A Study about the Determinants of Road Construction in the Philippines

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An efficient land transport infrastructure via an extensive road network has enormous multiplier effects on the economy. This paper aims to empirically determine the factors considered in choosing the region prioritized over the others in the construction of national roads. It hopes to suggest which among the multi-dimensional aspect of road construction should be explored by policy-makers in enhancing intraregional competitive advantage. The theoretical model used is the center-periphery model. Engineering data will be regressed in Panel Regressions to pinpoint significant variables which determine road construction per region. Panel regional data for the years 1988-2005 are collected for the study. Actual results indicate that the official budget, employed population, number of vehicles, number of firms, population density, and GDP per capita, are significant factors for road construction allocation in terms of monetary value and physical values. It has been found that centers have better quality roads compared to peripheries.

Keywords: intra-regional competitive advantage, center-periphery model, panel regressions, engineering data, road construction

I. Introduction

1.1 Background of the Study

One of the most vital elements that can serve as the key to achieving competitiveness is the provision of infrastructure. In general, infrastructure serves as the backbone of a functioning society by providing a well-suited environment for upgrading the economic status of a country. Research conducted by Aschauer (1989) and Munnell (1990) report a positive correlation between public infrastructure and productivity aggregated to the national level [as cited by Eberts, 1990]. Infrastructure affects economic growth through its impact on profitability, levels of output, income and employment through lessening production costs [NEDA, 2000].

The study will focus on hard infrastructure specifically roads. Roads are catalysts in promoting economic activity. It helps an economy adapt to the rapid pace of globalization. Roads promote the mobility of goods and services. Transport costs are considered as a crucial determinant of the location, scale of economic activity, and the pattern of trade. The presence of good quality roads help in decreasing transport costs and attaining better market access. There are lesser incidences of spoilage or breakage of goods transported. There will also be lesser repairs to the vehicle used

in transporting goods. Travel time will be shorter causing more efficiency. If the transportation cost is reasonable, it will also be easier for the government and for the firms to achieve their target in food production, farm crops, and manufactured goods [Llanto, 2003]. In addition, roads also help foster trade, foreign aid, market networks, and livelihood for the people.

This study is anchored towards verifying whether there is unequal distribution of infrastructure in the Philippines. It will focus on examining the possible determinants of road allocation in the geographic, political, and economic aspect. The geographic determinants that will be tested are population density and number of vehicles. The political determinant is the official budget for road construction. Finally the number of private establishments, number of employed individuals, and GDP per capita will be part of the economic determinants. These determinants will be tested on a per region basis to help answer the question whether the distribution of road infrastructure is really unequal or not through analysis of the regression results which are to be presented later in this paper. The dependent variables are road quality kilometers constructed like that of concrete, asphalt, gravel, and earth plus the official budget to measure road allocation in monetary terms. This will help provide information on whether the abovementioned determinants also affect the budget allocation for road construction. The results attained can help offer suggestions to help alleviate the plight of regions with limited road infrastructure.

1.2 Statement of the Problem

This study will address the question:

During the years 1991-2005 for actual road kilometers and 1988-2000 for the official budget for roads, was there an unequal distribution of national road infrastructure in the Philippines by region?

To be able to answer this question, other issues have to be addressed.

- What are the determinants of road provision in the Philippines?

1.3 Objectives

This paper aims to:

1. To establish the relationship between the chosen determinants; and the road length and quality levels per region
2. To confirm the validity of the Center Periphery Model on explaining the relationship between the chosen determinants of road construction and the different road quality levels; in addition to these, the official budget allocation (to be able to address the dimension of space and time of the database used).
3. To suggest policies which would further improve the currents status of road infrastructure in the Philippines

1.4 Scope and Limitations

It is important to note that the study will be focusing on the hard infrastructure, hence the roads allocated per region in the Philippines. The quantity of roads will be also be examined by the use of kilometers of roads (length). The width of a particular road will not be considered. The data for the dependent and independent variables gathered was during years 1988-2005. The time frame was restricted due to regional data limitations. In order to go about this study, the determination of the different types of roads constructed per region is a crucial step. This study is only restricted to national roads. This limitation to national roads is done due to the lack of data needed to account for the other kinds of roads. The paved (concrete and asphalt) and unpaved (gravel and earth) road classifications will be examined in this study. They will serve as the dependent variables that will help in addressing the issue of quality. In relation to these variables, another dependent variable which is the official budget allocated per region for road construction and maintenance is included as a complement for the analysis for the road quality variables.

