriculture, Crowding in, Crowding out, Azerbaijan.

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Introduction

Historically, in the wake of the Great Depression of 1930s, beginning from those very years onwards, it has been in the best interest of governments to take measures necessary to overcome economic downturns once they were present. John Maynard Keynes was the one who had firstly stressed the significance of the government intervention by means of implementing expansionary fiscal policy during those both economically and socially depressed years (Keynes, 1936). The fact that it practically comprises both increased government expenditures and reduced taxes is intended to augment aggregate demand which consequently, boosts the overall economy of a country concerning greater economic growth. Notwithstanding, this issue has long been in the centre of heated economic debates, since the views on this are polarised in terms of its validation.

Specifically, two notions regarding the impact of public expenditure on private investment are existent labelled "crowding-in" and "crowding-out" effects. If public expenditure to revive the economy is found to display a positive impact on private investment, then economists consider this phenomenon the crowding-in effect. In this case, the economic initiatives taken by public sector does not necessarily shrink the magnitude belonging to private sector, nor do they cause an increase in interest rates. Some empirical results studied by far in the case of various economies, inclusive of both developing and developed countries indicate that public expenditure crowd in private investment through different channels (Dreger and Reimers, 2015; Argimón *et al.*, 1997; Abiad *et al.*, 2015; Hebous and Zimmerman, 2016)

On the other hand, if public expenditure casts a negative impact on private investment, it is regarded as the crowding-out effect. Put differently, economic activities of public sector leads to diminishment of the share of private sector, as well as an increase in interest rates which leave fewer investment opportunities for private sector. Several authors have addressed this issue by providing empirical proof for that matter (Furceri and Sousa, 2009; Sinevičienė, 2015; Miyazaki, 2016; Kim and Nguyen, 2017; Şen and Kaya, 2014; Cavallo and Daude, 2011). Yet, we found in the existing literature that it is also possible to for public expenditure to illustrate both effects at the same time, depending on the sectors into which governments intrude (Mahmoudzadeh *et al.*, 2013; Hermes and Lensink, 2001; Mamatzakis, 2001; Xu and Yan, 2014; Atukeren, 2005).

Subsequent to Azerbaijan proclaiming its independence in 1991, its economic development phases have been divided up into several periods, being recession period (1991-1994), restructuring period (1995–2005), oil boom period (2005–2015), and post-oil period (2015–present) (Aliyev and Suleymanov, 2015). The higher magnitude of oil revenues during the oil boom period was intuitively on account of the worldwide upsurge in oil price which paved the way for the Azerbaijani government to adopt expansionary fiscal policy via undertaking various public economic and social programmes.

The underlying motive behind our analysis is to investigate the impact of government spending on private investment in agriculture. Applying the ARDLBT approach to cointegration, our objective is to discover whether the former crowds in or crowds out the latter for the period 2001Q4–2017Q3.

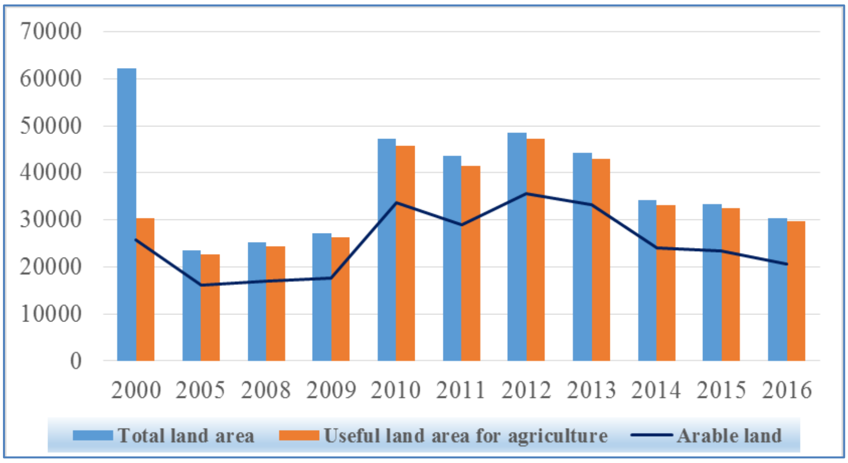
1. Background

In this section, we would like to touch upon several crucial points such as the geographical location of Azerbaijan which is one of the underlying factors in agriculture, agricultural output, as well as public support on agriculture along with the key statistics linked to the mentioned aspects.

Geographically, Azerbaijan is located in one of the most diverse, yet at the same time, historically, the most disputed areas of Eurasia, namely, Caucasus region. As any other developing country in the globe, agriculture is an integral part of the economy of Azerbaijan despite the fact that industry, predominantly, oil sector, constitutes the largest portion of the economy. In the figure 1 below, one can see the comparable bar chart representation of total and useful land areas for agriculture along with the line for arable land area by hectare built on the annual data for the period 2000–2016, exclusive of the period covering 2001–2004 as well as 2006 and 2007 due to the unavailability of data. One can noticeably observe that arable land area plummeted between 2012 and 2014, and from the latter year onwards, it has been declining steadily.

