THE IMPACT OF MACROECONOMIC VARIABLES TOWARD AGRICULTURAL PRODUCTIVITY IN MALAYSIA

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ABSTRACT

The paper aims to investigate the impact of macroeconomic variables toward agricultural productivity in Malaysia using annually data spanning the period 1980 to 2014. Agriculture sector plays a decisive role in economic growth and development. This sector still significantly becomes the main engine or a contributor to gross domestic product (GDP). The specific aims of this study are to examine the short run and long run links between agricultural productivity and some key macroeconomic fundamentals in Malaysia. Through the Autoregressive-Distributed Lag (ARDL) approach, we find that there is a long- run relationship between agricultural productivity and macroeconomic variables, namely net export, inflation rate, interest rate, nominal exchange rate, government expenditure and money supply. The notable result is only nominal exchange rate shows significant impact on agricultural productivity in the long run while the other variables do not have a significant impact upon agricultural productivity in the long run. In addition, net export, government expenditure, and inflation rate seem to influence agricultural productivity in the short run.

Key words**:** Agricultural Productivity, ARDL approach, Malaysia.

Introduction

Agriculture sector plays a decisive role in economic growth and development, especially for developing countries. Agriculture is known as the foundation of a country’s economy. This sector still significantly becomes the main engine or a contributor to gross domestic product (GDP) in developing countries including Malaysia. Back to 1980s, the gross domestic product (GDP) in Malaysia was worth USD 24.94 billion. Malaysia’s GDP increased significantly to USD 79.15 billion by the end 1990. Malaysia’s GDP rose rapidly from USD 93.79 billion in 2000 to USD 230.99 billion in 2008. However, GDP declined slightly about USD 202.25 billion in 2009. This is caused due to the global financial crisis where the economic performance was not going well in Malaysia, especially in the manufacturing sector that contributed the lowest GDP growth (Department of Statistics Malaysia, 2015). In 2010 to 2013, GDP raises back from USD 247.53 billion to USD 312.44 billion (World Bank, 2015).

The contribution of agriculture sector to Malaysia’s GDP growth is about 28.8 percent since the 1970s and become the second largest contributor after service sector. However, this contribution has gradually decreased for about 20.8 percent to 7.3 percent from 1985 until 2010. The factors that contribute to the slowdown of agriculture sector are the global events such as the Asian Financial Crisis (1998-1999) and the latest Global Financial Crisis (2007-2009). Both of these crises have significantly influenced the performance of agriculture sector through external trade. The Global Financial Crisis has given a huge impact on agriculture sector where the Malaysian currency unexpected to depreciate which lead to an increasing agriculture prices, interest rates, and decreasing credit availability. This shows that the macroeconomic indicators can influence the performance of agriculture sector especially its productivity.

There is numerous literature have been conducted to examine the effects of macroeconomic variables on agriculture sector worldwide. Cao and Birchenall (2013) found that agricultural productivity becomes the main factor in the reallocation of output and employment toward the non-agricultural sector in China’s. The contribution of agriculture sector to overall growth has the same portion with the amounts of non-agricultural total-factor-productivity (TFP). In addition, the author also found that agricultural sector plays a fundamental role in the economy in China. A recent study by Abro et al. (2014) believed that improvement in agricultural productivity can have a substantial direct impact on poverty reduction and finally help to boost economic growth and development in rural Ethiopia. Gollin et al. (2002) mentioned that low agricultural productivity can substantially delay industrialization. The improvement in agricultural productivity can hasten acceleration of industrialization and hence have large effects on a country’s relative income in the United Kingdom.

Meanwhile, emphasize on support policy and good governance can lead to increased agricultural productivity. According to Lio et al. (2008), better governance can indirectly improve agricultural productivity by driving agricultural capital accumulation. When government effectiveness is excellent, it is more likely that sound macroeconomic policies will be adopted and implemented. Rausser (1992) also stated that the government can set up agricultural policies to overcome market failures, lower transaction cost or enhance productivity. Both of these studied agreed that the implementation of policies in appropriate times can give substantial benefits to agriculture sector as well as agricultural productivity.

