The Relationship between Population Dynamics and Investments for Energy and Telecommunication Infrastructures in the Philippines

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THE RELATIONSHIP BETWEEN POPULATION DYNAMICS AND INVESTMENTS FOR ENERGY AND TELECOMMUNICATION INFRASTRUCTURES IN THE PHILIPPINES

by

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Abstract

The study examined the relationship between population dynamics and investments for energy and telecommunication infrastructures in the Philippines from 1990-2011. Ordinary Least Squares (OLS) and Two-Stage Least Squares (2SLS-IV) were explored to estimates the coefficients of the models. However, Hausman Specification test rejected the hypothesis of simultaneity problem in the models. Therefore, results of the OLS estimation is preferred than the results of 2SLS-IV.

Results revealed that investment for energy and telecommunication is negatively affected by total population but positively affected by the level of population below 15 years old and above 65 years old. Urban agglomeration has significantly increased investments for telecommunication. In general, level of population and its dynamics significantly affects the aggregate infrastructure investments.

INTRODUCTION

Background of the study

The role of infrastructure in enhancing economic development has been documented both in academic literatures and in the policy debate (Aschauer, 1989). According to Chan, et al., (2009), infrastructure can be thought of as the long-lived structural assets that either facilitate the flow of goods, information and factors of production between buyers and sellers (economic infrastructure) or underpin the delivery of essential services such as health and education (social infrastructure).

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Since the global crisis hit in 2008, talk of new infrastructure projects has abounded, principally because investment in infrastructure is seen as a potent way to provide a fiscal stimulus to economies in recession (Heller, 2010). More recently, it has been emphasized that by promoting growth, reliable and affordable infrastructure can reduce poverty. It can contribute to poverty alleviation directly by providing and supporting delivery of key services, such as those seeking to increase households access to safe drinking water, basic sanitation and secure tenure. Improved transport infrastructure and services will strengthen economic linkages between rural and urban areas, where the markets for farmers' products and inputs lie (Bayraktar, 2006; Garmendia, et al., 2004).

While the needs are increasingly well recognized in many developing countries, key infrastructure services are still much to be desired both in quantity and quality. In most countries, the potential contribution of infrastructure to economic growth and poverty reduction has not been fully realized, and existing infrastructure stock and services fall far short of the requirements (Kirkpatrick, 2008). Similarly, the capital spending on the building of infrastructures worldwide has declined. The reasons behind this decline in spending can be attributed to numerous factors. First of all, many countries have experienced large budget deficits in recent years and thus do not have the extra capital to spend on their infrastructures. Second, tax revenues in many countries have been stagnant since the oil crisis of the 1970s. Third, many countries have increased their spending on welfare, using money usually spent on the public sector, and have underestimated the increasing burden that population growth and other societal changes place on infrastructure (www.refererencebusiness.com).

In a number of studies [see; Bassetto and Mcgranahan, (2011); Sturm, (2001); and Plotnikova, (2005)] involving determinants of public capital expenditure, which include infrastructure investment, they cited several population dynamic factors, population growth and mobility, as one of the drivers of the variation of public capital spending. Population dynamics studies short-term and long-term changes in the size and age composition of populations, and the biological and environmental processes influencing those changes. Population dynamics deals with the way populations are affected by birth and death rates, and by immigration and emigration, and studies topics such as ageing populations or population decline (www.wikipedia.org). Moreover, Herrin, A. (1983) cited number of demographic aspects that can affect development planning which include population growth, age structure, components of population change, effect of alternative population growth rates and the concept of population growth momentum.

Philippine Context

Investment in the public expenditure has been less than optimal, and has declined in recent years. During the final years of Marcos regime one-third of the budget was spent on capital outlays. The share of capital expenditure dropped sharply to an average of 3.1% of GDP during the Aquino administration. It significantly decreased until then and hit a historic low of 2.0% during the Arroyo administration (Diokno, 2010). Philippine investment in physical infrastructure for the year 2005 was less than 2% of GDP- a level that is considerably lower than the World Bank-prescribed 5% of GDP to lead to a sustainable economic growth (World Bank, 2005). Table 1 shows the infrastructure investments of Asean countries as a percentage of GDP.

Table 1. Infrastructure investment as percentage of GDP in Asean countries.