In Azerbaijan, just like any other country in the world, agricultural output is divided up into two parts as being public and private agricultural production. Owing to the limitations in terms of data availability, we could not illustrate a figure for the public agricultural production. However, since this is not the case with the private agricultural production, we have constructed a bar chart to demonstrate the yearly changes utilising the annual data over the period 2005–2016 with the exception of 2006 and 2007 once again because of the data unavailability. Moreover, it should be emphasised that real total production by agricultural enterprises, which has been adjusted for inflation with regard to the consumer price index (CPI) on agriculture, processing, and fishery, has been designated to be regarded as the private agricultural production. As the figure 2 below suggests, it increased dramatically in 2010 and then remained levelled-off until 2011 which afterwards, rose relatively significantly beginning from that year on, and we contemplate it may well be due to new regulations on tax concessions, subsidies, etc., as well as agricultural grants.

Figure 1: Division of Land Area, *ha*



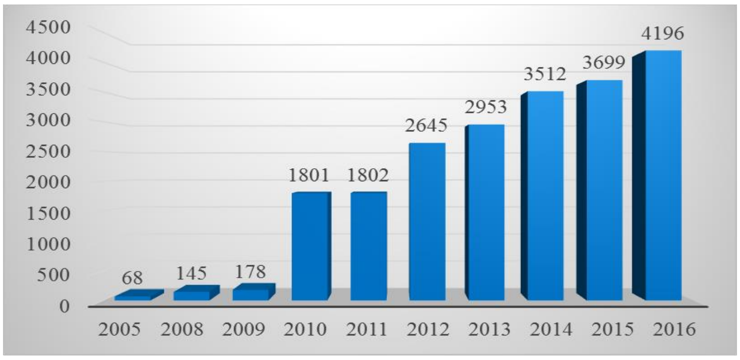
Source: The State Statistical Committee of the Republic of Azerbaijan, 2017

In addition, Azerbaijani government provides public support for the agricultural sector in the forms of various means such as subsidies, temporary tax exemptions and concessions as well as concessional loans for the farmers and entrepreneurs, discounts on fertilisers, and some other procedures alike (Danilowska, Ismayilov, and Aliyev, 2014; Aliyev and Gasimov, 2018a).

In a general sense, the National Fund for Entrepreneurship Support, numerous non-bank organisations, which give loans to entrepreneurs under soft terms, exist to ensure the development of agricultural sector. At the same time, one of the core principles of the "State Programs on Socio-Economic Development of Regions" is to establish favourable grounds to enhance agricultural sector. Huseyn (2014) has classified the subsidies to the agricultural sector into two categories which are subsidies by products and non-product subsidies. Subsidies by products include the certain amount of money allocated to wheat and rice producers depending on the planted areas, 50% government subsidy to farmers for acquiring seeds, 70% government subsidy to wheat farmers for obtaining mineral fertilisers, and 50% discount for the procurement of cattle pedigree. On the other hand, non-product subsidies cover relatively wider range of issues such as tax exemptions to agrarian producers, soft loans to agrarian producers, 50% discount to producers for acquiring fuel and motor oils, 50% discount to producers for obtaining mineral fertilisers, machinery sale to producers at advantaged leasing terms, and advantaged price set on irrigation water for the agrarian producers.

Additionally, Huseynov (2015) states that aid to the agricultural producers can be grouped into three general categories. The initial category is *direct budgetary support* (or *direct income support*) mechanism whose principles are defined by the "Law of State Support to Agricultural Producers" (SSAP, 2007).

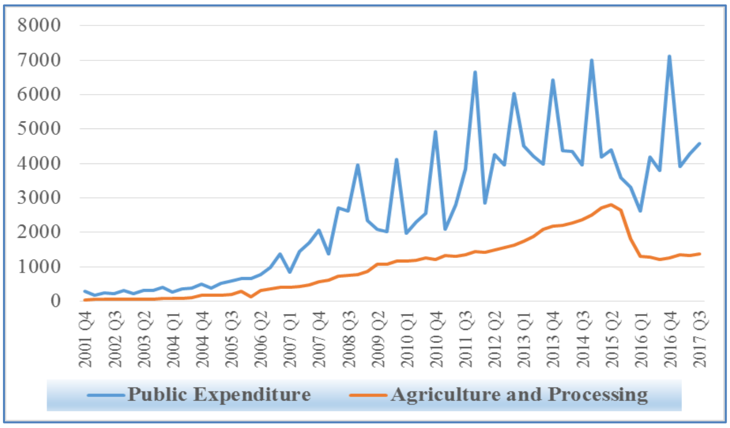
Figure 2. Real Total Production by Agricultural Enterprises, *mln. AZN*



Source: The State Statistical Committee of the Republic of Azerbaijan, 2017

This policy comprises per-hectare payments for agricultural producers so as to encourage the producers to augment the areas sown with wheat and rice. Another category is labelled as *input subsidies* which incentivise production as well as mitigate the variable input costs incurred by agricultural producers. In 2004, Azerbaijani government established the parastatal Agroleasing Open Joint Stock Company to implement domestic support policy in agriculture.

