Explaining Output Growth Using Total Factor Productivity: Evidence from the Philippine Agricultural Sector

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Abstract

This study investigates the performance of the Philippine agriculture employing the methodology of total factor productivity (TFP) using the available data from 1961 up to 2005. Total factor productivity was estimated by using simple growth accounting model. The weight on each input was determined using Cobb-Douglas production function with the assumption of the existence of competitive equilibrium. The variation in total factor productivity was analyzed by considering the effect of political changes and agrarian policies. Results show that TFP’s contribution to output growth has been relatively marginal compared to the share of input growth. This suggests that growth in the agricultural sector was largely dominated by the increasing share of inputs undermining technological growth in the agriculture sector. In addition, there is evidence to show that political instability has negatively affected agricultural productivity. Results imply that policy makers should design relevant public policy enhancing productivity in the agriculture sector and these approaches should be coupled with stabilizing the political system.

Keywords: Production function; Growth accounting; Agrarian policies; Political instability

Introduction

Amidst the efforts of government to modernize and upgrade agricultural practices, agriculture showed a declined growth from 4.2% in 2005 to 1.8% in 2006 (NSCB, 2008). Despite declining productivity, agriculture remains at the core of the government’s policies and strategies to sustain economic growth, reduce poverty, and improve the lives of more than 100 million Filipinos. Agriculture is one of the major sectors of the Philippine economy, however, it contributes the least to the gross domestic product (GDP). By 2008 figure, agriculture contributed to 14.7% of the total GDP (DA, 2009). Although agriculture’s contribution to GDP has declined, it continued to employ a third of the labor force.

The growth of productivity in the agriculture sector continues to be an important area of research for both policy makers and practitioners. Several agricultural and development economists have examined the growth dynamics in agricultural sector using total factor productivity (TFP). Investigating growth in agricultural sector is important in understanding whether the sector has transformed from natural resource-based to a science-based system of agricultural production (Ruttan, 2002). While a number of researches have been conducted in the Philippines to quantify TFP growth at the...
aggregate economy level (see for example de Silva, 1998; Lim, 1998 and Cororaton and Cuenca, 2001), very few have engaged in the examination of productivity growth of Philippine agriculture by considering major confounding political events. Thus, this paper seeks to contribute to the growing literature by examining patterns of total factor productivity, output and input growth in the Philippine agriculture. Examining total factor productivity is important in assessing agricultural growth because it captures the portion of output growth not explained by the amount of inputs used in the production (Comin, 2006). Seriño (2014) also highlighted the importance of increasing agricultural productivity as a feasible measure in easing out the worsening income inequality in the Philippines.

The main objective of this research is to assess the total factor productivity of Philippine agriculture as affected by the major political events, which defines the current political situation in the country. Political instability and total factor productivity is an issue that captured minimal or little attention in the standard TFP literature. Politics in the Philippines has been somewhat a roller coaster ride, which loops back and forth hardly arriving at the aimed destination. Major changes in the politics and governance radiate its effect throughout the whole economy. These events include the infamous Martial Law under Marcos regime, People Power revolution also known as EDSA I toppling down Marcos dictatorship, and the controversial People Power 2 or EDSA II ousting President Estrada. These events made drastic impact on the economy as well as programs relating to the improvement in agricultural sector. In addition, study will look into the changes in TFP considering the major agricultural land reforms in the country known as the Comprehensive Agrarian Reform Program. The agrarian reform program aims to acquire and redistribute land to rural farmers who have been tilling the land for decade long but not owning even a square inch of land. Such program aimed to enhance productivity by providing land to rural farmers.

During the last five decades, the Philippines has gone through boom-and-bust cycle of economic growth including a series of economic and political turmoil (Cas, 2004). Examining the productivity of Philippine agriculture is important in order to determine the performance of the agriculture sector in the spectrum of TFP. Understanding growth, productivity and efficiency of agriculture sector in an economy where agriculture plays a significant role can translate to better economic planning and development (Estudillo, 1997; and Ruttan, 2002). This could provide valuable input in designing relevant public policies that will help enhance the growth of Philippine agriculture.