Memon et al. (2008) have revealed that there exists a solid long run relationship between agriculture GDP and export in Pakistan. The result of Granger-causality explained that there occurs bi-directional causality between total exports and agricultural GDP. Meanwhile, result from the short run analysis shows that there is no evidence found from both of the variable to cause each other in either direction. Eyo (2008) has empirically found that in Nigeria, macroeconomic policies significantly can reduce inflation, increase foreign private investment in agriculture, introduce favorable exchange rates and make agricultural credit have a significant effect on agriculture output growth. Gil et al. (2009) specified that any changes in the monetary policy and the exchange rate have an effect on the agricultural sector but not in the opposite direction. This study also found that agricultural output and exports response to the changes of monetary policy, precisely in the money supply. Meanwhile, Awokuse (2005) found that changes in money supply give little impact on agricultural prices. Only exchange rate affects significantly to agricultural prices. Garba (2000) has confirmed that the major macroeconomic policy shifts heighten agricultural policy instability.

Several studies have discussed the impact of shock (external and internal) on the agriculture sector. Wang and McPhail (2014) investigated the impacts of energy price shocks on U.S. agricultural productivity growth and commodity price. This study found that energy price shocks give a negative impact on productivity growth in the short run (1 year). Further, energy shocks and agricultural productivity shocks the agricultural commodity prices fluctuate. Recently, Wang et al. (2014) analyze the impact of oil price shocks on agricultural commodity prices. The responses of agricultural commodity prices to oil price changes depend greatly on oil supply shocks, aggregate demand shocks or other oil-specific shocks mainly driven by precautionary demand.

We have seen many previous kinds of literature investigate the impact of macroeconomic variables toward agricultural productivity in many cases. However, a study in Malaysia on the relationship between macroeconomic variables and agricultural productivity are too limited. Previous literature, for example, Ali et al. (2010) have examined the dynamic interactions between macroeconomics indicators and agricultural income in Malaysia using Johansen Co-integration regression model. They found that the interest rates, inflation rates, and exchange rates have a significant negative relationship to both agricultural income and exports. Meanwhile, money supply or credit availability has a significant positive relationship to agricultural income and exports. In other words, an expansionary money supply or better credit availability can lead to increases in income and exports for the agriculture sector.

This study examines the impact of macroeconomic variables toward agricultural productivity in Malaysia. The specific aim of this study is to examine the short run and long run association between agricultural productivity and some key macroeconomic fundamentals in Malaysia. Agricultural productivity is said to be one of the important sectors that can really contribute to economic growth. Recently, many issues have arisen after agriculture sector is no longer can contribute a huge amount to GDP. As we know, agricultural productivity is likely to be affected by the overall technological level of the country. However, another factor such as macroeconomic indicator is also an important determinant of agricultural productivity. In addition, the changes of macroeconomic indicator directly come from implementation of monetary and fiscal policies that affect agricultural productivity through their influence on the exchange rate, inflation rate, net export, interest rate, government expenditure, and money supply. The conventional view is that tight monetary policy by increasing the interest rate causes relative prices of agricultural products tend to decrease while loose monetary policy has the reverse effect (see Schuh 1974; Chambers 1984; Rausser 1985). Thus, this paper is concerned with the impact of macroeconomic variables on the agricultural productivity performance.

In order to achieve objective study, we applied econometric model pioneered by Pesaran et al. (2001), the autoregressive distributed lag (ARDL) cointegration test with error correction model (ECM). The ARDL model lies in its flexibility that it can be applied when the variables are of a different order of integration (Pesaran and Pesaran, 1997). The remainder of the paper is organized as follows: section 2 lays out the empirical methodology and discusses the data; section 4 present and interprets the empirical results for the benchmark model; and, finally section 5 provides a summary of the results and the main conclusions.

Data and methodology

This study uses secondary data to examine the impact of macroeconomic variables toward agricultural productivity in Malaysia. In the selection of the macroeconomic variables, this part very crucial to ensure the objective study achieved. The selected macroeconomic variables consist of the nominal exchange rate (EXC), net export (EXP), government expenditure (GEXP), inflation rate (INF), money supply (MS) and interest rate (INT) which classify as independent variables whereas dependent variable is agricultural productivity (AGD). The choice of the macroeconomic variables referred to several previous studies (see Schuh 1974, 1976; Binswanger 1989; Killick 1990; Kwanashie and Ajilima 1997; Eyo 2008; Shombe 2008, Abro et al. 2014). All the data extract from IMF, World Bank, and Malaysia Statistics Department. Agricultural productivity is expressed by the ratio of agriculture to GDP. The exchange rate is expressed by the nominal exchange rate. Net export is expressed by the difference between the total export and total import. Government expenditure is expressed by general government final consumption expenditure. The inflation rate is expressed by the consumer price index. Money supply is expressed by monetary aggregate M2. The interest rate is expressed by deposit rate. All the variables are in natural logarithms except for interest rate, which is in percentages. The data are annuals and the sample period spanning from 1980 to 2014.