Infrastructure Investment (% GDP)		
0-3%	4-7%	7% over
Cambodia	Lao PDR	China
Indonesia	Mongolia	Thailand
Philippines		Vietnam

Source: World Bank Data

Moreover, according to a report by World Economic Forum, the quality of the Philippine institutions continues to be assessed as poor. The Philippine ranks beyond the 100 mark on each of the 16 related indicators. In particular, the country ranks a mediocre 113th on the overall state of its infrastructure, with low marks for the quality of its seaport (123rd) and airport infrastructure (115th). They grouped several components or indicators into 12 pillar of competitiveness and they consider infrastructure as the second pillar of competitiveness.

Rationale of the Study

This study was pursued on the following justifications. First, this study is based on the view that infrastructure investment is a key driver for the Philippines to foster economic growth. In a study conducted by PEP (2010), results revealed that increased public investment in infrastructure in the Philippines manifested itself in terms of greater capital accumulation and improved productivity. Indeed, the simulation results suggested that an increase in public infrastructure investment would not only bring about positive real GDP growth, but also a reduction in poverty and inequality, both in short- and long-run. Moreover, Tolo (2011) found out that a higher investment- proxied by gross fixed capital formation in percent of GDP- was significantly correlated with higher growth.

The second motive is due to the decline of infrastructure investments for decades in the country. As discussed above, there is no question on how significant infrastructure investments to the growth of a country. But because of the financial crisis experienced by the Philippine government for the long years public capital investment growth is in a level of stagnation (www.inquirer.net). Debt servicing, along with, wages and salaries, is the no.1 priority of the national budget, with capital expenditures being starved. Since government is the biggest investor in the country-indeed, in any country, the radical stripping away of capital expenditures goes a long way towards explaining the stagnant 1.0 %

average yearly GDP growth in the 1980's and 2.3% rate in the first half of the 1990.

Experts believe that one of the causes why public capital spending is decreasing for years is due to its rapid population growth. The population growth in the Philippines continues to be high at around 2% per year and has hardly changed much in rate of growth in recent years. This means that per capita growth of income and output is lower because the high population growth absorbs much of the growth of the economy if only to maintain consumption per capita (Sicat, 2006). The growth rate is a factor in determining how great a burden would be imposed on a country by the changing needs of its people for infrastructure (e.g., schools, hospitals, housing, roads), resources (e.g., food, water, electricity), and jobs.

The third and the last compelling reason for the study is based on the view that infrastructure investment is also affected by other population dynamics like urbanization and age structures. Infrastructure requirements can also be affected by the composition of a country's population. An aging population and lower birth rates, for example, can change infrastructure priorities with higher demand for health and aged-care services and lower demand for schools while a youthful population implies a greater demand for infrastructure related to the provision of education services.

Rapid urbanization in the Philippines also faced issues and controversies with regard to infrastructure formation. The current urban growth rates of about 3% over one million people are expected to be added to urban areas annually. Given the capital-intensive nature of urban infrastructure, investment requirements, though not as sensitive as population levels, are highly sensitive to the population growth rates of urban areas [(World Bank Group, (2005)]. In addition to creating an absolute demand for infrastructure, because of the difference in economic activities between urban and rural areas, rapid urbanization in the Philippines is also changing the nature of the infrastructure that will be needed in order to meet the demand. The transformation of rural settlements into cities implies denser settlements and shifting economic activities that have greater infrastructure requirements. Metro Manila is now the 17th among the world's population urban agglomerations. Moreover, more than a few observers of the Philippines contend that the poor performance in economic growth and poverty reduction has to do partly with large disparities in infrastructure across regions and island groups between rural and urban areas [Balisacan, et al., (2012); World Bank Group, (2005)].

Objectives of the Study

The study examined the relationship between infrastructure investment and population dynamics in the Philippines.

Specifically, it aims to;

a.) Present the trends of infrastructure investment, population, degree of urbanization and age structures in the Philippines; and

b.) Investigate the relationship of infrastructure investment and population dynamics

METHODOLOGY

Conceptual Framework

Figure 1 shows the possible linkages of infrastructure investments and population dynamics. A number of demographic factors have influenced demand for infrastructure needs. The kinds of transportation systems, and the numbers and type of schools and hospitals a country needs, are just some of the examples of infrastructure demands which are highly sensitive to demographic change.

There are several demographic factors that affect infrastructure investments in a direct or indirect ways. Population size is the most obvious. For spatially universal infrastructure, one would expect that the larger the population, the greater the need for a capacity to provide clean water and sanitation services, as well as medical care. Also, the age structure of a population influences the demand for specific types of infrastructure. For example, a young population implies, *ceteris paribus*, a greater demand for infrastructure related to the provision of education services. Lastly, urbanization also matter because as people move from rural to urban cities; infrastructure investments may rise as the demands of urban investments, such as transport and communication, increases.

