Breusch godfrey serial correlation lm test economics essay

Economics

Chapter 1

In general, the agricultural crops are most dependent on the natural factors such as temperature, rainfall, level of evaporation, soil, and etc. The factors other than natural resource such as capital, land, labor, and fertilizer plays an important role in the crop production function. In this study, cereal yield will be chosen to estimate the crop production function. Cereal yield includes wheat, rice, maize, barley, oats, rye, millet, sorghum, buckwheat, and mixed grains. No matter what is the religion, race, or gender of an individual, cereal become a significant source of main food in their daily life. For Asian people, the main carbohydrate intakes are come from rice, while for western people, the carbohydrate inputs are from bread that made by wheat. So it is important to have enough supply of cereals to maintain daily energy needed of human. Over the last several decades, the United State (US) agricultural sector has sustained impressive productivity growth. United States Department of Agriculture (USDA) data show that agricultural (crop and livestock) output grew 1. 63% per year while aggregate input use increased only 0. 11% annually, thus, positive growth in the farm sector was mainly due to productivity growth (1. 52% per year) from 1948 to 2009. The Nation’s agricultural research system, including Federal-State public research as well as private-sector research, has been a key driver of this growth. Besides that, total agricultural research and development (R&D) funding was increased since 2000. Investments in R&D generate new knowledge that eventually leads to improved technology that is adopted by farmers. Technology adoption increases average productivity (the output of crop and livestock commodities per unit of land, labor, capital, and intermediate inputs employed in production). According to Agriculture Department Government of Punjab Pakistan, around 21% of the GDP is supported by agriculture and 80% of the country's total export earnings are come from agro-based products during 2008-2009. It is clearly show how was the importance of agriculture sector in Pakistan. Agriculture sector adopted 48% of the labor force of the country. Pakistan's largest food crop is wheat and is the most grown crop. In 2005, Pakistan produced 21, 591, 400 metric tons of wheat, more than Africa (20, 304, 585 metric tons) and near to the South America wheat production (24, 557, 784 metric tons). The Federal Bureau of Statistics temporary compute major crop yields have grew over 55% growth since 2000, while minor crop yields were grew over 41% since 2000. According to data from USDA, Indonesia have a series of very beneficial developments from 1960-2000 helped Indonesia increased its rice production property to supply enough daily diet of Indonesian that had a rapid population growth. Indonesia's total rice area increased approximately 5. 25 million hectares or 76 percent between 1961 and 2010, primarily through gradual expansion of double and triple cropping on Java, Sumatra, and Sulawesi. The development of new irrigation schemes, including a sharp increase in the construction of major reservoirs, enabled many areas to intensify the rice cultivation cycle and harvest more than one crop per year. By 2011, more than 50 percent of total rice area routinely cultivated during the dry season (2nd and 3rd crops). Routine cultivated allow farmers to harvest different crop without waste the time and thus will increase the crop production. In this study, we will examine what variables will influence the crop production function of US, Pakistan, and Indonesia.

Problem statement

Since the 1972-1975 food crisis happened, analysts have devoted increasing attention to the world hunger problem. Efforts have been made to determine the prospects for increasing agricultural production to meet the expected growth in effective demand for food, and to improve the nutritional status of the people who live in impoverished condition (Martin and Esfandiari, 1980). The analysts of agricultural production and its planning can be studied on farmers' decision making. The main interest of farmer is to decide how many acres would be appropriate to seed. The surface of planted area could be explained by lagged variables such as planted area, and direct cost on crop production (labor, capital, pesticides, fertilizer…). The stationary time series must be tested and the most convenient mathematical form of model as well.

Objective

The general objective of this study is to examine the influence of no natural resources input on selected countries' crop production function. More specific, this study tends to investigate the influence of: land, capital, labor, and fertilizer on US crop production functionland, capital, labor, and fertilizer on Pakistan crop production functionland, capital, labor, and fertilizer on Indonesia crop production function.

Chapter 2

Literature review

Empirical evidence

There exists quite good literature on the trends of agricultural productivity, factors affecting agricultural productivity and ways to improve agricultural productivity in both developed and developing countries. However, there is dearth of work on the level of agricultural productivity at regional and enterprise level in these countries. Studies on enterprise level productivity specifically are mostly limited to Asian and Central Asian countries. Literature reviewed showed that agricultural productivity increases more in developed countries compared to less developed countries. This is due to high investment in research and development, labour, land and capital and improvement in the use of inputs such as fertilizer, machinery increases and others. According to Chang et al (2010), labour productivity in China increased by 4. 13% whilst that of the United States was 7. 16% during 1987-1994. In general land productivity is higher in less developed countries as compared to developed countries due to land reform. It must be noted that growth in agricultural productivity depends primarily on technological change, improved input use efficiency and conservation of natural resources. These in turn, depend crucially upon investments in agricultural research, extension and human capital.