The study is also limited to looking only at the intra-regional connectivity of roads. The study would not be investigating on the inter-regional connection of roads as that would prove difficult to measure, because all roads have a beginning and an end point. This study will not focus on the connectivity of roads across regions.

Financing for roads is not considered because of the Built-Operate-Transfer (BOT) assumption that even though the budget for road construction and maintenance is from the private sector and the actual roads will be operated by these firms through toll ways; consequently, these roads will be owned by the government in time even the ones financed by international banks such as the ODA.

Moreover, the aspect of international trade is held constant at this point to simplify the examination of the various independent variables in relation to infrastructure. This study will also disregard the aspect of toll fees in the national roads for simplicity. The road laws and policies will not be highlighted. Aspects such as travel cost will not be under the scope of the study.

To maintain consistency with the results, the data gathered per region were returned to their original list which only includes thirteen regions. ARMM, CAR and CARAGA were returned to their original regions; CAR in regions 1 and 2, ARMM in regions 9 and 12 and CARAGA in regions 10 and 11. Comparability is needed for regression purposes. If variables are not consistent as to time and characteristic, the regression results will be insignificant for the study. In order to satisfy the comparability aspect each variable has to undergo some adjustments so that the data per variable can be compared with one another for better regression results.

Some of the independent variables used in the study were adjusted for lags, such as GAA and GDP. The reason why GAA and GDP was lagged for three years when road quality variables are the regressands was due to the assumption that national elections for Congressional positions are held every three years and that the road construction budget is allocated in the basis of the current year for the GDP; the roads are assumed to be constructed three years after the approved budget

allocation. The other variables including the roads are in their current years because these are assumed to be considered only during the time of actual construction, even when GAA is the dependent variable.

When the official budget is used as the regressand, the GDP per capita data is five years later than the rest of the variables because the target GDP per capita in five years is assumed to determine the official budget allocation for the year. The assumptions is five years later since this is the time frame in which most medium term plans are made. The range for this one is from 1988 to 2000 due to data limitations.

II. Conceptual Framework

Based on the review of related literature, the determinants of road infrastructure are yet to be proved. The previous chapter established the possible factors that could be recognized as components that could be employed for road provision. In this section, the theoretical basis will be formed to create a more stable foundation for the relationships between the variables. The main theoretical framework to be utilized will be the Center Periphery Model, a growth model, wherein the impacts of the different variables are estimated. Contributing factors may also be illustrated so as to determine the rationale behind the disparities between some regions.

2.1 Center-Periphery Model

In some countries, specifically in the Philippines, regional disparities are a common occurrence. Some regions are endowed with more infrastructure than the others. The growth center-periphery model will be used to explain the disparities between regions in terms of three aspects: geographical, economic, and political. This model sheds light on the issue on why infrastructure is more accessible in the center than in the periphery. In this relationship, the principal factors of production are taken from the periphery, which will be used by the center to produce higher value goods. Infrastructure is said to be concentrated in the core and that its availability declines rapidly in the periphery [Wanmali & Islam, 1997].

A growth center is usually a city with high economic activity. It experiences self-sustaining growth due to urban economies of scale. There is a massive concentration of producers and consumers that are open to new products. The core is a place of change and innovation. They derive power from their ability to centralize economic activity, capital formation, decision making and other functions resulting to the modernization process [Wanmali & Islam, 1997]. On the other hand, the peripheries are regions with poor access to the core activities. They are characterized by limited access to markets, means of production, private and public services, cultural facilities, and sources of economic and political power. [Wanmali & Islam, 1997]

According to Williams (1977), the core and the periphery are in an uneven relationship of dominance-dependence expressed through four main processes such as: decision making and control, capital flows, innovation diffusion, and migration [as cited by Gradus, 1983]. The

peripheral areas are said to be dependent to the core. This gap between the core and the periphery continues to increase in the spirit of globalization.