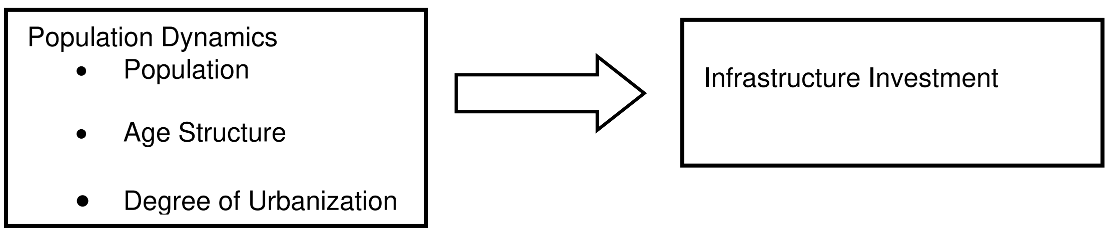

Figure 1. Relationship between infrastructure investments and population dynamics.

Capital spending was positively related to mobility, i.e., it declined with the fraction of the population that remains in the state in any given year [Basetto and Mcgranahan, (2011)]. This implies that the capital stock increases with gross migration. Second, capital spending by the states reacted to population growth less than would be needed to preserve a constant capital stock per capita. This implies that the capital stock per capita declines with population growth.

Studies of Sturm (2001) and Bruce, et al (2007) shows that population of age 15 below along with the population 65 above and urbanization were negatively related to infrastructure investments. This implied that an increase of the two explanatory variables would result to reduction of investments in infrastructure.

Data Source

This study employed panel data on infrastructure investments, telecommunication and energy, as well as the population of urban agglomeration for 1990 to 2011 was taken from the World Bank Data. Moreover, the data on annual population and age structures was gathered from the National Statistics Office (NSO) from the years 1990-2011.

Methods used

This section was divided into two parts. The first part is the descriptive analysis and trends of the infrastructure investments and population dynamics in the Philippines. The second part is the econometric models that investigate the relationship between the variables.

I. Trends of Infrastructure Investments and Population Dynamics in the Philippines

This study made use of graphs and tables to show the trends of infrastructure investments and population dynamics in the Philippines. Graphs and tables were generated using Microsoft Excel 2007.

II. Econometric Model

This study adopted the Ordinary Least Squares (OLS) and Two-Stage Least Squares (2SLS-IV) with the variables in their natural log form to avoid large variances.

The Ordinary Least Square method is used to find or estimate the numerical values of the parameters to find a function to a set of data in a linear way. In regression analysis, OLS is a method for linear statistical model by minimizing the sum of the squared residuals (the difference between the predicted and observed value). Estimates of parameters are best linear unbiased estimator (BLUE) if the following assumptions are satisfied:

a.) $E(\varepsilon) = 0$

This implies the mean of the error term is zero

b.) $var(\varepsilon) = \boldsymbol{\sigma}^2$

This is the property of homoscedasticity, i.e., that the errors have a common variance

c.) $cov(\varepsilon_i, \varepsilon_j) = 0$ where $i \neq j$

This is the property of autocorrelation, i.e., no two errors are serially correlated

To reiterate, the OLS estimator is consistent when the regressors are exogenous and there is no multicollinearity, and optimal in the class of best linear unbiased estimator (BLUE) when the errors are homoscedastic and serially uncorrelated. Under these conditions, the method of OLS provides minimum variance mea-unbiased estimation when the errors have finite variances. Under the additional assumption that the errors be normally distributed, OLS is the maximum likelihood estimator.

On the other hand, Two-Stage Least squares (2SLS) regression analysis is a statistical technique that is used in the analysis of structural equations. This technique is the extension of the OLS method. It is used when the dependent variable's error terms are correlated with the independent variables. Additionally, it is useful when there are feedback loops in the model. In structural equations modeling, we use the maximum likelihood method to estimate the path coefficient.

Statistical Model

First, we regress individually the types of infrastructure investments, energy and telecommunication, associated with the independent variables. Then, regress the summation of infrastructure investments, aggregate infrastructure investments, with the dependent variables.