Developed Countries

Grant (2002) estimated agricultural productivity from regional accounts for twenty one regions in 1880/4, 1893/7 and 1905/9 in Germany. The estimates were derived from regional accounts for agricultural production and costs.

Results indicated that productivity in East-Elbian agriculture was growing rapidly in the period, and tending to converge on the German average. Productivity in Southern region was not growing so fast, which showed that yield improvements were not limited to large farms and estates, but that smaller holdings also had access to new technology and improved husbandry methods. The main conclusion to emerge from this analysis was that there was a strong process of convergence which brought productivity up in the rural east to level equal to or above the national average. This convergence mechanism was associated with the spread of more advance agricultural techniques. Chang et al (2001) determined how to promote agricultural productivity growth to achieve sustainable food security most efficiently in Asia and the Pacific. The study looked at the role of investment, both in physical and human capital, in maintaining and increasing agricultural productivity. In order to achieve the objectives the study used TFP and partial factor productivity functions. Results indicate that agricultural output growth has remained positive from 1961 to 1994 with only one exception, Japan, compared to a slowdown during 1975-1987 in output and labour productivity growth in Australia and the United States.

Developing Countries

Zepeda (2001) examined agricultural investment and productivity in the context of developing countries. The study used number of models of production growth (index numbers or growth accounting techniques, econometric estimation of production relationships and nonparametric approaches) to measure the change in output, to identity the relative contribution of different inputs to output growth and to identify the Solow residual or output growth not due to increases in inputs. Results show a relatively weak relationship between physical capital and growth, as compared to investment in technology and human capital. Other factors found to be stimulants to growth included; the policy environment, political stability and natural resources degradation. Various authors support the findings of Zepeda (2001). Fulginiti et al (1998) examined changes in agricultural productivity in eighteen developing countries over the period 1961–1985. The study used a nonparametric, output based malmquist index and a parametric variable coefficient Cobb-Douglas production function to examine, whether declining agricultural productivity in less developed countries was due to use of inputs. Econometric analysis indicated that most output growth was imputed to commercial inputs like machinery and fertilizers. Chavas (2001) analyzed international agricultural productivity using nonparametric methods to estimate productivity indices. The analysis used FAO annual data on agricultural inputs and outputs for twelve developing countries between 1960 and 1994. Technical efficiency indices for time series analysis results suggested that in general the technology of the early 1990s was similar to the one in the early 1960s. This showed that the improvement in agricultural production was not because of technology but because of other inputs such as fertilizer and pesticides. The general empirical results indicated only weak evidence of agricultural technical change and productivity growth both over time and across countries. There was much evidence of strong productivity growth in agriculture over the last few decades corresponding to changes in inputs. In Asia, Chang et al (2001) determined how to promote agricultural productivity growth to achieve sustainable food security. The study looked at the role of investment, both in physical and human capital, in maintaining and increasing agricultural productivity. In order to achieve the objectives the study used TFP and partial factor productivity functions. Results indicated that the only way to promote agricultural productivity was through improving labour productivity. The improvement in labour productivity in China was 0. 68% per annum during 1961 to 1975, 4. 37% per annum during 1975 to 1987 and 4. 13% per annum during 1987 to 1994. The per annum improvement in labour productivity in India during the same periods was 0, 2%, 1, 07% and 2, 04% respectively. The per annum improvement in labour productivity over the period 1961 to 1994 was 7. 41% and 7. 16% for Japan and Korea respectively. Due to the improvement in labour productivity, the agricultural output growth for these countries, with the exception of Japan, has remained positive from 1961 to 1994. The total factor productivity for China surprisingly remained negative despite its growth in output and partial factor productivity of labour and land. This is because output growth was generated primarily from the expansion of inputs, rather than productivity increases. It is generally accepted that there are ample room for productivity improvements in the less developed countries. Tripathi et al (2008), however, argued that an improvement in not only labour but also capital and land productivity can improve agricultural productivity. They studied agricultural productivity growth in India and the impact of labour, capital and land on agricultural productivity growth from 1967-70 to 2005-06. A CobbDouglas production function was used to analyze data and the results indicated that output elasticity of land was 1. 98, labour 1. 06 and capital 0.

