Chapter 3

ANALYSIS OF THE RELATIONSHIP BETWEEN FINANCIAL DEVELOPMENT AND AGRICULTURAL PRODUCTIVITY IN DEVELOPING COUNTRIES

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1. INTRODUCTION

Agriculture is an economic sector that is intertwined not only with the people but also with the livestock and industrial sectors. Crop production includes and consists of livestock and forestry, fishing, processing and marketing of this agricultural production (Anthony, 2010: 1).

Production factors play a fundamental role in the agricultural sector. Therefore, the agricultural sector contributes to the national economy by increasing employment. Agricultural surplus is an important parameter for structural transformation that plays a role in economic growth. It is possible to list the importance of the agriculture sector for economies as follows. (i) Ensuring food for the teemed population, (ii) Providing sufficient raw material to enlarging industrial sector, (iii) Establishing the considerable employment structure, (iv) Setting up a major channel of foreign exchange earnings, (v) Making market product for industrial sector (Anthony, 2010: 2).

Agricultural productivity is one of the most important drivers of high and sustainable agricultural growth. Agriculture sector is vital for developed and developing countries and plays a critical role in poverty reduction especially in low-income countries (Dhrifi, 2014: 1).

There are many factors that affect agricultural growth and productivity, and it is important to identify the determinants of these factors. eg. environment, commercial openness, use of capital, skilled human capital. Financial development is one of the important factors. Financial development provides farmers to invest and adopt new tecnologies which provide to increase productivity in the agricul-

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ture. For this reason accessibility of financial services is need to boost the agricultural productivity. If farmers have efficiently access to credit, they can obtain new technologies and implement their production with less risk.

Financial development and uses of credit to develop agriculture sector and provide high income in rural area and raise the standart of living in the rural population. The facility to credit can also help farmers to get productivity enhancement (Iftikhar ve Mahmood, 2017: 3). Lack of adequate access to financial services remains an important factor preventing modernization of agriculture. Therefore, one of the important agendas of international development is the financing of the agricultural sector (Dhrifi, 2014: 1). Despite of agriculture's noteworthy contribution to poor developing countries, the supply of financial services to agriculture industry is not meet enough. Therefore, expanding accessibility of financial services is needed to raise the productivity in the agriculture industry.

The one of the important problem facing the farmers is the shortcoming of credit supply for getting new farming technologies (Iftikhar ve Mahmood, 2017: 3). Financial sector can affect agriculture sector in different ways. It is possible to list them as follows. (i) It creates various facilities to be improved agricultural productivity. The providing of credit simplify purchase inputs so it allows to maintan the crop cycle following harvest. (ii) The volume of financial services provide opportunities to diversificate farmer's livelihoods and increase their income. (iii) It keep them resilience to avoid poverty traps (Fowowe, 2020: 64).

The main purpose of this paper is to recognise the different ways through which financial development have an effect on agricultural productivity in six developing countries (Indonesia, Mexico, Brazil, India, China, Turkey) by panel data analysis from 1990 to 2019. Within the scope of the analysis, it was examined whether there is a cross sectional dependency among the variables that make up the panel and in the model. "In line with the results, the second generation CADF unit root test"which takes account of the cross sectional dependency was applied. Then "Westerlund and Edgerton (2007) Cointegration test was employed. At the end of the analysis, the causality relationship between variables was analyzed using the Konya (2006) causality test. Analysis results indicated that there is cross section dependence in variables and model. Furthermore, it was observed that the variables were not cointegrated in the long run. In Konya (2006) causality test, financial development is the granger cause of agricultural productivity in Indonesia and Brazil. Trade openness is the granger cause of agricultural productivity in Indonesia. Physical capital is the granger cause of agricultural productivity in China.

In reviewing literature, the researches on the impact of financial development on agricultural productivity is limited. Therefore, this study attemp to fulfill this gap.

The article is organized as follow. Section two presents an overview of the literature on the link between financial development and agricultural productivity. Section three presents describes the variables. Section four present the emprical model and the model results. Finally the paper presents policy implications in section five.

2. LITERATURE REVIEW

It is possible to list the studies in the literature as follows.