Equation Models

$$lnTele_t = \beta_0 + \beta_1 lnPop_t + \beta_2 lnUrb_t + \beta_3 lnPop{<}15_t + \beta_4 lnPop{>}60_t + \varepsilon t \qquad (1)$$

$$lnEner_t = \beta_5 + \beta_6\, lnPop_t + \beta_7\, lnUrb + \beta_8\, lnPop{<}15_t + \beta_9\, lnPop{>}60_t + \varepsilon t \qquad (2)$$

$$lnAgInfra_t = \beta_{10} + \beta_{11}\, lnPop_t + \beta_{12}\, lnUrb_t + \beta_{13}\, lnPop{<}15_t + \beta_{14}\, lnPop{>}60_t + \varepsilon_t \qquad (3)$$

where:

$Tele_t$ = Investments in telecommunication infrastructure during time t

$Ener_t$ = Investments in energy infrastructure during time t

$AgInfra_t$ = Total investments in infrastructure during time t

PGR_t = Total population during time t

Urb_t = Urban agglomeration population during time t

$Pop{<}15_t$ = Count of population age 15 below at time t

$Pop{>}65_t$ = Count of population age 65 over at time t

LF_t = Labor force at time t

If there is no simultaneous equation, or simultaneity problem, the OLS estimators produce consistent and efficient estimator. On the other hand, if there is simultaneity, OLS estimators are not even consistent. In the presence of simultaneity the methods of Two-Stage Least Squares (2SLS) will give estimators that are consistent and efficient.

Simultaneous Equation Model

Telecommunication sector

$$lnTele_t = \beta_{15} + \beta_{16} lnPop_t + \beta_{17} lnUrb_t + \beta_{18} lnPop{<}15_t + \beta_{19}\, lnPop{>}60_t + \varepsilon t \qquad (4)$$

$$lnPop_t = \beta_{20} + \beta_{21}\, lnUrb_t + \beta_{22}\, lnPop{<}15_t + \beta_{23} lnPop{>}60_t + \beta_{24} lnLF + \varepsilon t \qquad (5)$$

Energy Sector

$$lnEner_t = \beta_{25} + \beta_{26} lnPop_t + \beta_{27} lnUrb_t + \beta_{28} lnPop{<}15_t + \beta_{29} lnPop{>}60_t + \varepsilon t \qquad (6)$$

$$lnPop_t = \beta_{30} + \beta_{31}\, lnUrb_t + \beta_{32}\, lnPop{<}15_t + \beta_{33}\, lnPop{>}60_t + \beta_{34}\, lnLF + \varepsilon t \qquad (7)$$

Aggregate (Summation of the two sectors)

$$lnAgInfra_t\ \beta_{35} + \beta_{36}\, lnPop_t + \beta_{37}\, lnUrb_t + \beta_{38}\, lnPop{<}15_t + \beta_{39}\, lnPop{>}60_t + \varepsilon_t \quad (8)$$

$$lnPop_t = \beta_{40}\, lnUrb_t + \beta_{41}\, lnPop{<}15_t + \beta_{42}\, lnPop{>}60_t + \beta_{43}\, lnLF + \varepsilon t \qquad (9)$$

The equations are called simultaneous equation because the variables in each equation are related with each other. Two-stages Least Squares (2SLS-IV) was used because population may be endogenous. It is appropriate to use Two Stage Least Squares (2SLS-IV) to address the endogeneity problem. In ordinary least square method, there is a basic assumption that the value of the error terms is independent of predictor variables. When this assumption is broken, this technique helps us to solve this problem. This analysis assumes that there is a secondary predictor that is correlated to the problematic predictor but not with the error term. In this study the considered instrumental variable for population is the labor force (LF). Given the existence of the instrument variable, the following two methods are used:

1. In the first stage, a new variable is created using the instrument variable.
2. In the second stage, the model-estimated values from stage one are then used in place of the actual values of the problematic predictors to compute an OLS model for the response of interest.

The simultaneity arises because some of the regressors are endogenous and therefore likely to be correlated with the disturbance, or error term. Therefore, a test of simultaneity is essential test of whether regressor is correlated with the error term. If the simultaneity problem exists, case alternatives to OLS must be found; if it's not, then the study can use OLS. To find out which is the case in a concrete situation, Hausman's specification errors test is used. It can be explain as follows:

Call y_1 the dependent variable of the structural model, y_2 the endogenous independent variable, and z_1 the exogenous regressors in the structural model,

$$y_1 = z_1\delta_1 + \alpha_1 y_2 + u_1$$

where z_1 (l_1 X 1). Assume we have a subset of instruments z, which is a l X 1 vector, such that:

$$E(zu_1) = 0$$

Identification requires that at least one instrument in z is excluded in z_1 (order condition), and at least one instrument in z which is excluded in z_1 is partially correlated with y_2 (rank condition). The Hausman test for endogeneity consists in comparing ols and 2sls estimators for $\beta_1 \equiv (\delta_1,\alpha_1)$: if y_2 is uncorrelated with u_1, then the two estimators should differ only by the sampling error. Consider the regression based form of the test. Consider the linear projection of y_2 on z

$$y_2 = z\pi_2 + v_2 \text{ where } E(z'v_2) = 0$$

Since z is uncorrelated with u_1, it follows that y_2 is endogenous (that is $E(u_1y_2)\neq 0$) if and only if $E(u_1v_2)\neq 0$. Test if $E(u_1v_2)\neq 0$, and run

$$u_1 = \rho_1 v_2 + e_1$$

where $\rho_1 = E(u_1v_2)/E(V_2^2)$, $E(e_1v_2) = 0$ and $E(z'e_1) = 0$ (since $E(z'u_1) = 0$ and $E(z'v_2) = 0$). Substitute $u_1 = \rho_1v_2 + e_1$ in $y_1 = z_1\delta_1 + \alpha_1y_2 + u_1$ and obtain

$$y_1 = z_1\delta_1 + \alpha_1 y_2 + \rho_1 v_2 + e_1$$

The Hausman test consists in testing $H_0 : \rho_1 = 0$ since v_2 is not observable it can be obtained by the ols residuals of the first stage, $\hat{v}_2$,so that we can consistently estimate regression:

$$y_1 = z_1\delta_1 + \alpha_1 y_2 + \rho_1 \hat{v}_2 + e_1$$

by ols and then compute t statistic (the classical one or the heteroskedasticity robust if heresoskedasticity is suspected) for $\hat{p}_1$ in order to the $H_0 : \rho_1 = 0$ (Note: ols estimates from above equation are identical to estimates from the 2sls procedure).To implement the Hausman Specification test in the models of the study. Consider the equation for aggregate infrastructure investments:

$$lnAgInfra_t = \beta_{35} + \beta_{36}\, lnPop_t + \beta_{37} lnUrb_t + \beta_{38} lnPop{<}15_t + \beta_{39} lnPop{>}60_t + \varepsilon_t \quad (8)$$

Because of the possibility of simultaneity between aggregate infrastructure investment and population, it should first regress lnPop on the exogenous variables, lnPop>15, lnPop>65, lnUrb, and lnLF. Let the error term in this regression be v_2 and from this regression the calculated residual is $\hat{v}_2$.

$$lnPop_t = \beta_{40} lnUrb_t + \beta_{41} lnPop<15_t + \beta_{42} lnPop>60_t + \beta_{43}\, lnLF + v_2 \qquad (9)$$

Then regress lnAgInfra on lnPop, lnPop15, lnPop65, lnUrb, and $\hat{v}_2$

$$lnAgInfra_t = \beta_{35} + \beta_{36} lnPop_t + \beta_{37} lnUrb_t + \beta_{38} lnPop<15_t + \beta_{39} lnPop>60_t + \beta_{40}\hat{v}_2 + \varepsilon_t \qquad (10)$$

Perform a *t* test on the coefficient of calculated residual $\hat{v}_2$. If it significant, do not reject the hypothesis of simultaneity; otherwise, reject it.

RESULTS AND DISCUSSIONS

Trend of Infrastructure Investment in the Philippines

Energy and telecommunication infrastructure investments are the variables considered in this study. The aggregate investment is the summation of energy infrastructure investment and telecommunication infrastructure investment. The behaviors of the aforementioned economic variables for 22 years are shown in Figure 2.

Figure 2 illustrates the time series plots of energy, telecommunication and aggregate infrastructure investment in the Philippines from 1990-2010. After the economic and financial crisis in the late eighties and early nineties, the Philippines launched a robust reform program which included privatization, trade liberalization, and the involvement of the private sector in the development and financing of major infrastructure projects. As a consequence of the economic and financial reforms, real GNP grows at 6.9% by 1996, and poverty is reduced. As a result of increased political stability under the Ramos administration, improved macroeconomic fundamentals, and deregulation among other reforms, total investment inflows increased substantially in the 1990s, especially after 1993.