Figure 3: The dynamics of public expenditure and loans given to private investment in Agriculture and Processing, *mln. AZN*



Source: The Central Bank of the Republic of Azerbaijan, 2017

Specifically, the company carries out several measures such as provision of 50% subsidised fertiliser to agricultural producers, a subsidy for irrigation water, a 50% subsidy for farmers to purchase breed animals, and provision of machinery and technical equipments under concessional conditions. The final category is called *tax concessions* in accordance with the "Law on terms of the tax exemptions on agricultural producers" (1999). This regulation aims to exempt agricultural producers from tax payments inclusive of profit taxes, value added taxes, and income taxes; however, only the land tax is required to be paid.

Furthermore, in order to have a better comprehension of the changes in private investment in agriculture and processing with respect to the changes in public expenditure, we have built a line chart based on the quarterly data for the period 2001Q4–2017Q3. As the figure 3 below portrays, one can observe the gradual rise in private investment in agriculture and processing until the second quarter of 2015 when private investment in this category commenced to plunge which coincides with the first devaluation of the national currency, the Manat. Simultaneously, despite the fluctuations in public expenditure, the same tendency holds true for that matter due to the aforementioned reason. Nonetheless, it reached its highest level in the fourth quarter of 2016 although it followed the declining trend after 2014. On top of that, according to the annual data on the revenues and expenditures of the state budget formulated by the State Statistical Committee of the Republic of Azerbaijan, expenditures allotted to national economy underwent a sharp fall, while those of social protection and security, art and cultural activities as well as the category of other expenditures skyrocketed compared to the previous years.

2. Literature review

Thus far, several studies on the economies of various countries have been conducted as to discover whether public spending crowds in or crowds out private investment in agriculture as well as the impact of public spending in infrastructure on long-term agricultural productivity and growth. Despite the fact that what we are looking for in the existing literature is not so plentiful, we have done our best to unearth that fair number of studies and encompass them in our empirical analysis.

Binswanger *et al.* (1993) studied the impact of infrastructure and financial institutions on agricultural output and investment in the case of India, making use of district-level time-series data. Empirical results constitute that availability of education infrastructure and the rural banks convey a significant role in making decisions on investment, input, and output. Additionally, during the time that farmers respond to infrastructure, the governments in exchange earmark their infrastructure investments for the agroclimatic potential of the districts. Eventually, banks position their branches in such places where the agroclimate and infrastructure are beneficial for functioning.

Murgai *et al.* (2001) investigated the long-term productivity and sustainability of irrigated agriculture in the Indian and Pakistani Punjabs via estimating trends in total factor productivity for production systems since the inception of the Green Revolution. The measurements obtained therein suggest the necessity for policies which can lead to enhance agricultural productivity and sustainability by means of public investments in education, roads, as well as research and extension.

Evidence from the Indian agricultural sector concerning capital formation reveals that public sector investment casts a stimulation effect on the private sector capital formation, further speculating that other factors such as the terms of trade have significantly affected private investment in agriculture (Gulati and Bathla, 2001).

Another empirical analysis concerning the effect of public infrastructure on agricultural growth productivity in Greece by means of using the data for the period 1960–1995 reveals that there is a positive relationship between the abovementioned economic factors. Also, the decline in the productivity growth of Greek agriculture in 1980s can be, in some sense, justified by a decline in public infrastructure investment (Mamatzakis, 2003).

Evidence from Ghana exhibits that 1 percent increase in public expenditure on agricultural sector accompanies a 0.15 percent increase in agricultural productivity (Benin *et al*, 2009). Armas *et al.* (2012) concluded that public spending on agriculture and irrigation has a positive effect on agricultural growth, whereas public spending on fertiliser subsidies has the inverse effect. The empirical findings obtained by Ele *et al.* (2014) disclose that agricultural capital expenditure affects agricultural growth positively; furthermore, unidirectional relationship between these two economic variables portrays that agricultural public capital expenditure augments the country's agricultural economic growth.

Jambo (2017) demonstrated that agricultural growth and expenditures on input subsidy programs (ISPs) and price support programs (PSPs) expose an opposite impact on agricultural research in Zambia. In Malawi, on the contrary, spending on PSPs positively affects agricultural growth; moreover, spending on agricultural research has a greater effect on growth. In the case of South Africa, the empirical findings suggest that it allots public expenditure to spending categories with the greatest returns, further specifying that agricultural research is of prime concern.

3. Theoretical Framework

To the best of our knowledge, the impact of public expenditure over private investment in any categories has not been investigated before. However, in a number of studies, the role of public expenditure in stimulating economic growth of non-oil sector has been analysed empirically (Koeda and Kramarenko, 2008; Aliyev, 2013; Hasanov, 2013; Aliyev *et al.*, 2016; Dehning *et al.*, 2016; Aliyev and Mikayilov, 2016; Aliyev and Nadirov, 2016; Hasanov *et al.*, 2016; Hasanov and Alirzayev, 2016, Gurbanov *et al.*, 2017; Hasanov *et al.*, 2018). On the whole, fiscal policy is considered to be effective in the context of developing non-oil sector in Azerbaijan (Aliyev and Gasimov, 2018b). Therefore, we expect to find crowding-in effect of public expenditure over private investment in agriculture and processing in Azerbaijan. On top of that, strong government support to this sector also evinces our expectation.