Yazdani (2008), analyzed the relationship between development in financial sector and agricultural growth in Iran over the period 1979-2005. It was used VAR model in this study. Analysis results show that financial development, capital stock, international trade and real interest have significantly impact on agricultural growth.

Anthony (2010), examined the impact of agricultural credit on growth on GDP in Nigeria for the period 1986-2007. Analysis results show that agricultural variables have impact on economic growth and their contribution to export growth has been encouraging.

Hye and Wizarat (2011), analyzed financial liberalization index and evaluate its impact on agricultural growth. It used the autoregressive distributed lag approach to determine the long run and short coefficients. The analysis results show that financial liberalization affects agricultural growth positively in the short and the long run.

Shahbaz and others (2013), analyzed the relationship between financial development and agriclture growth for Pakistan over the period 1971-2011. It was used ARDL testing and VECM Granger causality test. The results show that financial development has positive effect on agricultural growth.

Yazdı and Khanalizadeh (2014), analyzed the casual relationship between the dynamic financial development, economic growth and instability in Iran. It was used to examine the long-run relationship between finance, growth and other variable by the Johansen Cointegration test. Granger causality test show that there is bidirectional causality between agricultural economic growth and financial development.

Dhrifi (2014), to research what extent financial system in African countries contributes to the development of agricultural productivity. In this context, 44

African countries over the period of 1990-2012 using GMM-System estimator. The results show that financial system by itself can't favor agriculture sector in African countries, but at the presence of a good quality of institutions, it contribute positively to improvements of agriculture productivity.

Chisasa ve Makine (2015), analyzed the relationship between bank credit and agricultural output in South Africa. This study is used time series data from 1970 to 2011. Analysis result show that credit and capital formation have significant positive impact on agricultural output in the long run. However, in the short run, bank credit has a negative impact on agricultural output reflecting the uncertainties of institutional credit in South Africa.

Rizwan-ul-Hassan (2017), examines the effect of financial sector development on agricultural growth and productivity in Pakistan for the period 1981-2015. This study was used to VAR model. The emprical analysis show that significant positive relationship between agricultural growth and capital formation, farm credit disbursement and liquid liability in the financial sector.

Oliynyk-Dunn (2017), analyzed financial development for agricultural growth in Ukraine. This study is used non-integrated and integral indicators, time series and regression analysis to investigate the link between the financial development and agricultural growth. Analysis results based on integral indicators show that the financial development does not affect agricultural growth in Ukraine. Results which based on non-integrated indicators show that various aspects of the financial system's banking component and agricultural growth provided a significant link between the financial system and agriculture growth.

Zakaria and others (2019), investigated the impact of financial development on agricultural productivity in South Asia using data for the period 1973-2015. Panel data method was used in the study. The analysis results show that agricultural productivity first increases with the increase in financial development and the it declines when financial development further increases. Also, agricultural productivity increases with the increase pysical and human capitals and improves trade openness and income level.

3. DATA

In this study, the factors determining agricultural productivity are discussed in six developing economies. In this context, annual time series data from 1990 to 2019 was collected. The data includes the agriculture value added (% GDP) for representing agricultural productivity; domestic credit to private sector by banks (% of GDP) for representing financial development; sum of exports of goods and services (% of GDP) + Imports of goods and services (% of GDP) for representing trade openness; GDP per capita (constant 2010 US$) for representing income level and gross fixed capital formation (% of GDP) for representing physical capital. The data used in the study are shown in Table 2.To capture the growth in agricultural sector, agriculture value added (% of GDP) and other data was collected from the World Bank database.

Table 2. Data Used in the Study and Descriptions

Data	Abbreviation	Explanation	Source
Agricultural Productivity	**AP**	The Agriculure Value Added (%GDP)	The World Bank
Financial Development	**FD**	Domestic credit to private sector by banks (% of GDP)	
Trade Openness	**TO**	Sum of exports of goods and services (% of GDP) + Imports of goods and services (% of GDP)	
Income Level	**IL**	GDP per capita (constant 2010 US$)	
Physical Capital.	**PC**	Gross fixed capital formation (% of GDP)	

Theoretical explanation of these independent variables is as follows:

Financial Development (FD): It is measured by the ratio of domestic credit provided by banking sector relative to GDP in this study. Financial development is expected to increase agricultural productivity. Financial sector provides easy credit farmers and increase the financing constraints by rising national saving, bank credit and investment activities in agriculture sector so agriculture output and agricultural productiviy. It expects that is a positive relationship between financial development and agricultral producitivity.