The relationship of the growth center and its surrounding areas are affected by different factors such as geographical barriers, adequacy of transportation facilities and cultural barriers [Davidson, 1989]. The growth center theory imposes gains and losses for its periphery. The beneficial effects will exceed the negative in the long run.

There are also various disadvantages to this model. The rural economy is usually stagnant and the presence of growth centers even further on their decline. These repercussions are selective outmigration to the center, displacement of new industries and the incompetence to the pull of the center to attract business and industry [Davidson, 1989].

2.2 Relation of Center-Periphery Model to Determinants of Road Infrastructure

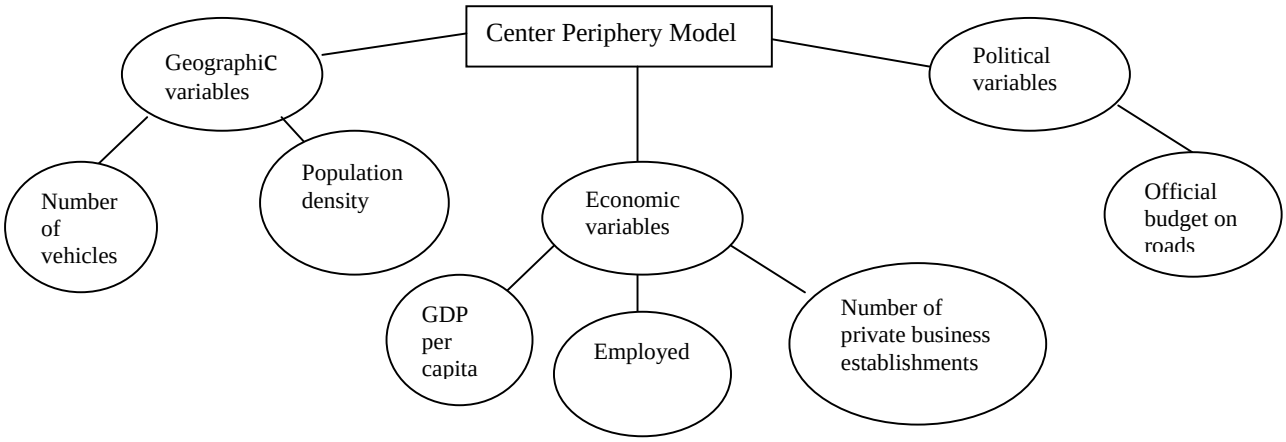

Figure 1: Center Periphery Model and Determinants Diagram

Economic Variables

GDP is one of the variables that affect road construction. Centers are known for their high relative GDPs as compared to the peripheries surrounding them. Majority of the economic activities can be found in the centers. To further enhance the economy, roads are constructed for easier mobility of goods and labor within the region and also to connect it to other regions. This form of action by the government which is to invest in the centers takes into consideration the spillover effects that the nearby peripheries can benefit from. Peripheries will experience an increase in GDP in the long run because goods, capital, and labor can move from the center to them but the initial effect is that the center will gain more from the road construction since it will be easier for the center to produce further since they already have the infrastructure needed; add to that, the supplementary infrastructure investments done by the government [Davidson, 1989].

Another economic variable is the actual number of employed individuals. Employment is one of the key regional development factors. To address the development problems of a region, one must look into employment and determine ways on how to improve its current condition. One known way is through the construction of roads. Highways contribute in enhancing the potential of regional employment. For example, in the construction of national roads, DPWH uses the industries related to the activity in the region where the roads are going to be built; thus, disregarding whether the region is a periphery or a center though it is usually in the centers that more people are employed.

Another determinant of road infrastructure allocated is the number of private establishments in the area. An observed clustering of services or industry in relation to population is mentioned also by Wanmali and Islam (1995). Dependent areas where there are lesser clustering are provided with basic infrastructure that are complemented by more complex service provision in the centers because this can initiate the strengthening of the peripheral system. Major district roads are used to connect centers and others with equal and higher importance while village roads are used to connect the dependent areas in order to attract more business in the center therefore strengthening it more including the peripheral areas surrounding it.

Geographic Variables

The number of vehicles is one of the geographic variables that affects road construction. Based on an article of Kajita et al. (n.d.), one decision to improve roads in terms of quality and quantity includes traffic congestion in the area which is represented by the number of vehicles. Another geographic variable that is associated with the provision of roads in a region is its population density. There is a negative relationship between the population density and the provision of roads. According to Randolph et al. [1996], Low population density requires higher expenditure for a given level of infrastructure specifically for telecommunications and roads.

