Acta Universitatis Danubius
ŒCONOMICA

Macroeconomic Determinants of Agricultural Sector Growth in Upper Middle-Income Countries: Is Financial Development Relevant?

Kunofiwa Tsaurai[1]

Abstract: The study investigated the determinants of agricultural sector growth in upper middle-income countries using panel data analysis (panel annual data ranging from 2005 to 2020). The impact of the complementarity between financial and human capital development on agricultural sector growth was also explored in the case of upper middle-income countries. Agricultural sector growth was positively and significantly influenced by its own lag under the dynamic generalized methods of moments (GMM) approach. Fixed effects show that financial development had a significant deleterious impact on agricultural sector growth whilst a significant positive relationship running from financial development towards agricultural sector growth was observed under the pooled ordinary least squares (OLS). The dynamic GMM and the pooled OLS indicates that economic growth's influence on agricultural sector growth was significantly negative. Fixed effects, random effects and pooled effects show that trade openness's influence on agriculture sector growth was found to be significantly positive. Fixed and random effects noted that population growth had a significant positive impact on agricultural sector growth whilst population growth's influence on agricultural sector growth was observed to be significantly deleterious. Consistent with majority of available literature, the study observed that the impact of urbanization on agricultural sector growth was significantly positive. Although the results are mixed, the study urges responsible authorities in upper middle-income countries to enact and implement financial development, trade openness, population increase and urbanization enhancement policies to boost agricultural sector production. Further studies can investigate the other different channels through which financial development can enhance agricultural sector growth in upper middle-income countries.

Keywords: Agriculture Sector; Determinants; Upper Middle-Income Countries; Panel Data

JEL Classification: D53; P2; Q1

[1] Professor, Department of Finance, Risk Management and Banking, University of South Africa, Address: P.O. Box 392, UNISA 0003, Pretoria, South Africa. Corresponding author: tsaurk@unisa.ac.za.

1. Introduction

Background, contribution and organization of the study are the three issues which were dealt with in this introduction section.

Background of the study: Agriculture is one of the key economic sectors of any country because it provides food security for the nation, ensures that people grows their own food for consumption, eradicates poverty especially in the rural and among most marginalized communities (Beckman et al. 2021). Abdullahi (2002) argued that agriculture enhances economic growth and development through product contribution, market contribution, factor contribution and foreign exchange contribution. Other scholars whose studies supported that agriculture is a cornerstone for economic growth and development include Oji-Okoro (2011), Olajide et al (2012), among others. Consistent with Gilal et al (2016), it is quite clear that the determinants of agriculture sector productivity and growth is of paramount importance if the responsible authorities are to effectively ensure maximum contribution of agriculture in the economy.

Despite its huge undisputable positive contribution towards economic growth and development, empirical research that exclusively devoted its attention towards investigating the determinants of agricultural sector growth and development are scant. The few researchers who investigated the determinants of agriculture growth include Trpeski and Cvetanoska (2018), Nwachukwu and Shisanya (2017), Paul et al (2018), Rehman et al (2019), Ketema (2020), Pfister and Kopsidis (2015), Ado and Bello (2020), Khapayi and Celliers (2016), Shita et al (2018), Urgessa (2015), Kakar et al (2016) and Potelwa et al (2016).

These empirical studies on a similar study had several methodologically related weaknesses. Firstly, majority of them used time series data analysis which are incapable of capturing the endogeneity problem associated with the agricultural sector growth function. Secondly, majority of the empirical researchers were narrow focused on investigating agricultural sector growth in a single country. Thirdly, most of these empirical researchers ignored the fact that agricultural sector growth and development can be influenced by its own lag. Fourthly, majority of them also used outdated data which is no longer relevant to futuristic agriculture policy making. Fifthly, none of these existing empirical researchers on the determinants of agriculture growth focused on upper middle-income countries as a unit of analysis, a weakness given the vast amount of agricultural activities occurring in this bloc of countries. Sixthly, none of these empirical studies on a similar subject matter in investigated the impact of the complementarity between financial and human capital development on agriculture growth in upper middle-income countries. This study is focused on filling these gaps.

Contribution of the study: There are five ways in which this study contributes towards literature. Firstly, this is the first study to the best of the author's knowledge to investigate the determinants of agricultural sector growth in upper middle-income countries as a bloc. Secondly, this study is one of the few studies to consider the lag of agricultural sector in exploring the determinants of agricultural sector production. Thirdly, the study used the most recent data set (2005-2020) unlike other similar related empirical research on the subject matter. Fourthly, using the dynamic GMM the study considered the endogeneity problem involved in the agricultural sector growth function. Fifthly, this is the first study to the best of the author's best knowledge to investigate the impact of the complementarity between financial and human capital development on agricultural sector growth in upper middle-income countries.