Trade Openness(TO): Trade openness increases agricultural growth through specialisation, economies of scale, use of capacity and technology.

Income Level(IL): Income level is expected to increase agricultural procutivity. Because, higher income allows farmers to buy more agriculture inputs like improved seeds, fertilisers and pesicides.

Physical Capital(PC): Physical capital ensure infrastructure for agriculture. Thus it helps to increase the agricultural productivity.

4. METHODOLOGY AND ANALYSIS FINDINGS

4.1. Testing Cross Section Dependence

In the Breusch and Pagan (1980) study in which cross-sectional dependency was tested, test statistics are expressed as follows (Pesaran et al., 2008):

$$\mathrm{LM} = \mathrm{T}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\bar{\rho}_{ij}^{2},\ \chi^{2}N(N-1)/2 \qquad \text{(i)}$$

The test statistics developed by Pesaran (2004) are expressed as follows (Pesaran et al. 2008):

$$CD = \sqrt{\frac{2T}{N(N-1)}}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\bar{\rho}_{ij}\right) \qquad \text{(ii)}$$

Pesaran et al. By (2008) $CDLM_{adj}$ tests have been developed. In this test, the LM test was developed using the variance and mean of the LM statistics.

$$LM(\rho)_{adj} = \sqrt{\frac{2}{\rho(2N-\rho-1)}}\sum_{s=1}^{p}\sum_{j=1}^{N-s}\frac{(\mathrm{T-k})\bar{\rho}_{i,i+s}^{2}-\mu_{Ti,i+s}}{\sigma_{Ti,i+s}}\ N(0,1) \qquad \text{(iii)}$$

The test's hypotheses:

H_0: There is no cross section dependency.

H_1: There is cross section dependency.

The calculated CIPS statistics are calculated by taking the average of the t statistics of each cross section. In this study, it was investigated whether there is a cross sectional dependency in the variables and the model, and the findings are shown in Table 3. In line with the results obtained the hypothesis that there is no cross-sectional dependency in variables and model was rejected. In other words, it was seen that there was cross-sectional dependency in the model and variables.

4.2. CADF Unit Root Test

In the CADF test developed by Pesaran (2007), the t statistics ti (N, T) are shown in the equation (Pesaran, 2007):

$$\Delta y_{it} = \alpha_i + b_i y_{i,t-1} + c_i\bar{y}_{t-1} + d_i\Delta\bar{y}_t + e_{it} \qquad \text{(iv)}$$

$$t_i = (N,\mathrm{T}) = \left(\frac{\Delta y'_i \bar{M}_w y_{i-1}}{\bar{\sigma}(y'_{i-1}\bar{M}_w y_{i-1})^{1/2}}\right) \qquad \text{(v)}$$

Table 3. Cross Section Dependency Tests in Variables

Cross-Section Dependency	AP		FD		TO		PC		IL	
	Statistics	p-value	Statistics	p-value	Statistics	p-value	Statistics	p-value	Statistics	p-value
CDLm1 (BP, 1980)	34.003*	0.003	27.243**	0.027	41.871*	0.000	24.646***	0.055	26.917**	0.029
CDLm2 (Pesaran 2004)	3.469*	0.000	2.235**	0.013	4.906*	0.000	1.7611**	0.039	2.176*	0.015
CD (Pesaran 2004)	-3.600*	0.000	-3.080*	0.001	-2.363*	0.009	-3.323*	0.000	-3.064*	0.001
LMadj (PUY, 2008)	20.525*	0.000	9.237*	0.000	8.357*	0.000	14.675*	0.000	20.426*	0.000

Note: *, **, ***respectively show that the 1%, 5% and 10% significance levels.