The first step of the analysis is to determine the order of integration, whether the variables in levels or in first differences. The order of integration test is important to determine whether the variables integrated of order zero, one or more than one. Granger and Newbold (1974) and Phillips (1986) pointed out that stationary data should be used for nonstationary data can lead to spurious regression results. Thus, as the first step, the order of integration of the variables is tested. Tests for the presence of a unit root based on the work of Dickey and Fuller (1979, 1981) and Said and Dickey (1984) and Perron (1988), Phillips (1987), Phillips and Perron (1988).

To empirically find the impact of macroeconomic variables toward agricultural productivity in Malaysia, we use the co-integration technique and error correction model. In this study, an econometric model for agricultural productivity will be established and it can be written as follows:

$$LnAGD_t = \beta_0 + \beta_1 LnEXC_t + \beta_2 LnEXP_t + \beta_3 LnGEXP_t + \beta_4 LnINF_t + \beta_5 LnMS_t + \beta_6 INT_t + U_t \quad (1)$$

where U_t is the stochastic error term, $LnAGD_t$ is the log of agricultural productivity, $LnEXC_t$ is the log of the exchange rate, $LnEXP_t$ is the log of net exports, $LnGEXP_t$ is the log of government expenditure, $LnINF_t$ is the log of the inflation rate, $LnMS_t$ is the log of money supply and INT_t is the interest rate. To examine the long run and short run association between agricultural productivity and macroeconomic variables, we employed the autoregressive distributed lag (ARDL) cointegration test with error correction model (ECM) pioneered by Pesaran et.al (2001). The main advantage of ARDL modeling lies in its flexibility that it can be applied when the variables are of a different order of integration (Pesaran and Pesaran 1997). In other words, independent variables could be I(0), I(1) or a mixture of I(0) and I(1) variables. Another advantage of this approach is that the model takes sufficient numbers of lags to capture the data generating a process in a general-to-specific modeling framework (Laurenceson and Chai 2003).

In addition, ARDL model can estimate the long-run and short-run dynamics simultaneously by using bounds testing procedures. In this aspect, it provides useful information on long-run and short-run elasticities. Besides, it allows to know whether the expected sign of each variable is consistent with the theory or not (see Pesaran and Pesaran, 1997; Jenkinson, 1986; Pesaran, Shin, and Smith, 2001; Ang, 2008). The bounds test is essentially based on an unrestricted error correction model (UECM) using OLS estimator. As such the model is also known as ARDL-UECM model which specified as follow:

$$\begin{aligned}\Delta LnAGD_t = \alpha &+ \sum_{i=0}^{n} \beta_{1i}\, \Delta LnAGD_{t-i} + \sum_{i=0}^{n} \beta_{2i} \Delta\, LnEXC_{t-i} + \sum_{i=0}^{n} \beta_{3i} \Delta\, LnEXP_{t-i} + \sum_{i=0}^{n} \beta_{4i}\, \Delta LnGEXP_{t-i} + \sum_{i=0}^{n} \beta_{5i}\, \Delta LnINF_{t-i} \\ &+ \sum_{i=0}^{n} \beta_{6i} \Delta\, LnMS_{t-i} + \sum_{i=0}^{n} \beta_{7i}\, \Delta INT_{t-i} + \beta_8 LnAGD_{t-1} + \beta_9 LnEXC_{t-1} + \beta_{10} LnEXP_{t-1} + \beta_{11} LnGEXP_{t-1} \\ &+ \beta_{12} LnINF_{t-1} + \beta_{13} LnMS_{t-1} + \beta_{14} INT_{t-1} + U_{1t}\end{aligned} \quad (2)$$

where Δ is the first difference operator, Ln is the natural logarithm, $\beta_{1i}, \beta_{2i}, \beta_{3i}, \beta_{4i}, \beta_{5i}, \beta_{6i}$ and β_{7i} indicate the short-run dynamics of the model, $\beta_8, \beta_9, \beta_{10}, \beta_{11}, \beta_{12}, \beta_{13}$and β_{14} denote the long-run association and n is the optimal lag lengths. To identify if all the series have cointegration association, the Wald test or F-statistic is computed to test the null hypothesis, $H_0: \beta_8 = \beta_9 = \beta_{10} = \beta_{11} = \beta_{12} = \beta_{13} = \beta_{14} = 0$ against the alternative hypothesis, $H_\alpha: \beta_8 \neq \beta_9 \neq \beta_{10} \neq \beta_{11} \neq \beta_{12} \neq \beta_{13} \neq \beta_{14} \neq 0$. The critical bounds values obtained from Pesaran et al. (2001). If the computed Wald or F-statistic exceeds the upper bound I(1), the null hypothesis of no cointegration can be rejected. It means that there exist long-run associations among all the series. However, if the Wald or F-statistic falls between the upper and lower bounds, no conclusive inference can be made. If the computed Wald or F-statistic falls below the lower bound I(0), the null hypothesis of no cointegration cannot be rejected.