Structure of the paper: The remaining part of the study is structured into five segments. Second part is the theoretical literature on the determinants of agricultural sector growth. Third part is the empirical literature on the determinants of agricultural sector production. Fourth part is the research methodology description. Fifth part describes data analysis, presents results and discussion. This part includes mean trend analysis, correlation analysis, panel unit root tests, panel co-integration tests and main data analysis. Sixth part concludes the study.

2. Determinants of agricultural sector growth-Theoretical literature

Table 1. Theoretical Literature on the Determinants of Agricultural Sector Growth

Variable	Proxy used	Theory intuition	Expected sign
Financial development (FIN)	Domestic credit to private sector (% of GDP)	Financial development enhances agricultural sector growth in two ways, according to Zakaria et al (2019). Firstly, financial development increases savings, investments and bank credit activities thereby alleviating the financial constraints in the agricultural sector and enhancing agricultural sector output. Secondly, financial development allows easy provision of credit to the farming community thereby boosting agricultural sector production. These theoretical rationales were also supported by Shahbaz et al (2013).	+

Economic growth (GROWTH)	GDP per capita	High economic growth enables the farming community to purchase more agricultural implements such as fertilizers, high quality seeds and pesticides thereby overally promoting agricultural sector production (Shahbaz et al. 2013).	+/-
Trade openness (OPEN)	Trade (% of GDP)	In line with Zakaria et al (2019), trade openness promotes economies of scale, specialisation, technology usage and capacity utilization, all of which enhances agricultural sector production.	+
Exchange rate (EXCH)	Local currency/US$	When the local currency depreciates, it enables the local agricultural products to be more demanded in foreign countries. Appreciation of the local currency makes local agricultural products more expensive in other countries. This according to Obiageli (2020) have far reaching consequences on the quantity of agricultural sector output farmers are enticed to produce.	+/-
Human capital development (HCD)	Human capital development index	According to Zaika and Gridin (2020), human capital development enhances agricultural sector production and productivity because a skilled farm worker can efficiently and effectively utilise land. This happens through their ability to be more innovative and them being more able to use technology in promoting the whole farming and agricultural sector activities.	+/-
Population growth (PG)	Population growth (annual %)	Increased population growth implies an increase in the demand for services and homes thereby pushing the price of land higher and higher. This scenario tempts some farmers to sell their agricultural land to the home seekers thereby overally negatively influencing	+/-

		agricultural sector production (Karim. 2013).	
Urbanization (URBAN)	Urban population (% of total population)	According to Raphael and Ukandu (2015), urbanization has a deleterious effect on agricultural sector production because it converts more agricultural land towards to urban land use. An increased number of youths migrates to urban areas thereby negatively affecting the quantity of labour force which would have ordinarily worked on the farms. The same study also noted that urbanization provides a ready market for the farmers thereby enhancing general agricultural sector production.	+/-

Source: Author compilation

3. Determinants of Agricultural Sector Growth- Empirical Literature

Table 2. Determinants of Agricultural Sector Growth - Empirical Literature

Author	Country/Countries of study	Period	Methodology	Results
Gilal et al (2016)	Pakistan	1976-2014	Multiple regression analysis	The study found out that in the long run, factors such as the lag of agricultural sector growth, international trade, gross national expenditures, population, foreign debt, gross fixed capital formation, inflation and real exchange rates were the factors that had an impact on the agricultural sector growth in Pakistan.
Igwe and Esonwune (2011)	Nigeria	1994-2007	Multiple regression analysis	Total annual rainfall and total land area were found to have had a significant positive impact on agricultural sector growth in Nigeria. On the contrary, total population had a significant deleterious effect

				on the agricultural sector in Nigeria.
Liu et al (2020)	South and Southeast Asian countries	2002-2016	General methods of moments (GMM)	The study noted that technical efficiency, economic development and agricultural imports had a negative influence on the agriculture sector. In contrast, human capital development, urbanization and financial aid flow into agriculture were found to have had a positive impact on the agricultural sector in the South and Southeast Asian countries.
Kakar et al (2016)	Pakistan	1990-2017	Autoregressive Distributive Lag (ARDL)	The size of cultivation area, agricultural credit, fertilizer consumption and rainfall amount received are the factors which had an enhancing significant positive effect on agricultural sector growth and productivity in the long run in Pakistan
Urgessa (2015)	Ethiopia	Survey data (2011/12 and 2013/14)	Pooled ordinary least square (POLS), random effects and fixed effects.	Land-labour ratio, usage of pesticides, household size, manure and the usage of fertilizer's impact on agricultural sector growth in Ethiopia was found to be positive and significant.
Potelwa et al (2016)	South Africa	Data between 2001 and 2004	Multiple regression analysis	South Africa's economic growth had an enhancing effect on agricultural exports. On the other hand, political stability's impact on agricultural sector growth was found to be negligible.
Khapayi and Celliers (2016)	South Africa	2010 survey data	Descriptive statistics	Poor roads, lack of marketing skills and information, poor market infrastructure, high transaction costs, poor management skills and lack of agricultural implements are some of the factors which