The manufacturing and financial sectors attracted the bulk of foreign direct investment, but investment in infrastructure rose as well. The increase in investments in the years 1990 and 1993 can be observed in the figure below. According to the Bangko Sentral ng Pilipinas, foreign direct investment in public utilities increased from about $15 million in 1992 to about $150 million in 1997. Investment in power generation was particularly high. However, early in 1997, the rising trade deficit and the rapid pace of credit expansion led to anxiety in the Philippine financial market; when Thai crisis erupted, the Philippine economy was among the first hit in the region.

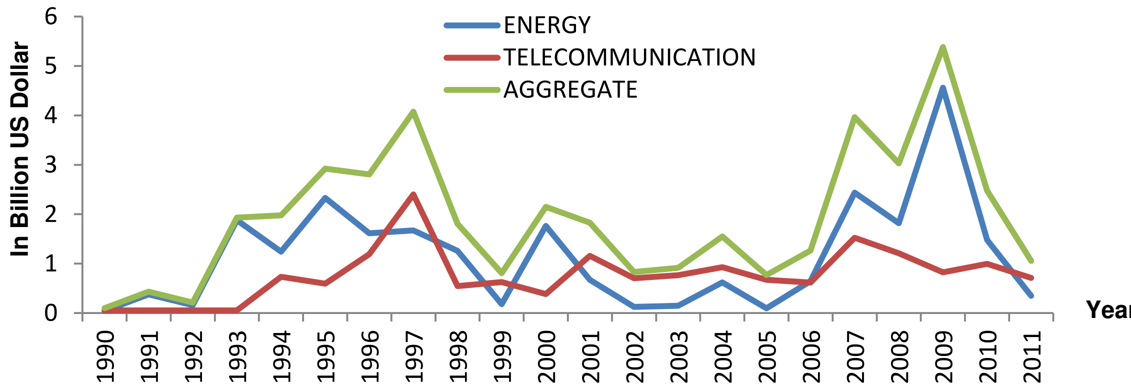

Figure 2. Infrastructure Investment with Private Participation in the Philippines, 1990-2011.

The world's private activity in energy, measured by total investment (private and public) in projects with private participation boomed in 1990-1997 period. It have even fell to US$25 billion in 1998 and to US$ 15 billion in 1999-the same level as it was in 1993 as a result of the financial crisis in developing countries in 1997-1999. The financial crises also made international financial markets reluctant to invest in developing countries. Most affected were Latin America and East Asia. In the Philippines annual private activity in energy in 1998-1997 was only fourth of that in 1993-1997.

In telecommunications, PLDT, a private monopoly, has been the dominant provider of the telephone services in the Philippines until recently. In 1993, the government decided to liberalize and open-up the Philippine telecommunication sector to competition through two Executive Orders (EO 59 and EO 109). Prior to this, there were only two cellular mobile telephone operators, Pilipino Telephone (PILTEL) and Express Telecommunication (EXTELCOM) in the cellular mobile telephone industry. These two were joined by Smart Communications in 1993, and later by Globe Telecom and Isle Communications, both using Government Services Administration (GSA) technology. Due to the admittance of new companies in the industry, the investment in infrastructure increased starting the year 1993.

Trend of Population Dynamics Factors

The population of the Philippines grew steadily from about 60 million in 1990 to over 90 million in 2008. Figure 3 shows the trends of population dynamic factors, namely: total population, population below 15 years, the population aged 65 years above and the urban population, from 1990-2011.

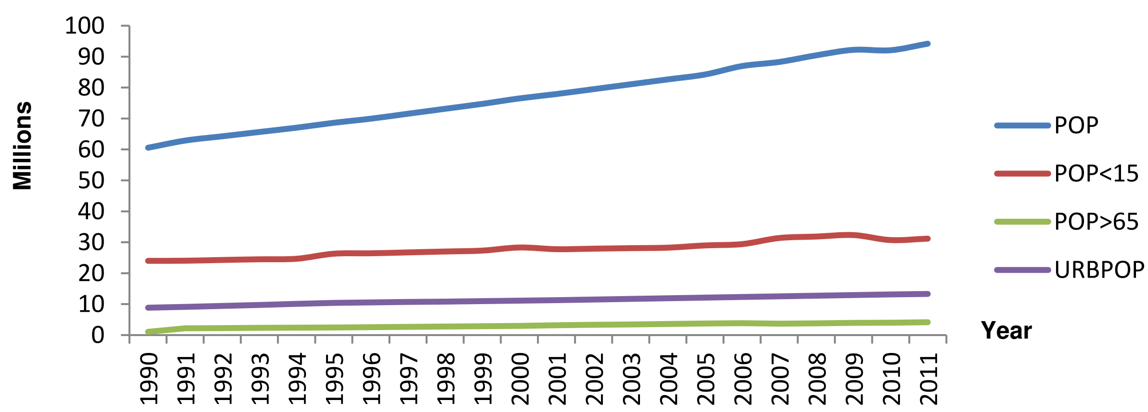

Figure 3. Population dynamic factors in the Philippines, 1990-2011.