Political Variables

To support the importance of the political variable, actual expenditure on road construction, another important model will explain it. It will be Friedmann's center-periphery model as mentioned by Bakaric et al. (2005). Referring to the traditional export base theory, Friedmann stressed out the importance of local politics, economy, and leadership roles; even the impact of the development history of the region. Big urban areas have initial competitive advantage for new growth because these will incur lower urbanization costs. Based on this theory, all factors favor the central regions while peripheral regions differ according to the relative autonomy of their economy. This theory implies that the leadership style of a certain region will indirectly affect the performance of that area. It is essential to note that all variables have important roles in explaining and determining the factors that establish road provision among regions.

One factor that is used in the estimating the determinants of road infrastructure is funds allocated per region, it is deemed that the greater the funds allocated in a region the more the capacity it has

in providing public goods, like road infrastructure, for the public. By looking at each region's funding allocation, one could determine which region has the greater resources to construct roads.

Having discussed the various determinants of road construction, it is deemed that provision of roads vary across regions depending on its current economical, political and geographical status, one factor that could be attributed to these variation could be the classification of a certain region, whether it is the center or the periphery. Knowing that it is vital to look into the center-periphery relation in the country, for this is theory could show whether the gap, in terms of road construction, has been converging or diverging between regions over time [Gren, 2003].

III. Operational Framework

This section explains how the Center-Periphery Model mentioned in the theoretical framework is implemented in the study. The regressand and the regressors in the model will be presented. The expected signs of the coefficients will be presented as well.

A model was formulated to capture the relationship between road kilometers and the determinants of road allocation. This model is expected to showcase the degree of significance of the effects of certain independent variables on our dependent variable which are the kilometers national roads (k_{rt}.):

$$k_{rt} = \alpha_{rt} - \beta \quad pd_{rt} + \beta_2 nv_{rt} + \beta_3^n of_{r(t-n)} + \beta_4 pe_{rt} + \beta_3^n gc_{r(t-n)} + \beta_6 e_{rt} + \varepsilon_{rt} \quad (1)$$

Where:

k = Kilometers of road per region (either in total, concrete, asphalt, gravel, or earth)
pd = Population density
nv = Number of vehicles
of = official budget for road construction
pe = Total number of private establishments
gc = GDP per capita
e = employed

Also where r represents the specific region (r=1, …, m), t represents a certain year (t=1, ..., k), and n represents an *n*th-order lag to backshift operator B from time series analysis because the assumption is that the political determinants are n year(s) older including GDP per capita since it is assumed that the current GDP was considered in the year the budget was allocated while the construction takes effect after three years following the assumption of national elections for Congressmen which are responsible for the allocation of the roads occurs every three years. The symbol (β) captures the effect of its corresponding independent variable on the dependent one.

This equation is based on a model provided by Bougheas et al (2003) as shown below where infrastructure investment (i) is a function of income in home country (y), foreign per capita

income (*fy*), population (*p*), population density (*pd*), government debt expressed as a percentage in GDP (*de*), long – run interest rate (*lri*), existing per capita road stock (*rden*), and a dummy variable (*coh*) which is equal to one if the country receives a bulk of the European Union aid.

$$i_{it} = \alpha_{it} \quad \beta_1 y_{it} + \beta_2 fy_{\iota\tau} + \beta_3 p_{it} + \beta_4 pd_{it} + \beta_5 de_{it} + \beta_6 lri_{it} + \beta_7 rden_{it} + \beta_8 coh_{it} + \mu_{it} \quad \textbf{(2)}$$

The constant α_{it} captures every variable that is directly related to the allocation of roads to regions but are exogenized in the specified model like trade, travel time, and travel costs. The stochastic error ε_{rt} accounts for those which are related to the road infrastructure allocation but are not included in the model. Peace and order factors like number of crimes, number of policemen, and other related determinants are examples.

The allocation of road kilometers per region depends on a number of determinants that are divided into three groups specifically: geographical factors, political factors, and economic factors; all under a per region basis.