Since the core aim of our study is to determine the impact of public spending on private investment in agriculture regarding the fact that whether the former crowds in or crowds out the latter, this section is devoted to discuss the two abovementioned economic terms in a broader sense. Fundamentally, three distinct approaches related to the impact of public spending on private investment are existent which they all differ from one another.

The first view is the *Neoclassical* approach which maintains that full employment exists, further stressing the significance of competitive markets contrary to government intervention. Once government spending tends to rise over time, interest rates have to also increase, since more demand is present owing to the government involvement in the loanable funds market which paves the way for the fact that it will, in the end, crowd out private investment (Grieve, 2004). Additionally, as a consequence of the budget deficit due to expansionary fiscal policy for undertaking welfare expenditures, one can expect that government will increase taxes which in turn, will crowd out private investment.

The *Keynesian* view, by contrast, holds that there is unemployment in the economy, and the interest rate responsiveness of investment is low. In this regard, expanded fiscal spending will result in negligible or no increase in interest rates and simultaneously, higher aggregate demand. Moreover, this approach claims that government spending affects private investment positively on account of the optimistic expectations of the investors as well as infrastructure effect. As a matter of fact, Aschauer (1989) argues that one percent increase in core infrastructure leads to 0.24 percent increase in GNP. By the same token, subsequent to four years or so, public investment of each marginal dollar in infrastructure augments private investment by 45 cents which is interpreted as a crowding-in effect. The primary reason as to why public spending enhances private sector efficiency profits and investment is that public premises such as a powerful transportation system of airports, highways, and mass transit deliver beneficial services to firms.

Last but not least, the *Ricardian Equivalance Theorem* emphasises that a surge in the budget deficit is envisaged to be co-existent with a soar in taxes in the future. Put differently, as households anticipate this very occasion, taking their reduced disposable income in the upcoming years into consideration, they will not tend to alter their consumption, but instead, they will be inclined to increase their savings. Furthermore, a fall in the government's saving, i.e., a current budget deficit will be offset by growth in private saving, resulting in zero change in national saving. Thus, interest rates and private investment will remain unchanged which is considered to be neither crowding-in nor crowding-out effect of public spending (Barro, 1989).

4. Data

All the data used herein are quarterly-based and have been elicited from the various sources, covering the period 2001Q4–2017Q3. The variables are designated as follows:

Private Investment in Agriculture (PIA) indicates the loans given to the legal entities operating under the agricultural and processing, forestry, or fishing sectors, estimated in million AZN. The quarterly data have been extracted from the statistical bulletins of the Central Bank of Azerbaijan (CBAR), constructed on a monthly basis.

Table 1: The descriptive statistics of the variables (2001Q4-2017Q3)

Variable	No. of observations	Mean	Maximum	Minimum	Std.Dev.	Sum
PIA	64	424.4066	953.2300	40.36000	272.0535	27162.02
PEx	64	1119.025	2914.850	161.2100	680.4614	71617.62
OPrc	64	66.45141	121.1000	19.30000	29.06997	-
OPrn	64	734.7270	1066.000	290.0000	258.5076	47022.53

Source: Authors' own creation.

Public Expenditure (PEx) denotes public spending through the central budgetary channels, estimated in million AZN. The quarterly data have been obtained from the statistical bulletins of the CBAR.

Oil Price (OPrc) portrays the quarterly adjusted world price of the Brent crude oil per barrel which has been acquired from the Bloomberg. Despite the fact the initial data were monthly-based, we converted them to the quarterly-based frequency.

Oil Production (OPrn) signifies the quarterly oil production, measured in thousand barrels per day. The data existent on a monthly basis have been taken from the Trading Economics database and altered to a quarterly basis.

Table 1 depicts the descriptive statistics of the variables.

5. Empirical methodology

This section is allocated to tackle the empirical methodology conducted herein. In our research, we apply the Autoregressive Distributed Lag Bounds Testing (ARDLBT) approach to cointegration method to estimate the long-run relationship and short-run dynamics between the factors affecting the private investment in agriculture and public expenditure. However, prior to conducting this methodology, we have to initially determine the order of integration of the variables utilised via employing the Augmented Dickey-Fuller (hereinafter ADF) unit root tests which analyse non-stationarity in a given time series (Dickey and Fuller, 1981).

a. Unit root test

In the ADF test, the null hypothesis which is that y_t is I(1) against the alternative, I(0), is tested while assuming that the dynamics in the data convey an ARMA structure. In other words, it tests the existence of non-stationarity in a provided time series, hypothesising that this time series is non-stationary. The test is conducted by means of estimating the regression

$$\Delta y_t = \mu_0 + \varphi trend + \mu_1 y_{t-1} + \sum_{j=1}^{k} \delta_j \Delta y_{t-j} + \varepsilon_t \tag{1}$$

where Δ is the first difference operator, and μ_0 is a constant term. In addition, the vector of deterministic term, in this regard, $trend$ portrays linear time trend. The number of lagged values is symbolised as k, and j denotes the lag order. Lastly, ε_t is a sign of white noise residuals.