				inhibited agricultural sector growth in South Africa.
Shita et al (2018)	Ethiopia	1990-2016	ARDL	Economic growth and fertilizer usage had a significant positive effect on agricultural sector growth both in the short and long run. Size of the arable land had a significant enhancing effect on agriculture in the long run, its impact on agriculture in the short run was found to be negative.
Pfister and Kopsidis (2015)	Saxon	1660-1850	Descriptive statistics	Two factors that were found to have had a positive influence on agricultural sector growth in Saxon.
Ado and Bello (2020)	Nigeria	1981-2017	ARDL	Inflation had a deleterious effect on the Nigerian's agricultural sector growth. Real exchange rate and labour force were found to have enhanced agricultural sector growth in Nigeria.
Rehman et al (2019)	Pakistan	1978-2015	Multiregression analysis	Water availability had a deleterious effect on agricultural sector growth in Pakistan. Improved seed distribution, fertilizer consumption and credit distribution had a significant positive impact on Pakistan's agricultural sector growth.
Ketema (2020)	Ethiopia	1980-2018	ARDL	Drought had a negative impact on agricultural sector growth in Ethiopia in the long run. Rainfall, fertiliser input import, trade openness and inflation had a significant positive influence on Ethiopia's agricultural sector growth. In the short run, labour force and fertiliser input import were found to have had a significant positive effect on

				agricultural sector growth in Ethiopia.
Nwachukwu and Shisanya (2017)	Kenya	1970-2012	Multiple regression analysis	Size of agricultural land, labour efficiency and livelihood productivity had a significant positive effect on Kenya's agricultural sector growth.
Paul et al (2018)	Nigeria	1985-2016	Time series analysis	Government funding in agriculture, climate change and agriculture credit were found to have had a significant positive influence on Nigeria's agricultural sector growth.
Trpeski and Cvetanoska (2018)	Macedonia	2006-2017	Descriptive statistics	Labour productivity and economic growth are the two main factors which were found to have an enhancing impact on Macedonia's agricultural sector growth.

Source: Author compilation

It is evident from the findings in Table 2 that the results from the empirical research on the determinants of agricultural sector growth are mixed, divergent and conflicting. In other words, the findings from the empirical research is an indication that the subject matter on the determinants of agricultural sector growth and development is far from being conclusive. There is no agreeable list of variables that determine the growth of the agricultural sector, hence this study attempts to add its voice to the discourse.

4. Research Methodology Description

In line with Liu et al (2020) and other empirical studies done by Trpeski and Cvetanoska (2018), Paul et al (2018), Nwachukwu and Shisanya (2017), Ketema (2020), Rehman et al (2019), Ado and Bello (2020), Pfister and Kopsidis (2015), Shita et al (2018), Khapayi and Celliers (2016), Potelwa et al (2016), Urgessa (2015) and Kakar et al (2016), among others, equation 1 stands for the agricultural sector production.

$$AGRIC = f(FIN, HCD, GROWTH, OPEN, PG, URBAN) \quad [1]$$

Where AGRIC, FIN, HCD, GROWTH, OPEN, PG and URBAN represents agricultural sector production, financial development, human capital development, economic growth, trade openness, population growth and urbanization respectively.

Agricultural sector production (AGRIC) is measured by employment in agriculture (% of total employment) in this study.

Equation 2 econometrically transforms the general model specification of the agricultural sector production.

$$AGRIC_{it} = \beta_0 + \beta_1 FIN_{it} + \beta_2 HCD_{it} + \beta_3 (FIN_{it}.HCD_{it}) + \beta_4 GROWTH_{it} + \beta_5 OPEN_{it} + \beta_6 PG_{it} + \beta_7 URBAN_{it} + \mu + \varepsilon \quad [2]$$

Where β_1 , β_2 , β_3 ,β_4 β_5 , β_6 and β_7 stands for the coefficients of the variables used in the study. They stand for the co-efficients for financial development, human capital development, the combination of financial development and human capital development, economic growth, trade openness, exchange rate, population growth and urbanization respectively. β_0 is an intercept.

If the value of the co-efficient β_3 is positive and significant, the results would mean that the combination of financial development and human capital development enhances agricultural sector production in the upper middle-income countries. If β_3 is negative and significant, it means that the deleterious effect of the complementary variable on agricultural sector production in upper middle-income countries is huge and cannot be taken lightly. Fixed effects, FMOLS, random effects and pooled OLS were used to estimate equation 2.