**Literature Review**

The evaluation of TFP was clustered based on the major significant events of the Philippine politics after the World War II. In addition, it will investigate how TFP changes with the implementation of the Comprehensive Agrarian Reform Program (CARP) in 1988.

When Marcos came to power in 1965, he initiated ambitious public works projects and intensified tax collection which brought the country economic prosperity throughout the 1970s. His administration built more roads than all his predecessors combined, and more schools than any previous administration. However due to continued civil uprising in 1972, Marcos declared the country under Martial Law. But the economy during 1970s was robust, with budgetary and trade surpluses. It was also this period that Masagana 99 program was initiated to enhance growth in agriculture sector (EO 879, 1983). However due to allegation of corruption, a peaceful civilian-military uprising popularly known as People Power Revolution, forced Marcos into exile and installed Corazon Aquino as president in 1986 (Santiago, 1985). Under the presidency of Corazon Aquino, the Department of Agriculture implemented policy and institutional reforms that freed
the agriculture markets, enabling farmers to enjoy higher farm-gate prices. These reforms included the dismantling of agricultural monopolies and the elimination of agricultural taxes. It was also in year 1988 that the agrarian reform program was intensified under the Comprehensive Agrarian Reform Program (DAR, 2009). This program was aided with the implementation of Comprehensive Agrarian Reform Law. Fidel Ramos succeeded Mrs. Aquino in 1992. His administration committed to the vision “fairer, faster and more meaningful implementation of the Agrarian Reform Program”. Ramos revived the economy through building infrastructures.

After Ramos, Estrada assumed presidency in 1998 amidst Asian Financial Crisis. The economy was first to recover from the crisis among South East Asian nations. Estrada pledged to help the poor and develop the country’s agricultural sector. However, within Estrada’s administration another huge political chaos took place, depicting the same scenario that ousted President Marcos. President Estrada was accused of accepting huge sum of money from gambling business. This prompted congress to file an impeachment against the president. The hampered impeachment process against Estrada brought massive street protest that pressured him to step down as president (BBC, 2015). His vice-president succeeded, Gloria Arroyo, took the office of presidency. The administration of Gloria Arroyo has suffered various coups and accusations of corruptions. Philippines has suffered from failure of politics and unhealed wounds of political division. The curse of corruption still creeps through the blood of politicians that contributed to the declining performance of the Philippine economy.

With the current data limitation, the present study does not include the performance of the agriculture sector under Benigno Aquino’s presidency.

**Methodology**

Several studies have employed the methods of total factor productivity to assess the productivity and efficiency of agricultural sector (Coelli, 1995; Lusigi and Thirtle, 1997 and Thirtle et al., 2003). For this current study, a growth accounting model of the Solow (1957) type is used. This model assumes that there exists a linear and homogenous cross-country production function, a competitive equilibrium and neutral technical change (Gemma, 2003).

To address the objective of this study, the production function is assumed to be in the following form:

\[
Y = A(t)F(L, N, F, M, S) \tag{1}
\]

where \(Y\) refers to output, \(L\) is labor, \(N\) is land, \(F\) is fertilizer, \(M\) is machinery and \(S\) is livestock. This assumes that output growth is based on total input growth (or factor accumulation growth) and total factor productivity growth. We follow the mechanism applied by Gemma (2003) in estimating total factor productivity. The growth in output can be approximated and decomposed into the following form for the discrete data assuming constant returns to scale:

\[
\frac{Y_2 - Y_1}{Y_2} = W_F \frac{F_2 - F_1}{F_1} \times 100 + W_M \frac{M_2 - M_1}{M_1} \times 100 + W_S \frac{S_2 - S_1}{S_1} \times 100
\]

\[
\frac{A_2 - A_1}{A_1} \times 100 + W_L \frac{L_2 - L_1}{L_1} \times 100 + W_N \frac{N_2 - N_1}{N_1} \times 100 \tag{2}
\]

where 1 refers to the base year, 2 is the current year, \(Y\) is output, \(L\) is labor, \(N\) is land, \(F\) is fertilizer, \(M\) is machinery, \(S\) is livestock, \(A\) is total factor productivity and \(W_L, W_N, W_F, W_M, W_S\), are weights for each of the above inputs.