b. Autoregressive Distributed Lag Bound Testing (ARDLBT) Approach

This alternative method to the cointegration is developed in Pesaran *et al.* (2001) which we are going to apply in our research. By contrast to the alternative approaches, this method has numerous upsides such as its applicability in small samples through utilising Ordinary Least Squares (OLS) under the absence of the endogeneity problem with both I(0) and I(1) series or their combination, as well as simultaneous estimation of the long- and short-run coefficients (Pesaran *et al.* 2001, Oteng-Abayie and Frimpong, 2006, Sulaiman and Muhammad, 2010). Considering the fact that we have a relatively small number of observations, this approach is consistent to apply in our empirical analysis. The approach is composed of the subsequent stages (Pesaran *et al.*, 2001):

Construction of an Unrestricted ECM.

$$\Delta y_t = c_0 + \theta y_{t-1} + \theta_{yxx} + \sum_{i=1}^{n} \omega_i \Delta y_{t-i} + \sum_{i=1}^{n} \varphi_i \Delta x_{t-i} + u_t \tag{2}$$

The variables in the equation above are elucidated as follows; y is the response and x is the explanatory variable, while u symbolises white noise errors. On top of that, c_0 illustrates drift coefficient, θ_i is a sign of long-run coefficients, and ω_i together with φ_i represent short-run coefficients.

Employing the Wald Test (or the F-test) to test the existence of the cointegrating relationship.

Subsequent to building an Unrestricted ECM, the Wald Test (or the F-test) is employed to test whether there is a cointegrating relationship amongst the θ_i coefficients. By means of this test, the null hypothesis is considered no cointegration illustrated as, $H_0: \theta_1 = \theta_2 = \theta_3 = 0$, while the alternative hypothesis is the exact opposite demonstrated as, $H_1: \theta_1 \neq \theta_2 \neq \theta_3 \neq 0$.

Bear in mind that we reject the null if the value of computed F-statistic from the sample is higher than the greatest level of the critical level consistent with a given level of significance. By the same token, if the value of F-statistic from the sample is less than the lowest level of the critical level at a particular level of significance. On the other hand, test results will be inconclusive once the sample value of F-statistic falls between the lowest-and-highest bands of the critical value.

On a side note, it should be emphasised that since the F-statistic values in the ARDLBT cointegration exhibit non-standard distribution in comparison with the conventional critical values of F-distribution, these values are not of use. Thus, instead, we should take the critical values of F-distribution calculated by Pesaran and Pesaran (1997) or Pesaran *et al.* (2001) into account.

The next step is to estimate the long-run coefficients once a cointegrating relationship amongst the variables is existent. It should be underlined that the estimation of these coefficients can be calculated in line with the equation (2) through conducting the Bewley transformation (Bewley, 1979) or plainly setting $c_0 + \theta y_{t-1} + \theta_{yxx}$ manually to zero and estimating y as follows:

$$y = -\frac{c_0}{\theta} - \frac{\theta_{yxx}}{\theta} x + u \quad (3)$$

In the final stage, we can estimate the long-run residuals in line with the equation (3) and apply it on the equation (2), simultaneously removing the level variables and related coefficients:

$$\Delta y_t = c_0 + \sum_{i=1}^{n} \omega_i \Delta y_{t-i} + \sum_{i=1}^{n} \varphi_i \Delta x_{t-i} + \gamma ecm_{t-1} + u_t \quad (4)$$

where,

$$ecm_t = y_t - \frac{c_0}{\theta} - \frac{\theta_{yxx}}{\theta} x_t \quad (5)$$

We can deduce the stability of the co-integration relationship if the value of γ is between -1 and zero as well as statistically significant, implicating the temporariness of the short-run deviations from the long-run equilibrium path which correct toward the latter one.

Thus far, several analyses have been implemented to address the validity of the critical values of the F-distribution for small- and large-sized samples. Contrary to the upper and lower critical values of the F-distribution calculated by Pesaran and Pesaran (1997) via utilising sample sizes of 500 and 1000 alongside 20 000 and 40 000 replications, respectively, Narayan (2005) argues that these values are not pertinent to small-sized samples. Narayan (2004, 2005) further maintains that these values are not employable for small-sized samples, since they are calculated in line with large-sized samples. To substantiate his assumption, Narayan has compared the critical values drawn from 31 observations with those in Pesaran *et al.* (2001) together with four regressors at the 5% level of significance. His findings proved his own argument, and in this sense, he estimated new critical values of the F-distribution making use of the small-sized samples of 30 up to 80 observations. Hence, we will apply the Narayan (2005) critical values on our ARDLBT cointegration test so as to control the small sample issues.

6. Empirical Results

a) Unit Root Test Estimations

Table 2 below demonstrates the ADF, PP, and KPSS unit root test estimations with and without trend. According to the results, all the variables subject to these three different unit root tests are I(1) with or without the trend in the regression. Yet, we can obviously notice that *PEx* is I(0) while excluding and including the trend when we apply the PP unit root test. As per the KPSS unit root test, the only exception is *OPrn* which is non-stationary without trend at first difference, implying that it has a unit root and is not I(1); however, when we include the trend, we can blatantly observe that it is I(1) at first difference.

