

# EFFECTIVENESS OF PUBLIC SPENDING IN IMPROVING RURAL DEVELOPMENT: AN APPLICATION USING SEEMINGLY UNRELATED REGRESSION

Moises Neil V. Serião<sup>1</sup> and Therese C. Ratilla<sup>2</sup>

<sup>1</sup>*Department of Economics, Visayas State University (VSU), Baybay City, Leyte, Philippines*

<sup>2</sup>*Visayas Socio-Economic Research and Data Analytics Center, VSU, Visca, Baybay City, Leyte*

This study investigates the effectiveness of public spending on agriculture and education in analyzing its impact on the quality of life in the Philippines using the methods of seemingly unrelated regression. We used the available macroeconomic data with life expectancy as proxy variable to measure quality of life. Results show that public expenditure on education showed contrasting result on its effect on total factor productivity and literacy rate. Public expenditure on education showed negative impact on total factor productivity while literacy rate improves as public expenditure on education increases. This suggests that expenditure on education has more profound effect in improving quality of life in the Philippines as manifested by the positive and highly significant estimate. Results imply that with proper education, the farmers could easily adopt to new agricultural technologies, which can contribute to enhancing productivity thereby, potentially leading to the overall improvement of quality of life in the Philippines.

**Keywords:** life expectancy, literacy rate, total factor productivity, government expenditure

## 1. INTRODUCTION

The Philippine's strategy for rural development emphasizes economic growth with social inclusion. The positive streams of growth are expected to come from improved production, higher total factor productivity and greater value addition in the agricultural sector (World Bank, 2007). The government aimed at easing out rural poverty and improving welfare and condition of life especially the rural populace through improvements and innovations in agricultural sector.

---

<sup>1</sup> Corresponding author: Moises Neil V. Serião, email: moisesneil.serino@vsu.edu.ph

In addition, government spending on education is expected to improve the well-being of beneficiaries and enhance their capability to earn income in the future (Manasan et al., 2007). Several studies have examined the impact of public spending on agriculture and rural development. These studies have shown that public spending on agricultural research and extension services, infrastructure, and education could positively contribute to the improvement of the quality of life in rural areas. In particular, this proved to be true for a sample of developing and transition countries (Gemma, 2009). However, limited information is available for the case of rural development in the Philippines.

Studies have shown that increased public expenditure on education and health care is associated with improvements in both access to and attainment in schools, and reduces mortality rates for infants and children (Gupta et al., 2002, Rajkumar & Swaroop, 2008, Baldacci et al., 2008). Gemma (2009) on his study about public spending on agriculture and rural development states “that the conventional hypothesis that public spending on agriculture’s research and development, rural infrastructure, education and scientific research is contributing to the improvement in the quality of life in rural areas was proved to be true for the sampled developing and transition countries”. Thus given this perspective, this study investigates to what extent has the populace especially the poor benefited from government spending on education and agriculture in Philippines using the available macroeconomic data from 1970 to 2008. This paper seeks to contribute to the literature by examining the economic and social impacts of public spending on agriculture and rural development. In particular, rather than examining the direct impact of public spending on the quality of life in rural areas, we use a system of three equations that examines how public spending on education and agriculture could affect the agricultural productivity and adult literacy rate, and hence in effect the quality of life in rural areas.

This study could be valuable in designing relevant public policy in order to enhance the quality of life in rural areas. Employing system of equations approach, this study aimed to quantify and capture the impact of government spending on rural development through agricultural and education sector. It will analyze the collective effect of government expenditure on the quality of life measured using life expectancy in the Philippines.

## 2. METHODOLOGY

### **Empirical Model**

A classic approach in explaining impact of government spending on quality of life employs system of equations. The approach used in this study is

similar to what Cas (2006) and Gemma (2009) employed. However, the innovation of this study is to include a wider scope of data that runs from 1970 to 2008 and to include more independent variables or control variables in the main specification (Equation 1). Since Philippines is a remittance dependent country<sup>2</sup>, it is imperative to include remittance variable in Equation 1 as a major determinant affecting quality of life. The three linear equations considered are postulated as follows:

$$life\_quality_t = \alpha + \beta_1 TFPG_t + \beta_2 lit\_rate_t + \beta_3 PCGDP_t + \beta_4 remit + \varepsilon_t \quad (1)$$

$$TFPG_t = \gamma + \delta_1 educ\_exp_t + \delta_2 agri\_exp_t + \delta_2 trend_t + \mu_t \quad (2)$$

$$lit\_rate_t = \tau + \theta_1 educ\_exp_t + \theta_2 trend_t + \omega_t \quad (3)$$

where:  $life\_quality_t$  = refers to the quality of life at time  $t$ ;