Table 4. Cross Section Dependency Tests in Model

Cross Section Dependecy Test in Model	Statistics	P-value
CD_{Lm1} (BP, 1980)	36.459*	0.002
CD_{Lm2} (Pesaran 2004)	3.918*	0.000
CD (Pesaran 2004)	3.784*	0.000
LM_{adj}	25.184*	0.000

Note: ***, **, * respectively shows the 10%, 5% and 1% significance levels, The calculation of panel statistics is obtained from the following equation:

$$CIPS(N,T) = t - bar = N^{-1}\sum_{i-1}^{N} t_i(\mathrm{N,T}) \tag{vi}$$

If the CADF critical table value is greater than the CADF statistic value, the null hypothesis is rejected and it is concluded that only that country's series is stationary. CADF unit root test results in Table 5 shows that the first differences of the series are stationary.

Table 5. Panel CADF Unit Root Test

Countries/ Vaıiables	Constant Model									
	AP	AAP	FD	AFD	TO	ATO	PC	APC	IL	AIL
Indonesia	-3.050	-4.185	-1.679	-3.581	-1.222	-3.519	-2.566	-3.924	-1.490	-3.049
Mexico	-3.421	-5.656	-1.698	-10.085	-1.165	-4.448	-3.666	-3.664	-2.148	-2.159
Bıazil	-2.517	-4.715	-1.186	-3.837	-1.920	-2.761	-1.214	-3.095	-2.042	-3.292
India	-3.132	-3.291	2.644	-1.650	-1.875	-2.413	0.239	-2.636	-2.099	-3.168
Clıina	-4.212	-5.498	-1.203	-3.642	-1.365	-2.589	-2.988	-4.226	-0.262	-1.737
Tıııkev	-3.951	-3.366	-1.080	-2.799	-2.175	-4.098	-2.130	-2.862	-1.347	-2.917
Panel CİPS	-3.380	-4.452	-0.700	-4.266	-1.620	-3.305	-2.054	-3.401	-1.565	-2.720

Note: ***, **, * shows that the null hypothesis is rejected at the 10%, 5% and 1% significance level, respectively. Lag lengths are determined according to the Schwarz information criteria. CADF statistic critical values in constant model; -4.11(%1), -3.36(%5), -2.97 (%10) (Pesaran 2007,table I(b), p.275). Panel statistics critical values, in constant model; -2.57 (%1), -2.33(%5), -2.21(%10) (Pesaran 2007,table II(c), p.280).

4.3. Testing the Homogeneity of Variables

Delta test was developed by Pesaran and Yamagata (2008) to test whether the slope coefficients are homogeneous or not:

$$\tilde{\Delta} = \sqrt{N}\,\frac{\left(N^{-1}\tilde{S} - k\right)}{\sqrt{2k}} \tag{vii}$$

$(\mathrm{N,T}) \rightarrow \infty$ while going under the null hypothesis the error term shows normal distribution. Delta test has asymptotic normal distribution.

$$\tilde{\Delta}_{adj} = \sqrt{N}\left(\frac{N^{-1}\tilde{S} - E(\tilde{z}_{iT})}{\sqrt{Var(\tilde{z}_{iT})}}\right) \tag{viii}$$

In the above equation, average, $E(\tilde{z}_{iT}) = k$ and variance

$$Var(\tilde{z}_{\mathrm{iT}}) = \left(\frac{2k(T-k-1)}{T+1}\right) \text{ equals.} \tag{ix}$$

As seen in Table 6, according to the Delta_tilde and Delta_tilde_adj test statistics “Slope parameters are homogeneous ”is rejected according to the 1% significance level. In other words, the slope parameters vary between horizontal sections and are heterogeneous. Therefore, depending on these results, comments can be made for the countries in the panel.

Table 6. Homogeneity Test Result

Test	Test Statistics	Probality Value
Delta_tilte	6.651*	0.000
Delta_tilde_adj	7.011*	0.000

Note : ***,**,* shows that the null hypothesis is rejected at the 10%, 5% and 1% significance level, respectively.

4.4. Westerlund and Edgerton (2007) Panel Boostrap Cointegration Test

Westerlund-Edgerton (2007), the cointegration test is an important test because it takes into account the cross-sectional dependency, allows autocorrelation and varying variance in the cointegration equation, and also gives results in terms of small samples (Westerlund-Edgerton,2007:186-188).