Table 2: The unit root tests estimations

	Variable	The ADF test			The PP test			The KPSS test	
		Level $I(0)$	k	First Difference $I(1)$	k	Level $I(0)$	First difference $I(1)$	Level $I(0)$	First difference $I(1)$
Intercept	*PIA*	-1.584	1	-5.537***	0	-1.497	-5.535***	0.790***	0.247
	PEx	-1.472	4	-4.653***	3	-3.99***	-23.54***	0.801***	0.137
	OPrc	-2.362	1	-6.415***	1	-2.009	-5.832***	0.408*	0.246
	OPrn	-1.701	0	-6.529***	0	-1.658	-6.611***	0.661**	0.422*
Intercept and trend	*PIA*	-1.229	1	-5.650***	0	-0.816	-5.665***	0.160**	0.114
	PEx	-1.365	4	-4.724***	3	-5.59***	-23.37***	0.242***	0.098
	OPrc	-2.127	1	-6.566***	1	-1.534	-6.262***	0.203**	0.065
	OPrn	-0.641	0	-6.844***	1	-0.776	-6.695***	0.236***	0.094

Notes: ADF, PP, and KPSS denote the Augmented Dickey-Fuller, Phillips-Perron, and Kwiatkowski-Phillips-Schmidt-Shin tests, respectively. Maximum lag order is set to 10, and optimal lag order (k) is selected based on the Schwarz criterion in the ADF test; ***, **, and * indicate the rejection of the null hypotheses at the 1%, 5%, and 10% levels of significance, accordingly. The critical values are taken from MacKinnon (1996) and Kwiatkowski-Phillips-Schmidt-Shin (1992) for the ADF, PP, and KPSS tests, respectively. Estimation period: 2001Q4-2017Q3.

b) The Estimations from the ARDLBT Approach

In our empirical analysis, we have three independent variables; furthermore, it should be once again highlighted that we have denoted agricultural private investment, public expenditure, oil price, and oil production as *PIA*, *PEx*, *OPrc*, and *OPrn*, respectively. In this sense, the equation (2) is modified as follows:

$$\Delta y_t = c_0 + \theta y_{t-1} + \theta_{yx} x_{t-1} + \theta_{yv} v_{t-1} + \theta_{y\vartheta} \vartheta_{t-1} + \sum_{i=1}^{n} \omega_i \Delta y_{t-i} + \sum_{i=1}^{n} \varphi_i \Delta x_{t-i} + \sum_{i=1}^{n} \gamma_i \Delta v_{t-i} + \sum_{i=1}^{n} \mu_i \Delta \vartheta_{t-i} + \rho_1 SEAS(1) + u_t \quad (6)$$

where y_t is Private Investment in Agriculture (*PIA*), x_t designates Public Expenditure (*PEx*), v_t denotes Oil Price (*OPrc*), ϑ_t indicates Oil Production (*OPrn*), and $SEAS(1)$ accounts for the seasonality impact of the winter term.

In the first phase, we have to determine the optimal lag length which corresponds to the minimum value for the lag selection information criteria with non-correlated residuals. To implement that, we estimate the equation (6) with various lag lengths changing between zero and one. Table 3 below illustrates the estimation results of the optimal lag-searching process, and we can easily observe that only the lag order one is applicable. Moreover, it should be noted that the rest of the models suffer the problem of serial correlation of residuals at the lag orders one and/or four. Considering the fact that our data are quarterly, the serial correlation problem should not exist at the lag orders one and four. Hence, the lag order one is optimal so as to be opted for estimating the equation (6).

Table 3: Statistics for choosing the optimal lag size for ARDL

k	AIC	SBC	$\chi^2_{SC}(1)$	$\chi^2_{SC}(4)$
0	-0.784745	-0.444565	4.108466 [0.0478]	1.193034 [0.3257]
1*	**-0.784258**	**-0.303938**	**0.269347 [0.6062]**	**1.007221 [0.4141]**
2	-0.709882	-0.087001	0.086168 [0.7706]	0.376053 [0.8243]

3	-0.592770	0.175157	2.280444 [0.1395]	1.228680 [0.3170]
4	-0.568654	0.346871	3.031206 [0.0913]	1.900607 [0.1372]

Notes: k is a lag order, while AIC and SBC designate the Akaike and Schwarz information criteria, respectively. $\chi^2_{SC}(1)$ and $\chi^2_{SC}(4)$ indicate the LM statistics for testing no residual serial correlation against the lag orders of 1 and 4, respectively. The probabilities are provided in brackets.

As a follow-up, the table 4 below demonstrates the estimation results and diagnostics test statistics. The residual test diagnostics presented in Panel B reveal that the estimated results do not suffer the problems of serial correlation, heteroscedasticity, non-normal distribution of the residuals, and functional form misspecification.