5. Data Analysis, Results Presentation and Discussion

The study used panel data ranging from 2005 to 2020 to investigate the determinants of agricultural sector growth in upper middle-income countries. The list of upper middle-income countries included in this study are Argentina, China, Czech Republic, Hong Kong, Turkey, Mexico, Peru, Thailand, South Africa, Brazil, Colombia, Indonesia, India, Malaysia, Philippines and Singapore. International databases from where the data for all the variables was obtained include World Bank Development Indicators, African Development Indicators, United Nations Development Programme, International Monetary Fund.

Mean trend analysis: The mean trend analysis presented in Table 3 is for all the variables used in the current study during the period ranging from 2005 to 2020. Variables included in the mean trend analysis include agricultural sector growth, human capital development, trade openness, urbanization, financial development, economic growth and population growth.

Table 3. Mean Trend Analysis (2005-2020)

	AGRIC	FIN	HCD	GROWTH	OPEN	PG	URBAN
Argentina	0.64	14.04	0.82	11 079.69	32.61	1.03	91.14
Brazil	11.82	55.40	0.75	9 211.41	25.97	0.90	85.02
China	33.27	135.98	0.73	6 255.29	47.19	0.53	52.24
Colombia	17.56	39.24	0.74	6 034.96	37.13	1.19	78.82
Czech Republic	3.08	46.28	0.88	19 786.88	138.27	0.30	73.51
Hong Kong	0.21	193.25	0.91	37 885.30	383.45	0.63	100.00
Indonesia	35.79	32.99	0.69	3 085.28	47.20	1.27	51.50
India	48.35	49.38	0.60	1 464.55	46.26	1.25	31.92
Mexico	13.54	27.70	0.77	9 211.89	66.26	1.31	78.54
Malaysia	12.60	114.22	0.79	9 416.74	152.57	1.57	72.33
Peru	28.78	35.77	0.75	5 466.93	49.70	1.11	76.84
Philippines	30.19	36.09	0.69	2 503.25	65.83	1.61	46.07
Thailand	36.45	130.63	0.74	5 519.25	126.52	0.45	45.27
Turkey	21.74	53.16	0.77	9 724.68	52.54	1.44	72.14
Singapore	0.09	109.77	0.91	50 830.81	362.44	1.96	100.00
South Africa	5.39	124.48	0.67	6 463.23	54.92	1.42	63.50
Overall mean	**18.72**	**74.90**	**0.76**	**12 121.26**	**105.55**	**1.12**	**69.93**

Source: Author compilation

Countries such as China, Indonesia, India, Peru, Philippines, Thailand and Turkey are the countries whose mean agricultural sector growth were above the overall mean agricultural sector growth of 18.72% 0f total employment. The remaining upper middle-income countries which include South Africa, Singapore, Malaysia, Mexico, Hong Kong, Czech Republic, Colombia, Brazil and Argentina had their mean agricultural sector growth figures lower than the overall mean value of agricultural sector growth. Singapore, South Africa, Thailand, Philippines, India, Indonesia, Hong Kong, Czech Republic, China and Argentina are outliers because their mean values of agricultural sector growth far much deviated from the overall mean agricultural sector growth

With regards to financial sector development, the mean values are spread in a very mixed fashion such that there is no single country whose mean financial development value is closer to the overall mean financial development value of 74.90% of GDP. In other words, all the countries studied are outliers in as far as financial development is concerned.

Argentina (0.82), Czech Republic (0.88), Hong Kong (0.91), Mexico (0.77), Malaysia (0.79), Turkey (0.77) and Singapore (0.91)’s mean human capital

development values exceeded the overall mean human capital development index value of 0.76. Countries such as Czech Republic, Hong Kong and Singapore are clearly outliers as their mean human capital development were far away from the overall mean human capital index of 0.76.

Regarding trade openness, Czech Republic (138.27% of GDP), Hong Kong (383.45% of GDP), Malaysia (152.57% of GDP), Thailand (126.52% of GDP) and Singapore (362.44% of GDP) are the only upper middle-income countries studied whose mean trade openness values exceeded the overall mean trade openness value of 105.55% of GDP. Apart from Thailand, all the upper middle-income countries studied appears to be outliers because their mean trade openness values deviated from the overall mean trade openness by a wider margin.

Among the upper middle-income countries studied, only Czech Republic (US$19 786.88), Hong Kong (US$37 885.30) and Singapore (US$50 830.81) had their mean GDP per capita values greater than the overall mean GDP per capita value of US$12 121.26. Only Brazil (US$9 211.41), Mexico (US$9 211.89), Malaysia (US$9 416.74) and Turkey (US$9 724.68) are not outliers in as far as economic growth (GDP per capita) mean values are concerned. This is because their mean values of GDP per capita did not deviate too much from the overall mean economic growth value.