As a supplement for the main model, this is the other model where the dependent variable is the gaa:

$$of_{rt} = \alpha_{rt} - \beta \quad pd_{rt} + \beta_2 \quad nv_{rt} + \beta_3 pe_{rt} + \beta_4^n gc_{r(t+5)} + \beta_5 \ e_{rt} + \beta_6 co_{rt} + \beta_7 \text{as}_{rt} + \beta_8 gr_{rt} + \beta_9 ea_{rt} + \varepsilon_{rt}$$

Where: co = concrete; as = asphalt; gr = gravel; ea = earth **(3)**

All these quality roads are expected to have an incremental effect on official budget of roads since an additional existing stock of the roads means additional cost for maintenance, widening, and additional length expressed in kilometers. The GDP per capita variable here is assumed to be the targeted GDP per capita in five years since this is usually the time frame in which the medium term plans are made.

Regressors:

Population Density (pd)
Pd is measured by dividing the population of a region over the land area which is expressed in square kilometers of that region. This was included in order to account for the scale effects of a certain region. A negative relationship between population density and road construction is expected. This is because of the assumption that the more people in the area, the less services that area has to receive particularly in the form of infrastructure investment in roads.

Number of Vehicles (nv)
Nv is the number of registered motor vehicles in a given region. A positive relationship between the number of vehicles per region and road construction is expected. The number of vehicles

coincides with the idea of traffic congestion. The more vehicles there are in a certain place, the tendency is more roads will be constructed there.

Official Budget on Roads (of)
of is the official cost allocated for maintenance and operational support for construction of national roads and bridges under the regional support section for funds allocated to DPWH by the Department of Budget and Management (DBM) presented in the General Appropriations Act.

Total Number of Private Establishments (pe)
pe stands for the number of private business establishments per region. Due to data limitations, this variable is the proxy for the total private investments which is considered as a determinant for road construction also.

GDP per capita (gc)
Gc represents the gross domestic product exhibited per region over the total population. Various studies have claimed that there is a positive relationship between Gross Domestic Product and road construction. One of which done by Gramlich [1994], states the relation of output and infrastructure. An increase in infrastructure, particularly roads, would most likely stimulate the economy, thus increasing GDP. By specializing on products that a region has a comparative advantage over another, then both regions could maximize production and return [Barrios, 2007].

Employed (e)
The employed individuals are active working members of the labor force. A positive relationship between the employment rate and road construction is expected. The government has to address one of the key factors of regional development which is employment. If there is a problem regarding employment, one way to address it is through the construction of roads because it will help foster the mobility of labor inputs in order to enhance more the economic activity of an area.

Coefficient	Variable	Sign
β_1	Population Density	(-)
β_2	Number of Registered Vehicles	+
β_3	Official Budget on Roads	+
β_4	Number of Establishments	+
β_5	GDP per Capita	+
β_6	Employed Individuals	+

Table 1: Variables with Signs

IV. Methodology

In this section, the empirical model, econometric techniques, and the data that will be used to explain the relationship of road construction to the various political, economic, and geographic factors will be explained.

The previous section has related the concepts behind the mentioned relationship and the actual variables that will be used in the model. The dependent variable which are the kilometers of national roads for each region in the country (k_{rt}.):

$$k_{rt} = \alpha_{rt} - \beta \quad pd_{rt} + \beta_2 \quad nv_{rt} + \beta_3^n \; of_{r(t-n)} \quad + \beta_4 \; pe_{rt} + \beta_3^n \; gc_{r(t-n)} \quad + \beta_6 \; e_{rt} + \quad \varepsilon_{rt} \quad \textbf{(1)}$$

As a supplement for the main model, this is the other model where the dependent variable is the gaa. The models presented in the methodology are already explained in the previous section which is the Operational Framework.

$$of_{rt} = \alpha_{rt} - \beta_1 \, pd_{rt} + \beta_2 \quad nv_{rt} + \beta_3 pe_{rt} + \beta_4^n \, gc_{r(t+5)} + \beta_5 \; e_{rt} + \beta_6 co_{\,rt} + \beta_7 \, \text{as}_{\,rt} + \beta_8 gr_{\,rt} + \beta_9 ea_{\,rt} + \varepsilon_{rt}$$