$TFPG_t$  = refers to the total factor productivity growth at time  $t$ ;

$lit\_rate_t$  = refers to adult literacy rate at time  $t$ ;

$PCGDP_t$  = refers to the per capita gross domestic product at time  $t$ ;

$remit_t$  = refers to the volume of remittance at time  $t$ ;

$educ\_exp_t$  = refers to the government expenditure in education at time  $t$ ;

$agri\_exp_t$  = refers to the government expenditure in agriculture at time  $t$ ;

$trend_t$  = captures the time trend; and

$\varepsilon_t$ ,  $\mu_t$ , and  $\omega_t$  = captures the error term.

Central hypothesis of the study states that improvement in total factor productivity and literacy rate would positively impact quality of life. In this facet, public spending is an exogenous variable which is assumed to have positive influence on total factor productivity and literacy rate. Within this context, this study evaluates whether the hypothesis holds and shows evidence whether public spending contributes to welfare improvement. For computation purposes all the data were logarithmically transformed. This allows interpreting the coefficients as elasticities.

In the regression above, it is necessary to convert annual expenditures into stocks in monetary terms. The following procedure similar to what Cas (2006) and Gemma (2009) did was used as follows:

---

<sup>2</sup> The volume of remittance in 2007 accounts to more than 10% of Philippines' GDP. In the world, Philippines is reputed as the third country receiving huge sum of remittances (Pernia, 2008).

$$K_t = I_t + (1-\delta)K_{t-1} \quad (4)$$

where  $K_t$  is the capital stock in year  $t$ ;  $I_t$  is gross capital formation in year  $t$ , and  $\delta$  is the depreciation rate (assumed to be 10%). To obtain initial values for the capital stock, a similar approach employed by Kohli (1978) and Fan et al., (2004) was used in this study. The initial capital stock ( $K_0$ ) is estimated as follows:

$$K_0 = \frac{I_0}{(\delta+r)} \quad (5)$$

Equation 5 shows that the initial capital stock in year 0 ( $K_0$ ) is the capital investment in year 0 ( $I_0$ ) divided by the sum of real interest rate ( $r$ ) and depreciation rate. In the individual country studies, the assumed real interest rate is usually 3% (Fan et al., 2004).

## Data Used

The data used in this study were aggregated from different government statistical and economic database to include National Statistical Coordination Board (NSCB), National Economic Development Authority (NEDA)<sup>3</sup>, and from World Development Indicator (WDI) (World Bank, 2009).

Table 1 presents the descriptive statistics of the data set used. Life expectancy was used to represent quality of life. On the average, life expectancy is reported at 65years. Adult literacy rate aged 15 years and above is 88.83% while total factor productivity growth posted positive growth at 1.02. Per capita gross domestic product (GDP) is at Php 12,007.51 (US\$ 253.78 at 1US\$ = 47.314Php<sup>4</sup>). Expenditure in agriculture recorded at 8800.83 million pesos<sup>5</sup> while expenditure in education posted almost three times higher than agriculture at 20142.78 million pesos. This shows that government allocated higher expenditure in improving the educational sector rather than agriculture. Remittances coursed through banks are on the average reported at 782.16 million pesos.

---

<sup>3</sup> Special thanks to Richard Emerson (from NEDA) for sharing relevant data. Without his special access, data used in this study would not be comprehensive as it is.

<sup>4</sup> Current exchange rate used by Bangko Sentral ng Pilipinas (2010).

<sup>5</sup> Peso is the currency unit of Philippine monetary system.

Table1. Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
Life Expectancy (years)	65.02	4.68	57	72
Literacy Rate (percentage)	88.83	5.27	80	94
Total Factor Productivity	1.02	4.54	-9.17	10.71
Per capita GDP (pesos)	12007.51	1448.06	9313.73	15832
Expenditure in Agricultural (million pesos)	8800.83	2961.58	4396.38	18406.43
Expenditure in Education (million pesos)	20142.78	10280.44	6815.56	36477.4
Remittances (million pesos)	782.16	806.99	76.8931	2865.88

Note: Life expectancy was used to represent quality of life. Per capita GDP is measured in local currency units. The values of expenditures and remittances were expressed in millions of pesos.