Regarding population growth, Colombia (1.19%), Indonesia (1.27%), India (1.25%), Mexico (1.31%), Malaysia (1.57%), Philippines (1.61%), Turkey (1.44%), Singapore (1.96%) and South Africa (1.42%) are the upper middle-income countries studied whose mean population growth exceeded the overall mean population growth of 1.12%. Notable upper middle-income countries which were outliers appears to be China (0.53%), Czech Republic (0.30%), Hong Kong (0.63%), Thailand (0.45%) and Singapore (1.96%) because their mean population growth deviated from the overall mean value of 1.12% by a very wide margin.

Upper middle-income countries such as China, Indonesia, India, Philippines, Thailand and South Africa's mean urbanization rates were lower than the overall mean urbanization rate of 69.93% of total population. Outliers appears to include Argentina, Brazil, China, Hong Kong, Indonesia, India, Philippines, Thailand and Singapore if the same reasoning used earlier on also applies here.

Correlation analysis: Table 4 lays out the correlation results between and among the main variables of the study.

Table 4. Correlation Results

	AGRIC	FIN	HCD	GROWTH	OPEN	PG	URBAN
AGRIC	1.00						
FIN	-0.21***	1.00					
HCD	-0.73***	0.29***	1.00				
GROWTH	-0.63***	0.48***	0.77***	1.00			
OPEN	-0.46***	0.62***	0.66***	0.85***	1.00		
PG	-0.02	-0.21***	-0.14**	-0.01	0.09	1.00	
URBAN	-0.86***	0.13**	0.78***	0.68***	0.50***	0.06	1.00

Note: ***/**/* denotes statistical significance at the 1%/5%/10% level respectively.
Source: Author compilation from E-Views

A significant negative relationship was observed between the following variables: (1) agriculture sector growth and financial development, (2) agriculture sector growth and human capital development, (3) agriculture sector growth and economic growth, (4) agriculture sector growth and trade openness, (5) agriculture sector growth and urbanization. Moreover, a non-significant negative relationship between agriculture sector growth and population growth was also detected. To a large extent, these correlation results contradict theoretical literature by authors such as Raphael and Ukandu (2015), Karim (2013), Zaika and Gridin (2020) and Shahbaz et al (2013). The contradiction provided a further basis upon which this study was carried.

Consistent with Aye and Edoja (2017), multicollinearity problem (correlation of 70% and above) exist in five different correlations in this study. (1) Human capital development and agricultural sector growth, (2) urbanization and agricultural sector growth, (3) human capital development and economic growth, (4) human capital development and urbanization and (5) trade openness and economic growth. The multi-collinearity problem was effectively dealt with by converting all the data sets into natural logarithms before using it for main data analysis, consistent with (Aye and Edoja. 2017).

Table 5. Descriptive Statistics

	AGRIC	FIN	HCD	GROWTH	OPEN	PG	URBAN
Mean	18.72	74.90	0.76	12121.26	105.55	1.12	69.93
Median	15.80	51.18	0.76	7619.92	55.84	1.15	73.61
Maximum	56.00	238.92	0.95	66679.05	442.62	5.32	100.00
Minimum	0.02	10.65	0.52	729.00	22.11	0.01	29.24
Std. Dev.	15.09	52.41	0.09	13597.30	108.98	0.59	19.60
Skewness	0.42	0.98	0.09	2.22	1.86	1.96	-0.25
Kurtosis	2.11	3.29	2.71	7.34	5.20	14.47	2.17
Jarque-Bera	16.07	42.15	1.30	411.02	199.44	1567.09	10.02
Probability	0.00	0.00	0.52	0.00	0.00	0.00	0.00
Observations	256	256	256	256	256	256	256

Source: Author compilation from E-Views

Apart from agricultural sector growth, human capital development and population growth, the range for all other variables used in this study exceeds 100, an indication that extreme values exist. On the other hand, trade openness and economic growth standard deviation figures indicates that there exist abnormal values in these two variables. Except for urbanization variable, the data for the remaining variables is skewed to the right, an indication that the data for the variables under study is not normally distributed. The probability of the Jarque-Bera criterion is zero in all the variables used in the study (except human capital development). Such results again provide evidence that the data used in this study is not normally distributed. The problems of extreme values and abnormally distributed data is effectively resolved by an earlier pronounced decision to first convert all the data into natural logarithms before main data analysis, in line with Aye and Edoja (2017).

Panel unit root tests: Four methods were used to estimate the stability of the data (panel unit root tests) and these include Augmented Dick Fuller Fisher Chi Square, Levin et al (2002), Phillip Peron (PP) Chi square tests and Im et al (2003). The use of these four methods is consistent with other empirical research done by Aye and Edoja (2017) and Tembo (2018).