Table 4: ARDL Specification and Residual Diagnostics tests results

Panel A: *The estimated final ARDL Specification*			
	Coefficient	Standard Error	P-values
$\ln(PIA)_{t-1}$	-0.357123	0.067945	**0.0000**
$\ln(PEx)_{t-1}$	0.392835	0.081488	**0.0000**
$\ln(OPrn)_{t-1}$	-0.067080	0.122829	0.5872
$\ln(OPrc)_{t-1}$	0.137253	0.065513	**0.0409**
$\Delta\ln(OPrn)_t$	1.050583	0.286814	**0.0006**
$\Delta\ln(PIA)_{t-1}$	-0.250113	0.095367	**0.0113**
@SEAS(1)	-0.266012	0.052116	**0.0000**
Intercept	-0.650202	0.487825	0.1882
Panel B: *Statistics and Residual Diagnostics test results*			
σ=0.141700; $\chi^2_{SC}(4)$=0.687540 [0.6040]; $\chi^2_{ARCH}(4)$=1.160110 [0.3389]; χ^2_{HETR} = 1.607931 [0.1530]; JB_N= 62.67198[0.0000]; F_{FF}= 1.872125 [0.1770]			

Notes: The dependent variable is $\Delta\ln(API)_t$; σ indicates standard error of regression; χ^2_{SC}, χ^2_{ARCH}, and χ^2_{HETR} denote Chi-square statistics to test the null hypotheses of no serial correlation, no autoregressive conditioned heteroscedasticity, and no heteroscedasticity in the residuals; $JB_N$and F_{FF} designate Jarque-Bera and no functional form misspecification statistics to test the null hypotheses of normal distribution and no functional form misspecification, respectively. The probabilities are provided in brackets. Method: Least Squares. Estimation period: 2001Q4-2017Q3.

In the next phase of the methodological stages for the ARDLBT application, we have to test the existence of the cointegrating relationship amongst variables by means of employing the Wald test, and the Table 5 below portrays the test results. As the estimations suggest, F-statistic value obtained from the sample is higher than the upper bound critical values calculated by Narayan (2005) and Pesaran *et al.* (2001) both at 1% level of significance. Consequently, we reject the null hypothesis of no cointegration at 1% level of significance while considering only the Narayan (2005) critical values due to the small sample size case as elucidated before.

Table 5: F-statistic for testing the existence of cointegration in the ARDLBT approach

The sample F-statistic	Level of significance	Pesaran et al. (2001) critical values		Narayan (2005) critical values	
		Low bound	Upper bound	Low bound	Upper bound
Null hypothesis: $\theta = \theta_{yx} = \theta_{yv} = \theta_{y\vartheta}$ or merely, *no cointegration*					
	1%	3.65	4.66	3.451	4.764
Fw **= 5.730381**	5%	2.79	3.67	2.589	3.683
	10%	2.37	3.20	2.204	3.210

Notes: *Fw* is the F-value of testing the null hypothesis that $\theta_i = 0$ in the Wald test. Critical values are taken from the combination of 4 lagged level regressors, restricted intercept and no trend (See: Pesaran et al., 2001, pp. 300), and 60 observations (Narayan, 2005, pp. 1987).

Since the test results ensured the evidence concerning the existence of the cointegrating relationship in the equation (6), we can proceed with estimating the long-run coefficients or elasticity. The equation (7) introduces the long-run coefficients which have been normalised for ln*(PIA)* in the model.

$$\ln(PIA)_t = -1.821 + 1.10\ln(PEx)_t - 0.188\ln(OPrn)_t + 0.384\ln(OPrc)_t + u_t \quad (7)$$

With regards to the last stage, we should estimate the final ARDLBT-ECM specification *(equation(4))* via solely substituting lagged level regressors with the one-lagged error correction term or symbolically, ect_ardlbt_{t-1} in the equation (6). In the estimation process, the error correction term is specified in line with the equation (5). Table 6 below exhibits the results.

Table 5: Final ARDL Specification and Residual Diagnostics tests results

Panel A: *The estimated final ARDL Specification*			
	Coefficient	Standard Error	P-values
ect_ardlbt_{t-1}	-0.357115	0.053701	**0.0000**
$\Delta\ln(OPrn)_t$	1.050314	0.268429	**0.0002**
$\Delta\ln(PIA)_{t-1}$	-0.250118	0.088778	**0.0066**
@SEAS(1)	-0.266006	0.045153	**0.0000**
Intercept	-1.299618	0.206482	0.0000
Panel B: *Statistics and Residual Diagnostics tests results*			
σ=0.137921; χ^2_{SC}(4)=0.704618 [0.5923]; χ^2_{ARCH}(4)=1.159144 [0.3393]; χ^2_{HETR} = 1.426527 [0.2369]; JB_N= 62.69377[0.0000]; F_{FF}= 1.335634 [0.1871]			

Notes: The dependent variable is $\Delta\ln(API)_t$, σ denotes standard error of regression, χ^2_{SC}, χ^2_{ARCH}, and χ^2_{HETR} denote the Chi-square statistics to test the null hypotheses of no serial correlation, no autoregressive conditioned heteroscedasticity, and no heteroscedasticity in the residuals. JB_N and F_{FF} indicate Jarque-Bera and no functional form misspecification statistics to test the null hypotheses of normal distribution and no functional form misspecification, respectively. The probabilities are provided in brackets. Method: Least Squares. Estimation period: 2001Q4-2017Q3.

One can undoubtedly notice that the coefficients from the estimated final ARDL-ECM equation are statistically significant. Therefore, the model satisfies the required conditions and eventually, passes the tests regarding the residual diagnostics and stability.