Where: co = concrete; as = asphalt; gr = gravel; ea = earth **(3)**

The data for most pf the variables mentioned will have a range of fifteen years from 1991 to 2005, except for the General Appropriations Act (1988-2000). All variables will cover thirteen regions which are NCR and Regions one to twelve. The original list of regions will be followed instead of the current which has the new regions such as CAR, ARMM, and CARAGA. In addition to that, Region IV is divided into A and B. For simplicity and comparability purposes, each variable presented under the new list of regional provinces are adjusted so that the data will fit the original list for regional provinces using ratios. This is due to the fact that more data which can easily be adjusted without distorting much of its original value are presented using the most recent list of regional provinces. Given below are the list of variables and its respective frequencies.

After the acquisition of data, econometric analysis was applied to determine which model will be used for the study. The set of data necessary for this study is panel data. With the help of the software, Stata9, one can determine which model, Naïve, Random Effect, Fixed Effect, under panel data regression analysis is the best, for each of the road types, so that the relationship between the dependent and independent variables can be properly explained. After doing so, each equation are tested for certain econometric problems, such as heteroskedasticity and autocorrelation, so as the results are inline with regression assumptions. Test varies depending on the model applicable to a certain road type.

V. Analysis

All regressions were subjected to various empirical tests to check the validity of the model. The three models normally used for panel data, Naïve, Fixed Effects, and Random Effects Models were pitted against each other to produce the model with the best results. Tests such as the Breusch-Pagan test and the Hausman test were conducted to determine the best model among the three. After obtaining the correct model, it was subjected to the said tests to determine if heteroskedasticity and autocorrelation are present among the variables. There are two ways to

check for heteroskedasticity and autocorrelation using *xtgls* and *xtpcse*. These commands provide for the proper model free from any disturbances among the variables.

5.1 Summary of Results

Table 2: Results Summary Table

Dependent Variable	GDP		Employed		Private establishments		vehicles		GAA		Population density	
	coefficient	*p-value*	*coefficient*	*p-value*	*coefficient*	*p-value*	*coefficient*	*p-value*	*coefficient*	*p-value*	*coefficient*	*p-value*
Total roads	.0046861	0.000	.0005591	0.000	.0031376	0.000	-.0023569	0.000	3.53e-06	0.000	-.0177255	0.000
Concrete	.0032081	0.000	.0000348	0.000	.0003738	0.000	.0004564	0.000	4.07e-07	0.000	-.0584031	0.000
Asphalt	.000161	0.431	.000138	0.000	.0001688	0.000	.0003138	0.000	1.59e-07	0.000	-.0568457	0.000
Gravel	.0013744	0.000	.0002779	0.000	.0033822	0.000	-.00269	0.000	1.83e-06	0.000	.0656058	0.000
Earth	.0007441	0.000	-.0000249	0.000	.0007609	0.000	-.0000334	0.000	4.79e-08	0.000	-.0063865	0.000

The table above shows the summary of results, where the dependent variables total roads, concrete roads, asphalt roads, gravel roads, and earth roads are regressed against the independent variable, GDP, number of employed individuals, Private Establishments, Number of Registered Vehicles, GAA and Population density.

Results show that the Gross Domestic Product per capita at the time of budget allocation planning which is 3 years ago per region, positively affects the provision of roads, whether total road or in any road types. The reason for such relationship could be attributed to the fact that in order to increase economic activity and investment attractiveness, it is vital that hard infrastructure, such as roads, should be constructed. It could also be noted that concrete has the highest coefficient relative to the 3 other road types, followed by gravel roads, and then earth roads. Thus, the government greatly prioritizes on greatest quality of roads. Although, asphalt has the lowest coefficient, it is important to note that GDP per capita is not a determinant of asphalt for results show that it is insignificant. It appears in the results that more quality roads such as concrete are constructed in centers which usually have higher GDP per capita as compared to the peripheries with low economic development.