15 and when added up they gave a sum greater than one. This meant all inputs had positive and significant influence on agricultural productivity growth. Velazco (2001) examined trends in agricultural production growth for the period 1950-1995, identified factors that affect agricultural growth and investigated any underlying constraints. The study used a Cobb-Douglas production function and supply function to analyze data. The study looked at how changes in land, labour and fertilizer, the role of public and private investment, technological change, policy and political violence influenced Peru's agricultural sector. A specific outcome of the agricultural growth estimation of the aggregate production function for 1970-1995 indicated that increasing agricultural employment would have the greatest impact on the output, followed by land, fertilizer and tractors. The general conclusion was that public and private investment was required to increase agricultural production. There is a relationship between public and private investment with the latter responding to increases in the former. However, it must be noted that land is still concentrated in larger holdings. Only few people have large farms, while a large group of the population has small holdings and little or no education. The implication is that investment in human capital appears to be an obstacle to the effectiveness of extension programmes and technological change. Improved inputs are only used in the coastal region where the large holdings are concentrated. The demand for tractors and agricultural machinery is also concentrated in the coastal region. A specific observation was that agricultural investment has been adversely affected by high inflation, the external debt crisis and hence lower availability of funds, as well as political violence. Kiani et al (2008) measured total factor

productivity in the crops sub-sector and analyzed the relationship between productivity and agricultural research expenditures during 1970-2004 in Pakistan. They used Tornqvist-Theil index method for measuring total factor productivity using outputs and inputs for fields and horticulture crops. Results indicated that total factor productivity index for crops sub-sector improved over time, at an average annual growth rate of 2. 2%. The reason for this improvement was the growth in productivity over the previous 35 years. The general conclusion drawn was that investment in agricultural research played an important part in productivity growth. Mechanization and development of roads infrastructure also had a positive significant effect on total factor productivity.

Chapter 3

Methodology

Estimation of method

In this study, the annual time series data covering the period 1980 to 2006 in United States, Pakistan, and Indonesia are used. The production of cereal yield kg per hectare () as the output for each of the country, land under cereal production in hectare (), agricultural machinery tractors (), economically active population in agriculture in number (), and fertilizer consumption in metric tons () as the input to estimate the crop production function for this three countries are obtained from the World Bank, World Development Indicators, and EconStats. All the variables are in the form of natural logarithm.

Least Square method

Least square method was used to test the relationship among the dependent and independent variables. It was the most widely used procedure for developing estimates of the model parameters.

Normality test

The normality tests are used to identify whether a data set is well-modeled by a normal distribution or to figure out how likely a related random variable is to be normally distributed.

Ramsey RESET Test

Ramsey Regression Equation Specification Error Test (RESET) test (Ramsey, 1969) is a general specification test for the linear regression model. More specifically, it tests whether non-linear combinations of the fitted values help explain the response variable. The intuition behind the test is that if non-linear combinations of the explanatory variables have any power in explaining the response variable, the model is mis-specified.

Heteroskedasticity test

Autoregressive Conditional Heteroskedasticity (ARCH) models are used to model financial time series with time-varying volatility, such as stock prices. ARCH models assume that the variance of the current error term is related to the size of the previous periods' error terms, giving rise to volatility clustering.

Breusch–Godfrey serial correlation LM test

The Breusch–Godfrey serial correlation LM test is a test for autocorrelation in the errors in a regression model. It makes use of the residuals from the model being considered in a regression analysis, and a test statistic is derived from these. The null hypothesis is that there is no serial correlation of any order up to p.

Model specification

In this study, the variable is the dependent variable, while , , , and are the independent variables. The economic model of crop production function is estimated as follow:(3. 1)The model specified is:(3. 2)Where, is the production function of cereal yield (kg per hectare), is intercept, is the land under cereal production (hectares), is agricultural machinery tractors, is economically active population in agriculture (number), is fertilizer consumption (metric tons), to is elasticities coefficients, and is error term. Above model can be estimated by using Ordinary Least (OLS) method. The Cobb- Douglas production function is transfer into log- linear form as:(3. 3)The values of the input coefficients imply their contribution to the production of crop.

Chapter 4

Results

Least Square method

Table 4. 1 shows the least square method results of US. The estimated least squares equation for the crop production as follow:(4. 1)Based on the estimated least squares equation for the crop production in equation (4. 1),