7. Interpretations of the Empirical Results

This section is allotted to interpret the coefficients obtained from the long-run equation (7). As the results set forth, public expenditure and oil price affect private investment in agriculture positively, whereas oil production poses a negative impact on the latter one. Considering the fact that the considerable portion of state budget is composed of the oil revenues transferred from the SOFAZ, public expenditure and oil price are correlated to some extent. In this case, they both portray a positive effect on agricultural private investment, implying that public expenditure and oil price crowd in, while oil production crowds out agricultural private investment.

Subsequent to applying the Bewley (1979) transformation, the equation (7) evinces that 1% increase in public expenditure will lead to increase private investment in agriculture by 1.10%. Likewise, 1% increase in oil price will yield approximately 0.38% increase in private investment in agriculture. In contrast, 1% increase in oil production will result in nearly 0.19% decrease in private investment in agriculture. Yet, inspecting the Table 3, one can evidently see that the impact of oil production on private investment in agriculture is statistically insignificant, while all other variables exhibit the reverse inference, statistical significance, in the long run.

Furthermore, the short-run effects of the regressors on private investment in agriculture should also be taken into account. In comparison with the long-run effect of oil production, one can unquestionably observe that it is both statistically and economically significant in the short run. Since agricultural investment as well as output are affected by the seasonal weather patterns, this issue has to be addressed, too. As a consequence, as the Table 3 suggests, the impact of seasonality during the winter term is statistically significant.

Last but not least, estimated speed of adjustment coefficient derived from the ARDLBT approach demonstrates that approximately 36% of the entire short-run disequilibrium is corrected towards the long-run equilibrium path during one quarter. Put differently, any shock in accordance with public expenditure will be entirely adjusted within three quarters.

8. Concluding Remarks and Policy Recommendations

It is no secret that the period covering a decade between 2005 and 2015 has been labelled as "Oil Boom Period" during which the Azerbaijani government conducted expansionary or loose fiscal policy. The focal point behind this fiscal sustainability through considerable public expenditure is the surge in oil revenues. As the existing statistics suggest, the main portion of these expenditures belongs to firstly public infrastructure spending and then social and cultural activities, whereas spending on scientific purposes accounts for a trivial amount. Since our motive is to study the impact of public expenditure on private investment in agriculture, it is also notable to mention the "Dutch Disease" which advocates the view of the gradual "deindustrialisation" for a resource-rich economy. Specifically, as the revenues from natural resources increase, the industrial as well as agricultural capacity or activity in an economy shrinks, and evidently, that is exactly what occurred to the economy of Azerbaijan.

In this regard, we conducted a research to discover whether public expenditure crowds in or crowds out private investment in agriculture by applying the ARDLBT approach to cointegration. On account of the reasons broken down above, other than public expenditure, we included oil-related factors as control variables in our model, further considering the current circumstances in the economy of Azerbaijan. According to the empirical estimations derived from our model, the impact of public expenditure along with oil price illustrates crowding-in effect on private investment in agriculture in the long run. Although the mentioned economic variables are both statistically and economically significant, public expenditure exhibits more robust economic significance compared to that of oil price which is of fair economic significance. By contrast, oil production crowds out private investment in agriculture in the long run, yet its effect has been found to be both statistically and economically insignificant. That being said, according to our findings, the short-run effect of oil production has been detected to crowd in private investment in agriculture which indicates both powerful statistical and economic significance. Lastly, the seasonal weather patterns in terms of the winter term have been accounted for.

Taking the abovementioned results into consideration, we would like to propose some possible solutions alongside recommendations and suggestions to incentivise the private investment in agriculture which may eventually enhance the agricultural potential and diminish the import dependency in Azerbaijan. First and foremost, as touched upon above, it is of crucial importance for a government to improve public agricultural infrastructure to ensure the inducement for private investment. Moreover, the role of public-private partnership concerning R&D should also be emphasised. In this sense, Chavas and Cox (1992) implemented an empirical analysis to address the influence of research on agricultural productivity. They found that in comparison with public research, private research indicates a stronger influence on farm productivity in the short run, but a less influence in the long run. Furthermore, considering the fact that we are keen on attempting to find the ways through which private sector can possibly be motivated to augment its share in the agricultural sector, the question may arise as to whether it can manage or cope with the sustenance of the innovation and research. Pray and Umali-Deninger (1998) carried out an empirical study to find out if the private sector can feel the gap of reduction of public research in developing countries. They deduced that it is improbable for the private sector to close the gap entirely once governments terminate financing research on public goods and technologies with insufficient market potential.

As a last remark, it should be noted that the various forms of support such as the National Fund for Entrepreneurship Support, "Aqrarkredit" Joint-Stock Credit Organisation, State Agency for Agricultural Credits under the Ministry of Agriculture of the Republic of Azerbaijan, for the private investors, entrepreneurs, and farmers are existent, the functionality and effectiveness of the aforementioned institutions are dubious. On top of that, the exacerbating situation in the financial sector primarily in lieu of the consecutive devaluations of the *manat* still remains to be one of the impediments for the private investors. Therefore, as per the policy implications, these issues should be addressed together with further research on the similar matters.

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