Table 6. Panel Root Tests –Individual Intercept

Level				
	LLC	IPS	ADF	PP
AGRIC	-3.16***	0.49	43.52*	71.54***
FIN	-1.08	1.15	24.84	45.59*
HCD	-7.68***	-3.86***	69.12***	75.99***
GROWTH	-7.21***	-4.18***	69.61***	157.51***
OPEN	-1.92**	0.57	25.99	30.82
PG	-4.45***	-2.00**	73.31***	16.87
URBAN	-5.25***	1.36	26.99	73.71***
First difference				
AGRIC	-6.59***	-4.37***	76.20***	116.69***
FIN	-4.55***	-5.18***	84.94***	122.37***
HCD	-20.45***	-18.27***	260.30***	189.58***
GROWTH	-5.98***	-3.58***	64.52***	65.47***
OPEN	-7.84***	-5.82***	92.53***	196.83***
PG	-2.49***	-2.96***	66.21***	57.17***
URBAN	-5.65***	-6.32***	86.00***	171.07***

Source: Author's compilation from E-Views

Note: LLC, IPS, ADF and PP stands for Levin, Lin and Chu; Im, Pesaran and Shin; ADF Fisher Chi Square and PP Fisher Chi Square tests respectively. *, ** and *** denote 10%, 5% and 1% levels of significance, respectively.

The panel unit test results at level are mixed. At first difference, all the variables studied were found to be integrated of order 1, hence clearing way for panel co-integration tests (Odhiambo. 2021).

Panel co-integration tests: Panel co-integration tests is done to establish if a long run relationship exists among all the variables used in the study. Aye and Edoja (2017) noted that main data analysis cannot proceed if there is no long run relationship among the variables employed in the study. This study used the Johansen Fisher panel co-integration tests whose results are presented in Table 7.

Table 7. Johansen Fisher Panel Co-Integration Test

Hypothesised No. of CE(s)	Fisher Statistic (from trace test)	Probability	Fisher Statistic (from max-eigen test)	Probability
None	5.9324	0.7315	5.9922	0.6625
At most 1	5.9324	0.7316	5.3293	0.6625
At most 2	3.1284	0.8492	78.25	0.0000
At most 3	112.64	0.0000	108.43	0.0000
At most 4	132.54	0.0000	93.16	0.0000
At most 5	94.23	0.0000	88.03	0.0000

Source: Author's compilation from E-Views

Table 7 shows that a long run relationship (co-integrating relationship) exists among the variables used. This is supported by evidence in Table 7 which shows that five co-integrating vectors were observed among the variables used in the study. Put differently, the study rejected a null hypothesis which says that a co-integrating relationship does not exist among the variables used in the study.

Main Data Analysis

Table 8. Panel Data Analysis Results

	Dynamic GMM	Fixed effects	Random effects	Pooled OLS
$AGRIC_{it-1}$	1.01***	-	-	-
FIN	0.03	-0.52***	-0.28	1.31***
HCD	-0.01	-2.49	-2.70	-1.04
FIN.HCD	0.04	0.35	0.40	0.34
GROWTH	-0.06**	-0.01	-0.17	-1.45***
OPEN	0.02	0.92***	0.38**	0.43**
PG	-0.004	0.11***	0.12***	-0.31***
URBAN	0.06	1.23**	0.10	1.04
Adjusted R-squared	0.73	0.67	0.61	0.63
J-statistic	84.28	27.19	15.34	31.85
Prob(J/F-statistic)	0.00	0.00	0.00	0.00

***, ** and * denote 1%, 5% and 10% levels of significance, respectively.
Source: Author's compilation from E-Views

According to Table 8, the dynamic GMM approach shows that agricultural sector growth was positively and significantly influenced by its own lag, consistent with a study done by Gilal et al (2016) using multiregression analysis in the case of Pakistan. A non-significant positive relationship running from financial development towards agricultural sector production was observed in upper middle-income countries under the dynamic GMM methodology. Such results are consistent with Zakaria et al (2019) whose study noted that financial development increases savings, investments and bank credit activities thereby alleviating the financial constraints in the agricultural sector and enhancing agricultural sector output. Fixed effects and pooled OLS observed that financial development had a significant negative impact on agricultural sector production whilst random effects noted the existence of a non-significant negative relationship running from financial development towards agricultural sector growth. These results contradict the available theoretical literature proffered by Zakaria et al (2019).

Across all the four panel econometric estimation techniques used, human capital development was found to have had an insignificant deleterious effect on agricultural sector production, in line with the reasoning that educated people shun away from

the physical laborious activities associated with agriculture. Such results contradict the literature which says that human capital development enhances agricultural sector production and productivity because a skilled farm worker can efficiently and effectively utilize land (Zaika and Gridin. 2020).