The Philippine population in the early 1990s continued to grow at a rapid, although somewhat reduced rate from that which had prevailed in the preceding decades. In 1990 the Philippine population was more than 66 million, up from 48 million in 1980. The total population in Philippines was last recorded at 94.9 million people in 2011 from 27.1 million in 1960, changing 251% during the last 50 years. The population of Philippines represents 1.37% of the world´s total population which arguably means that one person in every 74 people on the planet is a resident of Philippines (www.tradingeconomics.com).

From 1990 to 2010, the age structure of Philippine population exhibited different trends for the broad age groups: young age group (0-14) and older age group (65 years and over). The proportion of population in the older age group had increased at a faster pace than the proportion in the younger age group. But the younger age group continues to have the significantly larger share in the population.

Like most Asian countries, the urban population in the Philippines has grown steadily since 1950 and more rapidly during the last four decades, reaching almost 50% in 1990. In 2007, the National Statistics Office (NSO) estimated that 54% of the population lived in urban areas compared to 30% in 1950, 47% in 1990 and 48% in 2000. The degree of urbanization in the Philippines follows an increasing trend. From the year 1990 until 2011, the urban population is increasing. The increasing trend of the degree of urbanization is due to the high migrant inflow in NCR, Central Luzon, Southern Tagalog, Central Visayas, Northern Mindanao and Southern Mindanao since 1970.

Relationship between population dynamics and infrastructure investments

Ordinary least square (OLS) and Two-stage least-square (2SLS) estimation was used to estimate the unknown regression coefficients of the equations. In order to identify what method, OLS against 2SLS, generate unbiased and consistent coefficients the study carried out Hausman Specification test to address simultaneity problem. The study regress the dependent variables, energy, telecommunication and aggregate infrastructure investments, to the independent variables along with the calculated residuals. The estimated coefficients in this regression are identical to the 2SLS procedure. The generated coefficients of the calculated residuals are shown in the table below along with the t-ratio and p-value:

Table 2. Hausman Specification Test result for calculated residual

	Estimated Coefficient	T-ratio	p-value
Energy sector	-7.29E-07[ns]	-1.552	0.14
Telecommunication sector	-122.64[ns]	-1.157	0.264
Aggregate	24.716[ns]	1.624	0.124

*significant at 10% level
[ns]not significant\

As shown in Table 2 the coefficients of the calculated residuals are not significant. The null hypothesis that population is endogenous is rejected. Therefore, there is no simultaneity in the models. Thus, this study preferred to used Ordinary Least Squares (OLS). Results for the 2SLS regression are presented in the Appendices.

Table 3 shows the summary of the OLS outputs for energy, telecommunication and aggregate infrastructure investments. The result shows that a percent increase in population has significantly reduce infrastructure investment on energy and telecommunication, as well as aggregate infrastructure investments with a reduction of -46.363%, -37.75% and -39.745% respectively. This is consistent with the findings of Nakamura and Tahira (2008) and Basetto and McGranahan (2011) that population growth can reduce investments on infrastructure.

In terms of the factor population aged below 15 years, findings show that it has significant positive impact to infrastructure investment in energy sector as well as aggregate infrastructure investments. This means that if the population aged 15 years old will increase, the investments in infrastructure will significantly increase. The investments in infrastructure may entail infrastructures that favored the young population. However, it is statistically insignificant in telecommunication investment, which means that the percentage increase of the population aged 15 years below does not significantly affects investments in telecommunication infrastructure. The results also showed that the population aged 65 years above is significantly related to the aggregate infrastructure investments. The results suggest that a percentage increased in population aged 15 years below will increase aggregate infrastructure investments by 2.36%. Yet, the estimated coefficient of population aged 65 years above is found to be statistically insignificant with investments in telecommunication and energy.