Source: National Statistical Coordination Board (NSCB) (2009).

### Variables used in the empirical model

Equation 1 captures the determinants of quality of life using life expectancy as dependent variable. Life expectancy at birth refers to the number of years a person could expect to live. Controlling for per capita gross domestic product and level of remittances received, Equation 1 investigates how total factor productivity and literacy rate contributes to improvements in the quality of life.

Adult literacy rate measures the percentage of adults aged 15 and above who were able to read, comprehend, and write or in general, literate. The total factor productivity growth was used to represent agricultural productivity growth. To control the level of income, per capita gross domestic product was used in this equation. It is expected that all specified independent variables will display positive relationship with life expectancy. Remittances directly increase income level of household beneficiaries left behind in Philippines. This variable is hypothesized to affect quality of life since the Philippines is a remittance dependent economy (Pernia, 2008). Increase in literacy rate, agricultural productivity, per capita GDP and remittances are expected to contribute to poverty alleviation thereby improving quality of life.

For factors affecting total factor productivity growth, Equation 2 considers expenditure in agriculture and education with time trend included as main explanatory variables. Expenditure in agriculture includes improvement in infrastructures, land utilization, access to raw materials, and market development which are expected to contribute to growth in agricultural productivity. Thus, it is expected that expenditure in agriculture will have positive relationship with agricultural productivity. Similarly, expenditure on education will contribute to capacity building and hence it is expected to contribute positively to agricultural

productivity. In addition, time trend was included in Equation 2 to capture for time effect associated with growth on agricultural productivity. It is plausible that changes in growth might be attributed with time.

Equation 3 takes into account expenditure in education as the independent variable affecting literacy rate. This equation captures the impact of public spending directed towards improvements in the education sector. It is expected that expenditure on education will result to improve school facilities, new school buildings, more teachers and will open wider opportunities for getting quality education. Hence it is assumed to have positive relationship with literacy rate. Time trend was included to capture changes in literacy rate not captured by the included controlled variables. The inclusion of time trend in the estimation will control for changes associated with time. Since the data set used in the study spans around four decade series, then there are changes in the Philippine economy attributed with time. Including time trend is practical approach in analyzing time series data set.

This system of equations was estimated with the convenience of Stata software using the methods of seemingly unrelated regression. A seemingly unrelated regression (SUR) system comprises several individual relationships that are linked by the fact that their disturbances are correlated (Fiebig, 2001; Moon and Perron, 2006). For instance, demand functions for several households can be estimated jointly for a particular good. The correlation of several equations can come from income shocks affecting household income. With this approach, different equations can be estimated together. Similarly, we will apply SUR approach in explaining factors that influences countryside development. The progress of a developing country is multi-faceted. Hence, applying systems of equations approach is relevant in our current study.

### 3. RESULTS AND DISCUSSION

The main regression on life expectancy is presented in Table 2. All variables are expressed in logarithmic terms. Estimates should be interpreted as elasticities. Results of equation 1 showed that all signs of the explanatory variables are expected. Literacy rate and remittances significantly contribute to increase in life expectancy at 1% level of significance while per capita GDP is significant at 10%. This could be attributed to the fact that as society acquires more knowledge and information, quality of life increases. Similarly, remittances posted significant positive association with life expectancy. This suggests that the level of remittances received by household beneficiaries of migrant workers contributes to

improvement in the quality of life. This implies that these unrequited transfers (remittances) directly increase income level of households. With higher income, quality of life improves. The same observation can be drawn with per capita GDP. An increase in per capita GDP is associated with an increase in the quality of life. This result conforms to the socio-economic report from the National Economic Development Authority (NEDA) (2009) that an increase in income will alleviate poverty and contributes to welfare development. This will eventually translate to improvement in the quality of life.

Table 2. Regression results for equation 1 with life expectancy as dependent variable.