The weights on the input variables can be determined using the production elasticities.
or cost shares of individual inputs under the assumptions of a Cobb-Douglas type production function and the existence of competitive equilibrium.

**Data Sources**

The data used in this study were exclusively aggregated from the database of Food and Agriculture Organization (FAO) of the United Nations (FAO, 2010). Available data from 1961 up to 2005 were used to evaluate the total factor productivity of the Philippine agriculture. The output variable is based on agricultural production indices. These indices are net of amount used for feed and seed (Cas, 2004). Likewise, the input variables where aggregated from five major components such as labor, land, machinery, fertilizer and livestock. These variables capture the main inputs, which greatly influence agricultural production. The description of the specific variables used in the study is presented as follows:

a) Labor (L) refers to the economically active population in agriculture. By economically active, mean persons engaged in actively seeking for employment; in an economic activity, whether as employers, self-employed, salaried employees or unpaid workers. Economically active population in the agriculture sector includes all persons engaged in agriculture, forestry, hunting or fishing.

b) Land (N) covers total arable land and permanent crops. Arable land includes land planted with temporary crops, temporary meadows for mowing or pasture, land temporarily fallowed, and land under market and kitchen gardens. Land under permanent crops is the land cultivated with crops that occupy the land for long periods and need not be replanted after each harvest. This category includes land under flowering shrubs, fruit trees, coconuts and vines but excludes land cultivated for wood or timber.

c) Fertilizers (F) measures the consumed fertilizers related to agriculture production. This captures the total fertilizers consumed including nitrogenous, phosphate and potash fertilizers. This variable is expressed in metric tons.

d) Machinery (M) accounts for the number of wheel and crawler tractors, but excluding garden tractors, used in agriculture. It is important to note that only the number of tractors was used as input variable with no consideration made to the horsepower of the tractors.

e) Livestock (S) was based on the aggregation of poultry and different animals (e.g. chickens, duck, turkey, geese, buffalos, cattle goat, horses, and pigs). To get the total number of livestock, the considered animals were weighted as follows: cattle and buffalo (0.8); sheep and goat (0.1); pig (0.2); chicken, duck, geese and turkey (0.01); and horse (1.0).

In order to aggregate the above inputs, the following weights were adopted from Hayami and Ruttan (1985): 0.45 for labor, 0.10 for land, 0.15 for fertilizer, 0.10 for machinery and 0.20 for livestock.

**Results and Discussion**

In general view, a greater portion of the growth in agricultural output in the last four decades of Philippine agriculture was mostly attributed to the increasing share of inputs used in the production. Figure 1 shows that output growth mirrors the behavior of the input growth. Somehow the total factor productivity throughout the period appears to be relatively unstable. TFP displayed decreasing contribution from 1961 to 1973 and started to increase from 1974 and showed increasing contribution to output growth from then on upward trend to 1986 and then remain
Figure 1. TFP growth, total input growth and total output growth of Agriculture from 1961 to 2005.

Table 1. Summary of TFP growth, total input and total output growth from 1961-2005 (in percentage).

<table>
<thead>
<tr>
<th>Political Period</th>
<th>Period</th>
<th>TFP Growth</th>
<th>Input Growth</th>
<th>Output Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Martial Law Period</td>
<td>1961-1972</td>
<td>-0.885</td>
<td>3.863</td>
<td>2.978</td>
</tr>
<tr>
<td>People Power and Post Revolution</td>
<td>1986-2000</td>
<td>-0.547</td>
<td>3.288</td>
<td>2.741</td>
</tr>
<tr>
<td>People Power 2 and Post Revolution 2</td>
<td>2001-2005</td>
<td>3.001</td>
<td>1.117</td>
<td>4.118</td>
</tr>
</tbody>
</table>

Note: Author’s calculation based on FAO statistics database.

fairly stable from 1987 to 2001. However, from 2002 up to 2005, TFP growth is promising and is depicting an increasing trend (Figure 1).