The complementarity between financial development and human capital development was found to have had a non-significant positive influence on agricultural sector production across all the four panel econometric estimation methods. The results show that the availability of financial assistance to the farmers coupled with the human capital development (farming skills) could improve agricultural sector production, though not in a significant manner. These results resonate with Zaika and Gridin (2020) whose study mentioned that human capital development enhances agricultural sector production and productivity because a skilled farm worker can efficiently and effectively utilize land especially given the availability of finance that enhances innovation and the use of technology.

The dynamic GMM and pooled OLS produced results which shows a significant negative relationship running from economic growth towards agricultural sector production. On the other hand, fixed and random effects show that economic growth had a non-significant deleterious effect on agricultural sector production. These results are in stark contrast to the available literature advanced by Shahbaz et al (2013), which says that high economic growth enables the farming community to purchase more agricultural implements such as fertilizers, high quality seeds and pesticides thereby overally promoting agricultural sector production.

A non-significant positive impact of trade openness on agricultural sector production was observed under the dynamic GMM approach which the remaining three panel data analysis methods (fixed effects, pooled OLS, random effects) shows a significant positive relationship running from trade openness towards agricultural sector growth. The results are in line with Zakaria et al (2019), whose study noted that trade openness promotes economies of scale, specialisation, technology usage and capacity utilization of the farm and or agricultural land.

Fixed and random effects show that population growth had a significant enhancing effect on agricultural sector growth in upper middle-income countries, in support of Karim (2013) whose study observed that the increase in population is most likely to provide more farm laborers, all factors remaining constant. A deleterious impact of population growth on agricultural sector production was noted under the dynamic GMM and pooled OLS approaches. The results are consistent with Karim (2013), whose study argued that increased population growth implies an increase in the demand for services and homes thereby pushing the price of land higher and higher. The scenario tempts some farmers to sell their agricultural land to the home seekers thereby overally negatively influencing agricultural sector production.

Fixed effects produced results which show that urbanization's impact on agricultural sector production was positive and significant. The dynamic GMM, pooled OLS and the random effects show a non-significant positive relationship running from urbanization towards agricultural sector production. These results confirm Raphael and Ukandu's (2015) argument that urbanization provides a ready market for the farmers thereby enhancing general agricultural sector production.

6. Conclusion

The study investigated the determinants of agricultural sector growth in upper middle-income countries using panel data analysis (panel annual data ranging from 2005 to 2020). The impact of the complementarity between financial and human capital development on agricultural sector growth was also explored in the case of upper middle-income countries. Agricultural sector growth was positively and significantly influenced by its own lag under the dynamic GMM approach. Fixed effects show that financial development had a significant deleterious impact on agricultural sector growth whilst a significant positive relationship running from financial development towards agricultural sector growth was observed under the pooled OLS. The dynamic GMM and the pooled OLS indicates that economic growth's influence on agricultural sector growth was significantly negative. Fixed effects, random effects and pooled effects show that trade openness's influence on agriculture sector growth was found to be significantly positive. Fixed and random effects noted that population growth had a significant positive impact on agricultural sector growth whilst population growth's influence on agricultural sector growth was observed to be significantly deleterious. Consistent with majority of available literature, the study observed that the impact of urbanization on agricultural sector growth was significantly positive. Although the results are mixed, the study urges responsible authorities in upper middle-income countries to enact and implement financial development, trade openness, population increase and urbanization enhancement policies to boost agricultural sector production. Further studies can investigate the other different channels through which financial development can enhance agricultural sector growth in upper middle-income countries.

References

Abdullahi, F. A. (2002). *Spectrum Memory Guide, Agricultural Science for Senior Secondary Certificate Examination*. Ibadan: Spectrum Books Limited.

Ado, M. B. & Bello, B.M. (2020). Economic determinants of agricultural productivity in Nigeria. *International Journal of Research and Innovation in Social Science,* 1V (1X), pp. 418-423.

Aye, G. C. & Edoja, P. E. (2017). Effect of economic growth on CO2 emission in developing countries: Evidence from a dynamic panel threshold regression model. *General and Applied Economics*. https://doi.org/10.1080/23322039.2017.1379239

Beckman, J. & Countryman, A.M. (2021). The importance of agriculture in the economy: Impacts from COVID-19. *American Journal of Agricultural Economics,* 103 (5), pp. 1595-1611.

Gilal, M. A.; Ajmair, M. & Hussain, K. (2018). Determinants of agricultural sector growth in Pakistan: A time varying parametric approach. *Journal of Economics and Sustainable Development*, 9 (19), pp. 953-964.

Igwe, K. & Esonwune, C. (2011). Determinants of agricultural output: Implication on government funding of agricultural sector in Abia State, Nigeria. *Journal of Economics and Sustainable Development,* 2 (4), pp. 86-90.

Im, K.S.; Pesaran, M. H. & Shin, Y. (2003). Testing unit roots in heterogeneous panels. *Journal of Econometrics,* 115 (1), pp. 53-74.