Moreover, a dynamic error correction model (ECM) can be derived from ARDL through a simple linear transformation (Banerjee et al. 1993). The ECM integrates the short-run dynamics with the long-run equilibrium without losing long-run information. The general form of the ECM to be estimated for the agricultural productivity in Malaysia is shown below:

$$\Delta LnAGD_t = \beta_0 + \sum_{i=0}^{n} \beta_1 \Delta AGD_{t-1} + \sum_{i=0}^{n} \beta_2 \Delta X_{t-1} + \beta_3 ECM_{t-1} + \mu_{2t} \quad (3)$$

where X is as defined previously in equation (1), ECM_{t-1} is the error correction term and μ_{2t} is stochastic error term. If the result of the Wald test provides evidence for the existence of cointegration, then we should move to the next step to identifying the coefficients and the significance level. The optimal lag order is selected via using SIC model selection criterion. After identifying the optimal lags, the long run ARDL model through Bounds test and error correction model is estimated. To check whether the estimated ARDL model is valid or not, we adopt a better of diagnostic tests. Parameter stability is tested by applying the CUSUM test. Serial correlation is tested using Lagrange multiplier (LM) test and the ARCH test is used to test for conditional homoscedasticity.

Results

The first step to analyze time series data is to look at the stationary of the variables. There have two classes of tests investigating the presence of a unit root: unit root tests (see Dickey and Fuller, 1979, 1981 and Said and Dickey, 1984) and stationary tests (see Kwiatkowski et al., 1992 and Leybourne and McCabe, 1999). In this study, we employed a unit root test such as ADF and PP to check the order of integration for all series. The results of ADF and PP are presented in Table 1 and 2.

Table 1: Unit root tests using ADF test

	Level		First Difference	
Variables	Intercept & No Trend	Trend & Intercept	Intercept & No Trend	Trend & Intercept
LnAGP	-1.6459(26)	-1.7661(6)	6.2436(32)***	-7.7420(32)***
LnEXC	-1.7209(1)	-1.4820(0)	-4.7241(3)***	-4.6770(4)***
LnEXP	3.1113(1)**	-3.9845(0)**		
LnGEXP	0.9999(6)	-1.8293(5)	-5.5689(2)***	-6.1507(7)***
LnINF	-1.7264(3)	-3.3408(4)*	-5.3082(2)***	-4.9509(2)***
LnMS	-0.9743(7)	-3.0359(1)	-6.6551(8)***	-6.5334(8)***
INT	-1.6414 (4)	-3.2530(3)*	8.0105(24)***	-10.5473(32)***

Notes: ***, ** and *denote rejection of the null hypothesis of a unit root at the 1%, 5% and 10%, level of significance, respectively. The augmented dickey-fuller tested the null hypothesis of that the relevant series contains a unit root I(1) against the alternative that it does not.

The result of ADF tests indicates that the null presence of unit root hypothesis (with intercept & no trend and with trend & intercept) in level I(0) cannot be rejected at the 5 % significance level for all series except net export and interest rate (with trend & intercept) that integrated of order zero I(0). In other words, other variables appear to be I(1) at the 5% significance level (with intercept & no trend and with trend & intercept). For PP tests reported in Table 2 shows that all the variables are non-stationary in their levels at 5% significance level except net export (with intercept & no trend and with trend & intercept). Other variables become stationary after taking the first difference. Overall, we can conclude that the order of integration for all series is in mixed order, which are integrated of order zero, I(0) and integrated of order one, I(1).