Total Factor Productivity and Political Environment in the Philippines

The Philippines has gone a series of economic and political turmoil. This political turmoil disrupted government services also affecting the agriculture sector. To empirically investigate the effects of these political instability on the changes in output growth, input growth and TFP, the time series was divided into four categories enclosing significant political changes in the Philippine government.

Table 1 provides a summary of the growth in TFP, total output and total input of the Philippine agriculture from 1961 to 2005 disaggregated into several political periods. Results from Table 1 showed that the contribution of TFP to total output growth were negative in the pre-Martial Law period and on the onset of People Power I or post people power revolution. Likewise, TFP was positive during the period of military rule or Martial Law in the Philippines and post People Power 2 / EDSA 2 period. In the last period, agricultural condition of Philippines looks good and seems to be on the right direction since output growth was observed highest compared to other periods while using the least amount of inputs. To thoroughly evaluate TFP in each political period, each period was discussed separately. To further evaluate the changes in agricultural growth, trend analysis was conducted across several political periods. It is helpful to examine whether the growth in agriculture is largely driven by input growth or output growth.
Pre-Martial Law Period

In the pre-martial law period, the average output growth is lower than the average input growth. Figure 2 shows that growth in output was offset by heavy use of inputs. The average output growth posted at 2.98% while input growth was 3.86%. TFP posted negative growth at around 0.89%. This implies that growth in agriculture in this period is not really in good shape as growth is mainly attributed to heavy use of inputs.

Martial Law Period

The period of martial law was observed to be relatively good in terms of output growth and TFP as manifested by results presented in Figure 3. This is because output growth is higher than the previous period despite the fact that Philippines was under military control. Almost half of the output growth was contributed by the average growth of TFP. In this period, input growth was significantly lower than output growth. Output growth from agriculture could be attributed to the Masagana 99 and green revolution program implemented by President Marcos. Innovative program revolutionizing the rice industry and made the Philippines a rice-exporter and self-sufficient in white corn. Agriculture gains from the program initiated by Marcos that experienced relatively stable governance few years after the declaration of Martial Law.

People Power Revolution and Post People Power Period

In 1986, Philippines wowed the world by demonstrating peaceful protest toppling down the long running Marcos regime. However, this period was plagued with lots of civil unrest from separatist growth. With regards to output growth, a decline in output was observed in comparison to the previous period. Figure 4 shows that TFP was observed to be low and negative. Input growth exceeded output growth implying that growth is attributed to increase in input rather than TFP. During this period much of the attention of government were focused on maintaining order in the country. In addition, series of crisis were observed in this period such as oil or energy crisis, natural calamity like typhoons, eruption of volcano, and El Niño and also the Asian Financial crisis further slumps the economy.

Agrarian Reform Program in the Philippines

After discussing TFP as affected by major political events, this part focuses on evaluating TFP as influenced by major agrarian reforms in the Philippines. Ending Martial Law was considered a major political achievement in the Philippines, an affirmation of democracy in the country. Change in leadership has brought new policies towards improvement of the Philippine economy. A major innovation
of policy on agriculture is the formulation and implementation of Comprehensive Agrarian Reform Program. This program was designed to redistribute and allocate lands to rural farmers who have been tilling the land for such a long period of time but never owned a parcel of land.

The CARP tries to acquire lands from hacenderos and redistribute it to farmers who are justifiably entitled to have. Thus, this study

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**Table 2.** Summary of TFP growth, total input and total output growth from 1961-2005.