Variables	Coefficient	Standard Error
Total factor productivity	0.0128	0.0337
Literacy rate	0.8803***	0.0401
GDP per capita	0.0672*	0.0390
Remittance	0.0129***	0.0021
Constant	-0.3732	0.3002

Note:  $R^2 = 0.9735$

\*\*\* significant at 1%, \*\* significant at 5%, and \* significant at 10%

Meanwhile, though total factor productivity posted positive association with quality of life, the estimate is insignificant. This shows that there is no concrete evidence showing that the estimate is significantly different from zero. This implies that the link between total factor productivity and quality of life is not well established. Although it can be argued that the increase in total factor productivity (TFP) improves quality of life through income generation in agriculture, but it should be interpreted with caution since the associated relationship of TFP and life expectancy is significantly not different from zero. Overall, the estimation of Equation 1 is of good fit with an estimated R-square of 97%.

Estimates of Equation 2 are presented in Table 3. Results showed that public spending on education has unexpected sign showing negative relationship with total factor productivity with highly significant estimate. This implies that a percentage increase in government spending directed towards education sector is associated with a 0.14% reduction in total factor productivity, holding other factor constant. This result presents an interesting and plausible argument which is contrary to our expectation. This situation could be attributed to the fact that most educated people do not engage in agricultural related activities. As people acquire more years of education, they tend to seek high paying jobs in industrial or service

sector and not in agriculture. This might explain why spending in education does not translate to improvement in TFP. However, public spending on agriculture showed positive association with TFP but estimate is insignificant. Sufficient evidence could not be well established since public spending on agriculture is not significant in affirming its impact on total factor productivity. Public spending on agriculture does strongly influence total factor productivity. This may further imply that the government needs to increase its budget on agriculture. As shown in Table 1, expenditure in agriculture is three times lower than the expenditure on education.

Controlling for variation in time, the estimate of time trend posted positive and significant effect on TFP. This indicates that time has influence on changes in total factor productivity. This captures the underlying assumption that as farmers acquire more experience in farm technologies, they become more efficient in the production. This will translate to enhancement in the production system, eventually improving total factor productivity. However, estimation of Equation 2 has moderate fit since the computed R-square value is relatively lower compared to Equation 1 and 3. However, this estimation can be improved if the variables included will be treated as endogenous.

Table 3. Regression results for Equation 2 with total factor productivity as dependent variable.

<b>Variables</b>	<b>Coefficient</b>	<b>Standard Error</b>
Expenditure in education	-0.1405***	0.3453
Expenditure in agriculture	0.0283	0.0392
Trend	0.1176***	0.0272
Constant	5.4424	0.3453

Note:  $R^2 = 0.3214$

\*\*\* significant at 1%, \*\* significant at 5%, and \* significant at 10%

Public expenditure directed towards education sector showed positive and highly significant contribution to literacy rate (Equation 3). Holding other factor constant, a 1% increase in education expenditure is associated with a 0.04% increase in literacy rate (Table 4). This finding is in line with the objectives and expectations of government that increase public expenditure on education positively affects literacy rate (NEDA, 2009). The trend estimate also shows positive and highly significant association with literacy rate implying that time has influenced the improvement in literacy rate.



Table 4. Regression results for Equation 3 with literacy rate as dependent variable.

Variables	Coefficient	Standard Error
Expenditure in education	0.040***	0.0690
Trend	0.0484***	0.0063
Constant	3.9612	0.0690

Note:  $R^2 = 0.8983$

\*\*\* significant at 1%, \*\* significant at 5%, and \* significant at 10%

We check the robustness of the regression results by evaluating the significance of the model. If the p-value of the model is lower than 5% and 1% level of significant, then we can confidently claim that the model was able to explain the variations in life expectancy as influenced by several specifications. Table 5 summarizes the test of significance of the different models. Results show that the three equations simulated in a seemingly unrelated regression model appears to be significant at 1%. This indicates that there is evidence to indicate that the variations in life quality measured in terms of life expectancy is explained by the model.

Table 5. Test of significance of the seemingly unrelated regression model.