when the arable land increased 1% and other things hold constant, the crop production will decreased by 1. 70%; when the capital increased by 1% and other things hold constant, the crop production will increased by 0. 06%; when the labor increased by 1% and other things hold constant, the crop production will decreased by 2. 09%; when the fertilizer increased by 1% and other things hold constant, the crop production will decreased by 0. 30%; Land, labor and fertilizer have a negative relationship, while capital have a positive relationship with the crop production function of US. Table 4. 1 Least Squares Method results of USVariablest-statisticp-valueC4. 22110. 0004-3. 42980. 00240. 11680. 9081-8. 06260. 0000-1. 92060. 0678R2 = 0. 8584Table 4. 2 shows the least square method results of Pakistan. The estimated least squares equation for the crop production as follow:(4. 2)Based on the estimated least squares equation for the crop production in equation (4. 2), when the arable land increased 1% and other things hold constant, the crop production will increased by 1. 67%; when the capital increased by 1% and other things hold constant, the crop production will decreased by 0. 26%; when the labor increased by 1% and other things hold constant, the crop production will increased by 0. 42%; when the fertilizer increased by 1% and other things hold constant, the crop production will increased by 0. 38%; Land, labor and fertilizer have a positive relationship, while capital have a negative relationship with the crop production function of Pakistan. Table 4. 2 Least Squares Method results of PakistanVariablest-statisticp-valueC-4. 16250. 00045. 05250. 0000-3. 19080. 00423. 16710. 00453. 50360. 0020R2 = 0. 9571Table 4. 3 shows the least square method results of Indonesia. The estimated least squares equation for the crop production as follow:(4. 3)Based on the estimated least squares equation for the crop production in equation (4. 3), when the arable land increased by 1% and other things hold constant, the crop production will increased by 0. 51%; when the capital increased by 1% and other things hold constant, the crop production will increased by 0. 04%; when the labor increased by 1% and other things hold constant, the crop production will increased by 0. 66%; when the fertilizer increased by 1% and other things hold constant, the crop production will increased by 0. 15%; Land, capital, labor, and fertilizer have a positive relationship with the crop production function of Indonesia. Table 4. 3 Least Squares Method results of IndonesiaVariablest-statisticp-valueC-1. 29150. 20998. 06120. 00001. 68910. 10535. 41710. 00003. 85630. 0009R2 = 0. 9590

Normality test

Normality test was conducted for the residuals of the crop production function model based on equation (3. 3). The aim of this test was to test whether the residuals are normally distributed or not. The hypotheses testing for the normality are as follow:: the residuals are normally distributed: the residuals are not normally distributedTable 4. 4 show the normality test results of US, Pakistan, and Indonesia. Based on the results, all the p-values are greater than 0. 05. Thus, the residuals are normally distributed. Table 4. 4 Normality test resultsCountriesUSPakistanIndonesiaJarque-Bera1. 58193. 29840. 2868p-value0. 45340. 19220. 8664

Ramsey RESET Test

Regression Specification Error Test was tested using Ramsey RESET Test based on the equation (4. 4) below:(4. 4)This test is conducted to detect omitted variables and incorrect functional form. In this test the number of fitted is set at 1. The hypotheses testing for the RESET Test are as follow:

:

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Based on the results in Table 4. 5, since all the countries' p-value are more than 0. 05, so the fail to be rejected. There is no misspecification in the crop production function model that has been estimated. Table 4. 5 Ramsey RESET test resultsCountriesUSPakistanIndonesiaF-statistic1. 13470. 01210. 0678p-value0. 29890. 91360. 7971

Heteroskedasticity test

Next was conducted Heteroskedasticity Test by using ARCH model based on the equation (4. 5) below:(4. 5)This test is conducted to detect the random variable and the random are heteroskedastic or not. The hypotheses testing for the Heteroskedasticity Test are as follow:

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: not all the in are zeroBased on the results in Table 4. 6, will not be rejected because all the countries' p-values are greater than 0. 05. There is a homoskedasticiy in the crop production function model that be estimated. Table 4. 6 Heteroskedasticity Test: ARCH resultsCountriesUSPakistanIndonesia-statistic0. 94850. 53600. 3487p-value0. 95100. 55480. 3688

Breusch–Godfrey serial correlation LM test

Serial Correlation LM Test was conducted by using Breusch-Godfrey Serial Correlation LM Test based on the equation (4. 6) below:(4. 6)This test is to detect whether the are serially correlated or not with the number of lag set at 2. The hypotheses testing for the Serial Correlation LM Test are as follow:

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Based on the results in Table 4. 7, failed to reject because the all the countries' p-values are larger than 0. 05. So, there is no autocorrelation in the crop production function model that have been estimated. Table 4. 7 Breusch-Godfrey Serial Correlation LM Test resultsCountriesUSPakistanIndonesiaLag222-statistic0. 52760. 96810. 1855p-value0. 61550. 97620. 2637

Chapter 5

Conclusion

Using annual data from the year 1980-2006, this paper has deployed the ordinary least square approach to determine the demand for crop production function in US, Pakistan, and Indonesia. In this finding, the results of US shows that the independent variables, namely land (arable land), and labor (economically active population in agriculture) are statistically significant, while the capital (agricultural machinery tractors), and fertilizer (fertilizer consumption) are statistically insignificant. For Pakistan, all the variables (land, capital, labor, and fertilizer) are statiscally significant. There are three variables namely land, labor, and fertilizer are important for Indonesia crop production function. Diagnostic test then has been carried out to test the validity of the model. Jarque-Bera test, normality test, heteroskedasticity test, and Ramsey RESET test are the tests that were used in testing the validity of the model. The results of the tests showed that the null hypothesis for all the tests failed to reject at five percent level of significant.