<table>
<thead>
<tr>
<th>Summary</th>
<th>Period</th>
<th>TFP Growth</th>
<th>Input Growth</th>
<th>Output Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-CARP Agrarian Reform Program</td>
<td>1961-1987</td>
<td>-0.033</td>
<td>3.217</td>
<td>3.184</td>
</tr>
<tr>
<td>Comprehensive Agrarian Reform Program</td>
<td>1988-2005</td>
<td>0.936</td>
<td>2.368</td>
<td>3.083</td>
</tr>
</tbody>
</table>

*Note: Author's calculation based on FAO statistics database.*
further evaluates how far CARP impacted the agriculture sector of the Philippines. Since CARP took effect in 1988, the period was divided into two major clusters. Table 2 presents the summary of TFP, input and output growth. From 1961-1987, output growth was observed to be high but a greater portion of its growth is attributed to the increase in inputs used but TFP was observed to be negative in this period. However, after conceptualizing and implementing CARP, output growth was observed to be lower compared to the previous period. In addition, TFP posted positive contribution to output growth while usage of input declines. This implies that though output declines after CARP implementation, TFP was gaining advantage and is improving.

**Pre- Comprehensive Agrarian Reform Program / Agrarian Reform Program**

Before the implementation of Comprehensive Agrarian Reform Program (CARP), there is already an existing agrarian reform program. However, the strength of the program is not that intensified as CARP. Hence it is logical to separate this period from the implementation of CARP and evaluate the performance of TFP in this period.
Results from Figure 6 shows that output was observed to be increasing. On average the increase in output can be attributed to the increase in input use. From 1961 to 1974, TFP was lower than 100 implying negative growth. However, from 1974 up to 1986 TFP was above the 100 baseline implying positive contribution to growth. The higher TFP level from 1975 was offset by the negative level observed from 1961 to 1974. Likewise, input has continually increased which contributed to the increase in output growth (Figure 6).

**Comprehensive Agrarian Reform Program (CARP)**

The significant difference of this agrarian program from the previous agrarian program is the presence of law known as Comprehensive Agrarian Reform Law (CARL) which settles dispute on land issues. Aside from this, CARP gives full land ownership to rural farmers qualified under the program. The period considered after implementing CARP encloses from 1988 to 2005 with 1987 values as base values. In this period TFP was in better position because it lies within 100 level and is seen to be increasing from year 2000.
onwards (Figure 7). From Table 2, output growth was relatively lower in comparison to the previous level. However, an interesting result showed that growth from input declined but contribution of TFP to total output growth posted an increase and is positive. This implies that at this period, agriculture was in better position considering that TFP was positively contributing to output growth. Base from these results, CARP’s impact to agriculture has seen some improvements in TFP. This improvement in TFP may capture farmers’ efforts in improving and maximizing output. Since they own the land, they can reap all benefits from their own farm production.

**Conclusion**

This paper aims to evaluate the performance of the Philippine agriculture employing the methodology of total factor productivity (TFP). This study evaluates TFP under two main dimensions; (i) political changes and (ii) agrarian reform program. Under political changes, the analysis of TFP was divided into four periods enclosing major political and defining events in the country. Results show that TFP growth was found to be erratic and is fluctuating significantly posting negative to positive growth and then to negative growth and towards the later part posted positive growth. The TFP was highest during the recent period, People Power 2 / Post Revolution 2 period, and the next highest TFP period was observed during Martial Law period. However, negative TFP growth was also evident during Pre-Martial Law period and People Power/ Post-Revolution period.

Considering agrarian reforms in the country, TFP was observed highest under the implementation of CARP but TFP’s contribution to output growth is very marginal compared to the share of input growth. Nevertheless, its level is positive compared to the TFP growth under the pre-CARP period.

Basing from the results of the study, it can be concluded that major political changes affected productivity in the agriculture sector. It is indeed very important to have stable governance to enhance the implementation of policies geared towards productivity improvement in the agriculture sector. In addition, distributing land to farmers improved total factor productivity as farmers would maximize their production since they can get all the benefits from their own farm production. Meanwhile under the Marcos regime, the Masagana 99 program may have played a major role in introducing high-yielding rice varieties to the rural farmers. Hence, results suggest that the use of technology as well as channeling of government resources into research and development, improvement of marketing skills of farmers might be good policies to pursue to increase productivity in the agriculture sector.

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