Table 2: Unit root tests using PP test

	Level		First Difference	
Variables	Intercept & No Trend	Trend & Intercept	Intercept & No Trend	Trend & Intercept
LnAGP	-1.4530(2)	-0.8728(2)	-6.1276(1)***	-6.2821(1)***
LnEXC	-1.6849(0)	-1.4820(0)	-4.7687(0)***	-4.7468(0)***
LnEXP	-2.4841(1)	-3.9845(0)**	-8.5520(0)***	
LnGEXP	0.6730(0)	-2.0034(0)	-5.5641(0)***	-5.8196(0)***
LnINF	-2.1368(0)	-2.6569(3)	-5.2316(0)***	-4.9106(0)***
LnMS	-0.8626(0)	-2.9001(0)	-5.6129(1)***	-5.5429(1)***
INT	-2.5250(1)	-3.6228(1)**	-4.1611(3)***	

Notes: ***, ** and * denote rejection of the null hypothesis of a stationary at the 1%, 5% and 10%, significance level, respectively. The null hypothesis of the KPSS test is stationary around a constant or around trend and intercept.

After identifying time series properties, the existence of the long run relationship is tested. We employed ARDL model through bounds test to identify the presence of the long run relationship among all the series. The result of the bounds tests reported in Table 3. Because of the result of ARDL procedures is sensitive to the lag length, therefore the lag length is carefully selected. This study followed Pesaran et al. (2001) recommendation to use SIC in choosing a lag length. As a result, the selected model of ARDL (2, 1, 2, 2, 0, 0, 0) is used to examine a long run relationship among all the variables. The order of the variables is agricultural productivity, exchange rate, net export, government expenditure, inflation rate, money supply and interest rate. Turning to bounds test results shown in Table 3, the F-statistic of 4.4803 is found to be higher than the critical value of 4.43 at the 1 percent significance level Thus, the result concludes that there is a long-run relationship among all the variables, namely agricultural productivity, exchange rate, net export, government expenditure, inflation rate, money supply and interest rate. In other words, these variables are moving together in the long run.

Table 3: The ARDL Bound Testing for Cointegration analysis

F-Statistics
4.4803***
Pesaran, Shin and Smith (2001), Case III: Unrestricted intercept and no trend, k=6

Critical Value	Lower Bound	Upper Bound
1%	3.15	4.43
5%	2.45	3.61
10%	2.12	3.23

Notes: *,** and *** indicates significance at the 10, 5 and 1 percent levels.

The long-run coefficients of the ARDL model are reported in Table 4. The result shows that only the exchange rate has a significant impact on the agricultural productivity at 1 percent level. In other words, an increase in the exchange rate about 1 percent will lead to a decrease in agricultural productivity about 0.6927 percent. This result shows that there exist a negative long-run relationship between exchange rate and agricultural productivity. Conversely, the other variables do not have a significant impact on agricultural productivity in the long run.

Table 4: Estimated Long Run Coefficients using the ARDL Approach

Variables	Coefficient	Std. Error	T-stats	P-value
Constant	6.1458	1.9577	3.1392	0.0040***
LnEXC	-0.6927	0.2236	-3.0976	0.0044***
LnEXP	0.0018	0.0014	1.2416	0.2247
LnGEXP	0.0773	0.1693	0.4565	0.6516
LnINF	-1.1757	0.8302	-1.416	0.1678
LnMS	0.0488	0.1677	0.2910	0.7732
INT	0.0055	0.0142	0.3885	0.7006

Notes: *, ** and *** indicates significance at the 10, 5 and 1 percent levels.

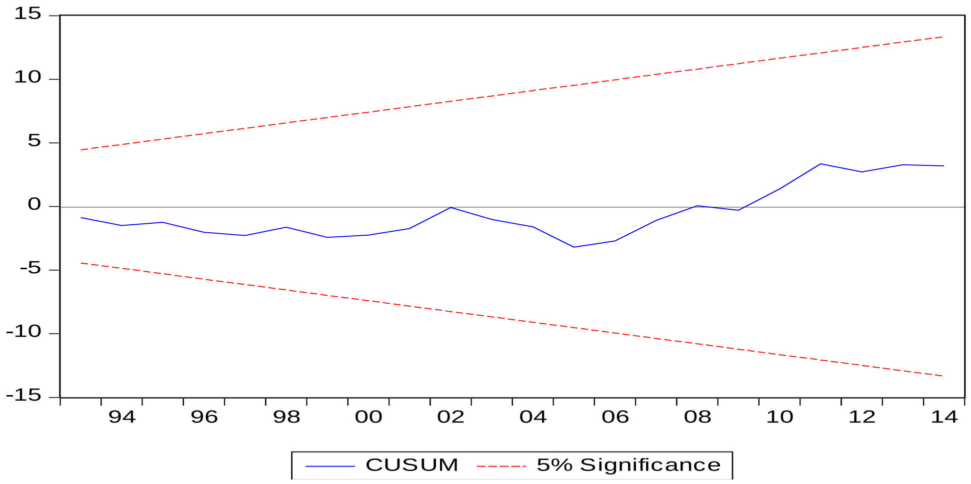
The result of the ECM is reported in Table 5. We employed ECM model purposely to capture the dynamics in the agricultural productivity equation in the short-run and to investigate the speed of adjustment as a response to departures from the long-run equilibrium. The coefficient of the error correction term is found to be negative and statistically significant at the 1 percent level. Approximately 73.04 percent of long-run disequilibrium is adjusted from lagged period error shocks. Diagnostic tests of serial correlation through Lagrange multiplier (LM) test and parameter stability through the cumulative sum of recursive residuals (CUSUM) test are conducted. The result of the LM test shows no serial correlation exist. Figure 1 shows the plot of CUSUM test and it shows no evidence of instability of the error correction model. In other words, the error correction model can be said to be stable. The adjusted r-squared (R^2) is consider high, that is about 0.6342. In the short run, only net export, government expenditure, and interest rate seem to be important variables to affect agricultural productivity at 10 percent significance level. Nevertheless, the other variables do not have a significant impact upon agricultural productivity in the short run.