The panel cointegration test is derived from the following equation:

$$y_{it} = \alpha_i + x'_{it}\,\beta_{it} + z_{it} \quad \text{(x)}$$

$t = 1.....,T$ and $i = 1.....,N$

indices refer to time series and cross section units, respectively. z_{it} shows the error term.

$$z_{it} = \mu_{it} + v_{it} \quad v_{it} = \sum_{j=1}^{t} \eta_{ij} \quad \text{(xi)}$$

η_{ij} with zero mean and variance $\sigma^2_{\ i}$ is an error term.

The test’s hypothesis is as follows:

$H_{oi} = \sigma^2_{\ i} = 0$ There is a cointegration relationship between series for all i's.

$H_{1i} = \sigma^2_{\ i} > 0$ There is no cointegration relationship between series for all i.

The LM statistics created by Westerlund to test these statistics is as follows:

$$LM_N^{+} = \frac{1}{NT^2}\sum_{i=1}^{N}\sum_{t=1}^{t}\hat{\omega}_i^{-2}s_{it}^2 \quad \text{(xii)}$$

Westerlund and Edgerton (2007) cointegration test result is included in Table 7. The Boostrap probability value was taken into account as there is a cross sectional dependency in the model. According to the results of the Westerlund and Edgerton (2007) cointegration test, the null hypothesis "there is cointegration" is rejected. It was observed that there was no cointegration relationship between the variables considered in the study.

Table 7. Westerlund and Edgerton (2007) Cointegration Test

	LM Statistic	Asymptotic-p Value	Bootstrap-p Value
LMNT	16.799	0.000	0.000

4.5. Konya (2006) Causality Test

The first step in the Bootstrap panel causality approach is to estimate the system of equations given through the following equations (Konya, 2006: 981):

$$y_{2,t} = \alpha_{1,2} + \sum_{l=1}^{mly_1} \beta_{1,2l}\, y_{2,t-l} + \sum_{l=1}^{mx_1} \gamma_{1,2l}\, x_{2,t-l} + \varepsilon_{1,2,t}$$

$$y_{2,t} = \alpha_{1,2} + \sum_{l=1}^{mly_1} \beta_{1,2l}\, y_{2,t-l} + \sum_{l=1}^{mlx_1} \gamma_{1,2l}\, x_{2,t-l} + \varepsilon_{1,2,t} \qquad \text{(xiii)}$$

$$y_{Nt} = \alpha_{1,N} + \sum_{l=1}^{mly_1} \beta_{1,Nl}\, y_{N,t-l} + \sum_{l=1}^{mlx_1} \gamma_{1,Nl}\, x_{N,t-l} + \varepsilon_{1,N,t}$$

and

$$x_{1,t} = \alpha_{2,1} + \sum_{l=1}^{mly_2} \beta_{2,1,l}\, y_{1,t-l} + \sum_{l=1}^{mlx_2} \gamma_{2,1,l}\, x_{1,t-l} + \varepsilon_{2,1,t}$$

$$x_{2,t} = \alpha_{2,2} + \sum_{l=1}^{mly_2} \beta_{2,2,l}\, y_{2,t-l} + \sum_{l=1}^{mlx_2} \gamma_{2,2,l}\, x_{2,t-l} + \varepsilon_{2,2,t} \qquad \text{(xiv)}$$

$$x_{N,t} = \alpha_{2,N} + \sum_{l=1}^{mly_2} \beta_{2,N,l}\, y_{N,t-l} + \sum_{l=1}^{mlx_2} \gamma_{2,N,l}\, x_{N,t-l} + \varepsilon_{2,N,t}$$

When the Wald statistic is higher than the bootstrap critical values, the null hypothesis stating that there is no causality relationship between the variables is rejected.