Lastly, degree of urbanization has a significant positive impact with infrastructure investments in telecommunication and investments as a whole (aggregate). This implies that a percentage increase in the degree of urbanization will result to increases in investments in telecommunication and aggregate investments by 45.31% and 28.43%, respectively. This is consistent with the Modernization Theory which views urbanization a positive phenomenon for economic growth. It is thought that, rapid urbanization in developing countries, and continued urbanization in advanced economies, will be the biggest driver of infrastructure spending over the next few decades (Aldred, 2012). Needless to say, however, excess urbanization beyond the appropriate speed for economy and society to adjust causes various problems. These are internal urban issues, such as deficiency in public infrastructure services (i.e. shortage in supply of electricity).

Table 3. Estimates of the effects of Population Dynamics to Infrastructure Investments

Variable Name	Energy (Estimated Coefficient)	Telecommunication (Estimated Coefficient)	Aggregate (Estimated Coefficient)
Constant	-126.33* (0.0657-)	-145.03* (0.0014-)	-106.58* (0.0070-)
ln(Pop)	-46.363* (0.0049-)	-37.75* (0.0004-)	-39.745* (0.0001-)
ln(Pop<15)	34.352* (0.0079)	6.945^{ns} (0.3214)	20.592* (0.0039)
ln(Pop>65)	3.4006^{ns} (0.1032)	-0.25725^{ns} (0.8294-)	2.3576* (0.0413)
lnUrbPop	21.515^{ns} (0.2142)	45.312* (0.0003)	28.427* (0.0058)
R^2 adjusted	0.3907	0.7375	0.6956

*significant at 10% level ^{ns}not significant

The OLS estimator R^2 adjusted for aggregate, energy and telecommunication infrastructure investments is 69.56%, 39.07% and 73.75%, respectively. R^2 shows the variability of infrastructure investments that can be explained by the population dynamics factors used in the study.

SUMMARY, CONCLUSION, RECOMMENDATIONS AND AREA FOR FURTHER RESEARCH

Summary and Conclusion

This paper studied the relationship between population dynamics and investment for energy and telecommunication infrastructure in the Philippines. The study focuses on energy and telecommunication infrastructure investments and used annual observation of the variables from 1990-2011. Two methods are used for the estimation of the equation, Ordinary Least Square (OLS) and Two-

Stage Least Square (2SLS). The study made used of two estimators for comparison and to address problems such as simultaneity, if there exist.

Through Hausman Specification test the models were tested if the simultaneity is present. The null hypothesis that population is endogenous has been rejected; therefore there is no simultaneity in the model. Thus, OLS has been preferred against 2SLS.

Findings of the study indicated that as population increases there will be a decrease for investments in infrastructure in both energy and telecommunication sector. When examining the overall performance of the two sectors, OLS results showed that for every 1% increase of population, infrastructure investment decreases significantly by 39.75 %.

The study also revealed that, both the population age 15 years below and 65 years above has a positive effect to infrastructure investments. The degree of urbanization is also positively related to infrastructure investments.

Recommendations

Results emphasized how numbers of population dynamic factors affect investments in infrastructure on energy and telecommunication. Using the results of the study, a number of policy recommendations in population control for the expansion on infrastructure investments can be drawn. First, increasing the investment for infrastructure is needed in the Philippines; therefore, in order to raise investment the Philippines should control the increasing population to convert spending to productive goods like infrastructure from the consumption spending. Investments in infrastructure are positively related and are essential to economic growth (Bayraktar, 2006). Second, results revealed that the degree of urbanization does not affect infrastructure investments in energy. This may due to the fact that urbanization may not translate into increased infrastructure if fiscal constraints prove binding. Many of the world's larger cities in low-income and emerging market countries reveal dramatic differentials in the quality and quantity of infrastructure available. The government must thought-out of strategic policies on how to increase private investments since Philippines infrastructure development has not kept pace with population growth and urbanization. Lastly, large population may also be considered a way to boost a country's economy if other factors are carefully studied such as the labor force. The government should make policies that can aid unemployment to pay off the unproductive investments.

Areas for Further Research

This study has a limited scope. It is recommended to cover longer time period and perform cross-country examination to determine the effects of population dynamics to the performance of infrastructure investment and see if the findings in this study will still hold in other economy. The study is limited only to the investments on energy and telecommunication due to the lack of data; it is far better if the other sectors on infrastructure investment (e.g. roads and water sanitation) are included. Also, for future studies it is recommended to consider small infrastructure investments, which are not included in this study, since this type of investment also gives a significant impact to the economy. Lastly, it is suggested to conduct a study which tackles the significant impacts of population dynamics factors to poverty and inequality in the country.

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