Equation	Observation	R-square	Chi-square	p-value
Life expectancy	38	0.9735	1508.15	0.0000
Total factor productivity	38	0.3214	18.85	0.0003
Literacy rate	38	0.8983	345.44	0.0000

#### 4. CONCLUSION

This study investigates the effect of public spending in agriculture and education and investigates its impact on the quality of life in the Philippines. The study explores the available macroeconomic data from 1970 to 2008 with life expectancy used as proxy to measure quality of life. Results show that public expenditure on education shows contrasting result on its effect on total factor productivity and literacy rate. Public expenditure on education shows negative impact on total factor productivity. This result suggests that as people acquire more years of education, they tend to seek for high paying jobs and choose to work in industrial sector rather than in the agricultural sector. This is reflected by the insignificant estimate of the association between total productivity and quality of life. However, literacy rate improves as public expenditure on education increases. Expenditure on education has more profound effect on the quality of life as manifested by the positive and highly significant estimate of literacy rate on

quality of life. The difference on the significance of impact between literacy rate and total factor productivity on quality of life can be attributed to the difference in the level of public expenditure spent between education and agriculture. On the average, expenditure on education is three times higher than expenditure in agriculture.

Findings of the study suggest that public expenditure on education is associated with negative total factor productivity hence its contribution to improvements to quality of life is not well established. However, public expenditure on education contributes to improvement in literacy rate leading to improvement in quality of life. Effect of public expenditure on education in improving the quality of life in the Philippines is more evident than the effect of public expenditure on agriculture. With these results, policy makers should intensify and continue investments and prioritize the development and mechanization of agriculture sector. This will eventually contribute to robust economic growth with social inclusion and later on translate to better quality of life.

## 5. REFERENCES

- Bangko Sentral ng Pilipinas (BSP). (2010). Status report on the Philippine financial system. Manila, Philippines.
- Baldacci, E., Clements, B., Gupta, S., & Cui, Q. (2008). Social spending, human capital, and growth in developing countries. *World development*, *36*(8), 1317-1341.
- Cas, A. (2006). Public Spending and Agricultural and Rural Development in the Philippines (1970-2004), International University of Japan, Japan.
- Gemma, M. (2009). Public Spending on Agriculture and Rural Development. Class Lecture Materials, Waseda University, Tokyo, Japan.
- Gupta, S., Verhoeven, M., & Tiongson, E. R. (2002). The effectiveness of government spending on education and health care in developing and transition economies. *European Journal of Political Economy*, *18*(4), 717-737.
- Fan, Shenggen, Somchai Jitsuchon and Nuntaporn Methakunnavut. (2004). The Importance of Public Investment for Reducing Rural Poverty in Middle-Income Countries: The Case of Thailand, DSGD Discussion Paper No. 7, *International Food Policy Research Institute*.
- Fiebig, D. G. (2001). Seemingly unrelated regression. *A companion to theoretical econometrics*, 101-121.
- Kohli, U.R. (1978). A Gross National Product Function and the Derived Demand for Imports and Supply of Exports, *Canadian Journal of Economics*, *11*, 111-125.

## EFFECTIVENESS OF PUBLIC SPENDING FOR RURAL DEVELOPMENT

- Manasan, R., Cuenca, J., and Villanueva, E. (2007). Benefit Incidence of Public Spending on Education in the Philippines. *Philippine Institute for Development Studies, Philippines*.
- Moon, H. R., & Perron, B. (2006). Seemingly unrelated regressions. *The New Palgrave Dictionary of Economics*, 1-9.
- National Economic Development Authority (NEDA). (2009). Socio-economic Reports. Retrieved from [http://www.neda.gov.ph/econreports\\_dbs.asp](http://www.neda.gov.ph/econreports_dbs.asp) on September 21, 2013.
- National Statistical Coordination Board (NSCB). (2009). Statistics. Retrieved from <http://www.nscb.gov.ph/activestats/default.asp> on November 8, 2012.
- Pernia, E. (2008). Migration, Remittances, Poverty and Inequality in the Philippines. University of the Philippines, Discussion Paper No. 0801.
- Rajkumar, Andrew Sunil and Swaroop, Vinaya. (2008). Public spending and outcomes: Does governance matter?, *Journal of Development Economics*, 86 (1), 96-111.
- World Bank. (2007). Rural Development Sector Strategic Priorities. Rural Development and Natural Resources Sector Unit East Asia and the Pacific Region, World Bank Manila Office, Philippines.
- World Bank. (2009). World Development Indicators (WDI Online). Retrieved from <http://data.worldbank.org/data-catalog/world-development-indicators> on March 23, 2012.