Table 8 show that the results of the Kónya (2006) Bootstrap Granger Causality test, which gives effective results under cross section dependence and heterogeneity. As seen in Table 8, null hypothesis stating that there is no causality granger from financial development to agricultural productivity is rejected for Indonesia and Brazil. In other words, financial development is the Granger cause of agricultural productivity in Indonesia and Brazil. Also, null hypothesis stating that there is no causality granger from trade openness to agricultural productivity is rejected for Indonesia. In other words, trade openness is the Granger cause of agricultural productivity in Indonesia. Also, null hypothesis stating that there is no causality granger from physical capital to agricultural productivity is rejected for China. In other words, physical capital is the Granger cause of agricultural productivity in China.

Table 8. Bootstrap Panel Causality Results

H0: FD does not cause AP					
Countries	**Wald Statistics**	**Bootstrap Possibility Value**	**Critical Values**		
			%1	**%5**	**%10**
Indonesia	17.084*	0.000	6.429	5.134	4.212
Mexico	0.073	0.710	2.838	2.137	1.672
Brazil	8.859**	0.020	15.249	4.430	2.984
India	1.949	0.260	5.102	3.681	3.067
China	2.189	0.870	13.094	9.875	8.509
Turkey	2.477	0.560	9.431	7.249	6.417
H0: TO does not cause AP					
Countries	**Wald Statistic**	**Bootstrap Possibility Value**	**Critical Values**		
			%1	%5	%10
Indonesia	8.704**	0.040	9.151	6.246	4.694
Mexico	1.266	0.250	6.654	2.866	2.052
Brazil	0.108	0.660	4.081	3.151	2.349
India	1.187	0.170	3.823	2.164	1.630
China	0.426	0.150	1.211	0.789	0.571
Turkey	1.644	0.460	7.648	5.701	4.748
H0: PC does not cause AP					
Countries	**Wald Statistic**	**Bootstrap Possibility Value**	**Critical Values**		
			%1	**%5**	**%10**
Indonesia	1.187	0.170	3.474	2.361	1.549
Mexico	3.755	0.370	13.268	10.384	8.156
Brazil	1.112	0.330	4.670	2.949	2.267
India	0.033	0.810	2.708	1.748	1.445
China	9.002*	0.000	6.875	4.214	3.206
Turkey	1.962	0.330	4.580	3.779	3.327

H0: IL does not cause AP					
Countries	**Wald Statistic**	**Bootstrap Possibility Value**	**Critical Values**		
			%1	**%5**	**%10**
Indonesia	2.116	0.980	24.249	20.309	17.882
Mexico	0.047	0.970	6.434	5.520	3.996
Brazil	4.509	0.470	16.905	11.728	9.788
India	0.072	1.000	12.364	9.959	7.968
China	7.398	0.740	19.947	17.754	15.879
Turkey	6.726	0.470	16.090	14.513	12.205

Note: ***, **, * indicate the 10%, 5% and 1% significance levels of the null hypothesis, respectively. Critical values obtained with 100 boostrap cycles.

5. CONCLUSION AND POLICY IMPLICATIONS

The level of the financial development acts a decisive role for efficient agricultural production. The one of the major problems for the farmers is the shortage of credit supply for adoption of new agricultural technologies in the industry. The study analyzed the effects of financial sector development on agricultural productiviy in six developing countries. Whether or not it has been investigated financial sector plays a important role in boosting agricultural growth and productivity in six countries for Indonesia, Mexico, Brazil, India, China, Turkey.

Analysis results indicated that there is cross section dependence in variables and model. In addition, it was observed that the variables were not cointegrated in the long run. In Konya (2006) causality test, financial development is the granger cause of agricultural productivity in Indonesia and Brazil. Trade openness is the granger cause of agricultural productivity in Indonesia. Physical capital is the granger cause of agricultural productivity in China.

As a result, it is possible to say the following. The level of financial development has a significant effect on agricultural growth, government should take precautions to raise agricultural productivity by making rural population accessibility to the financial service. This will allow to capitalize agriculture industry and increase its contribution to economic growth. The business enterprises in industry should be supported by attempting new financial reforms. So, government must take care of lowering the prices of agricultural products. A research and development initiatives should be stimulated to develope the quality of agricultural production. This is not only increase the share of agriculture industry to GDP but also the productivity of other sectors. The availability of road infrastructure from rural regions to agricultural markets should also be developed. The government should also establish vocational schools and encourage the projects to progress rural development.

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