Table 5: The Result of the Error Correction Model

Variables	Coefficient	Std. Error	T-stats	P-value
Constant	0.1563	0.0555	2.8161	0.0101**
$\Delta\mathbf{Ln\ AGD_{t-1}}$	0.5776	0.1578	3.6613	0.0014***
$\Delta\mathbf{Ln\ EXC_{t}}$	-0.1616	0.2433	-0.6639	0.5137
$\Delta\mathbf{Ln\ EXP_{t}}$	-0.0014	0.0010	-1.4818	0.1526
$\Delta\mathbf{Ln\ EXP_{t-1}}$	-0.0031	0.0010	-3.1614	0.0045***
$\Delta\mathbf{Ln\ GEXP_{t}}$	-0.5214	0.2849	-1.8300	0.0808*
$\Delta\mathbf{Ln\ GEXP_{t-1}}$	-0.7471	0.2509	-2.9781	0.0069***
$\Delta\mathbf{Ln\ INF_{t}}$	-1.9774	1.1868	-1.6661	0.1099
$\Delta\mathbf{Ln\ MS_{t}}$	0.0092	0.0911	0.1018	0.9203
$\Delta\ \mathbf{INT_{t}}$	0.0270	0.0127	2.1260	0.0450**
$\mathbf{ECT_{t-1}}$	-0.7304	0.1458	-5.0096	0.0001***
Diagnostic tests:				
Adj. $\mathbf{R^2}$	0.6342			
Cusum	Stable			
LM test	2.6816(2)			
ARCH test	0.0241(1)			

Notes: Adj. R^2 is the adjustedR^2. LM test is the Lagrange multiplier. ARCH test is used to test for conditional homoscedasticity. Cusum is the Cumulative sum of recursive residuals. *, ** and *** indicates significance at the 10, 5 and 1 percent levels.

Figure 1: Plot of Cumulative Sum of Recursive Residuals (CUSUM)



Conclusion

This study examines the impact of macroeconomics variables toward agricultural productivity in Malaysia. We employed autoregressive distributed lag (ARDL) approach through bounds test and error correction model (ECM) to identify the presence of a long run and the short run association between selected macroeconomic variables and agricultural productivity from 1980 to 2014. The results of bounds test show that all the variables examined are cointegrated in the long run. The result of ARDL approach shows that an increase in the exchange rate will lead to a decrease in agricultural productivity in the long run. In other words, there exist a negative long-run relationship between exchange rate and agricultural productivity. Conversely, the other variables do not have a significant impact on agricultural productivity in the long run. Based on the results of error correction model (ECM) approach, only net export, government expenditure, and interest rate are found to have a significant impact on the agricultural productivity in the short run while the rest of the variables do not show a significant impact upon agricultural productivity. Overall, we can conclude that the performance of the agricultural productivity in the short run seems to be influenced by macroeconomic variables, namely the net export, government expenditure and interest rate whereas only the exchange rate affects agricultural productivity in the long run. Thus, these findings suggest that farmers can really understand the linkages between macroeconomic variables and agricultural productivity and this useful information can facilitate them to boost their productivity and increases the production of agriculture. Lastly, this can ensure the agriculture sector still becomes the significant contributor to gross domestic product (GDP) in Malaysia.

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