Kakar, M.; Kiani, A. & Baig, A. (2016). Determinants of agricultural productivity: Empirical evidence from Pakistan's economy. *Global Economics Review,* 1 (1), pp. 1-12.

Karim, A. H. M. Z. (2013). Impact of a growing population in agricultural resource management: Exploring the global situation with a micro-level example. *Asian Social Science,* 9 (15), pp. 14-22.

Ketema, A. M. (2020). Determinants of agricultural output in Ethiopia: ARDL approach to co-integration. *International Journal of Business and Social Research,* 10 (3), pp. 1-10.

Khapayi, M. & Celliers, P. R. (2016). Factors limiting and preventing emerging farmers to progress to commercial agricultural farming in the King William's town area of the Eastern Cape Province, South Africa. *South African Journal of Agricultural Extension,* 44 (1), pp. 25-41.

Levin, A.; Lin, C. F. & Chu, C. S. J. (2002). Unit root tests in panel data: Asymptotic and finite-sample properties. *Journal of Econometrics,* 108 (1), pp. 1-24.

Liu, J.; Wang, M.; Yang, L.; Rahman, S. & Sriboonchitta, S. (2020). Agricultural productivity growth and its determinants in South and Southeast Asian countries, *Sustainability*, 12 (2020), pp. 21.

Nwachukwu, I. N. & Shisanya, C.A. (2017). Determinants of agricultural production in Kenya under climate change. *Open Access Library Journal*, 4 (5), pp. 1-10.

Obiageli, I. A. (2020). Effects of exchange rate on agricultural sector output in Nigeria (1987-2019), *International Journal of Innovative Finance and Economics Research*, 8 (3), pp. 43-54.

Odhiambo, N. M. (2021). Trade openness and energy consumption in sub-Saharan African countries: A multivariate panel Granger causality test, *Energy Reports*, 7 (November), pp. 7082-7089.

Oji-Okoro, I. (2011). Analysis of the contribution of agricultural sector on the Nigerian economic development. *World review of business research*, 1(1), p. 191.

Olajide, O.T.; Akinlabi, B. H. & Tijani, A.A. (2012). Agriculture resource and economic growth in Nigeria. *European Scientific Journal*, 8 (22), pp. 103-115.

Paul, O. S. O.; Ekpenyong, B. I. & Bidemi, O. J. (2018). Determinants of agricultural output in Nigeria. *International Journal of Science and Management Studies*, 1 (4), pp. 1985-2016.

Pfister, U. & Kopsidis, M. (2015). Institutions versus demand: Determinants of agricultural development in Saxony, 1660-1850, *European Review of Economic History*, 19 (2015), pp. 275-293.

Potelwa, X.Y.; Lubinga, M. H. & Ntshangase, T. (2016). Factors influencing the growth of South Africa's agricultural exports to world markets. *European Scientific Journal*, 12 (34), pp. 195-204.

Raphael, I. O. & Ukandu, I. (2015). Effect of urbanization on agricultural production in Abia State. *International Journal of Agricultural Science, Research and Technology in Extension and Education Systems*, 5 (2), pp. 83-89.

Rehman, A.; Chandio, A. A. Hussain, I. and Jingdong, L. (2019). Fertilizer consumption, water availability and credit distribution: Major factors affecting agricultural productivity in Pakistan. *Journal of the Saudi Society of Agricultural Sciences*, 18 (2019), pp. 269-274.

Shahbaz, M.; Shabbir, M. S. & Butt, M.S. (2013). Effect of financial development on agricultural growth in Pakistan new extension from bounds test to level relationships and Granger causality tests. *International Journal of Social Economics*, 40, pp. 707-728.

Shita, A.; Kumar, N. & Singh, S. (2018). Determinants of agricultural productivity in Ethiopia: ARDL approach. *The Indian Economic Journal*, 66 (3-4), pp. 365-374.

Tembo, J. (2018). Regional financial integration and its impact on financial sector development: The case of Southern Africa. *Unpublished Doctoral Thesis*, University of South Africa.

Trpeski, P. & Cvetanoska, M. (2018). The impact of the main determinants and changes in agricultural labour productivity in Macedonia. *European Scientific Journal*, 14 (10), pp. 119-135.

Urgessa, T. (2015). The determinants of agricultural productivity and rural household income in Ethiopia. *Ethiopian Journal of Economics*, XXIV (2), pp. 63-92.

Zaika, S. & Gridin, O. (2020). Human capital development in the agricultural economy sector. *Technology Audit and Production Reserves*, 1 (4), pp. 30-36.

Zakaria, M.; Jun, W. & Khan, M.F. (2019). Impact of financial development on agricultural productivity in South Asia. *Agricultural Economics*, 65 (5), pp. 232-239.