The next variable, employment, positively affects the provision of total national roads, except earth roads. It could be explained that as employment increases, the provision of earth roads decreases, for it has the cheapest quality and does not necessarily promote labor mobility. Also, the increase in the number of people travelling to their jobs would increase congestion. As a plan of action, it is important to increase the provision of roads, and in this case asphalt roads have a relatively higher coefficient than concrete and gravel roads. This is due to the fact that asphalt has more quality than gravel and at the same time cheaper than concrete even though concrete has better quality. Still, asphalt is under the classification of paved roads which are characterized by

the use of construction materials which are considered of higher value. It can also be seen in this result that the more people are employed; more quality roads such as asphalt will be constructed in that area. This is another scenario of centers attracting more investments since centers hire more laborers which is another characteristic of economic competitiveness.

The third independent variable, Private Establishments, shows that it positively affects all the road qualities, as well as, the total national roads. The p-values are also significant in all the regression. The reason for such relationship could be that an increase in the number of establishment in a region would mean that economic activity is augmented. In order to address congestion, and retain productivity, road infrastructure should be provided. This means that an increase in establishments in a particular region increases the number of roads provided in it, with greater emphasis on gravel roads. The result is widely applicable to peripheral regions, since these regions lack the capacity to provide the best quality roads, such as concrete. The government would settle on providing gravel and asphalt roads, due to resource constraints

The fourth independent variable is the number of registered vehicles. Results, in all the regression, shows that the independent variable is significant. It could be determined that an increase in the number of registered vehicles affects the concrete roads and asphalt roads in a positive manner. However, an increase in the number of vehicles negatively affects the gravel and earth roads. This shows that concrete roads and asphalt roads increases with an increase in the number of vehicles. The results are true, because as a manner of addressing congestion in centers since more people can afford to possess vehicles in such areas, it is vital that the kilometers of roads available for cars to drive on increases. It is also logical, that higher quality roads, such as concrete and asphalt, are chosen to be constructed, so that traffic would flow smoother and safer, for these types of roads are more robust, relative to gravel and earth roads since the initial roads in centers are already of quality. Although, results for the total national roads is negative, which means the incremental decrease in earth and gravel roads, due to the increase in the number of vehicles out weighs the incremental increase of concrete and asphalt, which could also be attributed to the number of vehicles. The negative coefficients of number of vehicles for earth and gravel simply mean that unpaved roads construction is not an option to address traffic congestion represented by number of vehicles in centers.

The fifth independent variable, General Appropriations Act, shows that an increase in GAA, official budget allocated for the provision of roads, positively affect the length of national roads constructed by region. Although it could be observed that the intensities vary in all road qualities, for gravel has the highest coefficient, which means that an increase by a million pesos in the GAA would yield the highest incremental change in gravel roads. This is due to the fact that gravel roads are abundant in periphery regions. The concrete and asphalt roads follow gravel roads, and concrete is given higher priority relative to asphalt. This is so, because concrete is deemed to be the best road quality compared to the other road types, thus given the chance the government would opt to allocate the increase in funds to concrete roads. It could also be observed that earth roads are given the least priority. For if GAA increases by a million pesos incremental earth roads will increase the least.

The last independent variable, population density, is negatively related to the total national roads, and all surface types, except gravel. It shows that whenever the population is compacted, lesser roads could be constructed to connect the population together. Another reason for such negativity could be attributed to the fact that a decrease in the population density of a region coincides with a decrease in population. The situation could be rooted to the migration of people living in periphery to the center regions. Thus in order to urge the people back to the periphery, it is vital to make that particular region attractive, in terms of an increase in economic activity. This could be done by augmenting investment infrastructure, like roads. Plus, an increase in population density would result to greater space being occupied by houses and other infrastructure, like buildings, and lesser space for road construction. Moreover, an increase in population density will increase the gravel roads constructed. This phenomenon is applicable for periphery regions because of their lack of resources to utilize the more desirable surface types such as concrete and asphalt. In addition to the gravel having a positive relationship with population density, peripheries have dispersed population considering huge land area, thus the need for more roads.

5.2 General Appropriations Act

To check for the robustness of the main model, which has roads as the dependent variable, this paper also utilizes a model wherein the actual funds allocated variable, or GAA, is taken as a dependent variable. An explanation why this process is undertaken is because the actual fund allocated is the monetary equivalent of the length of roads constructed. The following regression results exhibit the effects of the independent variables and the road surface types to the funds allotted for road construction.

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Cross-sectional time-series FGLS regression

Coefficients:  generalized least squares
Panels:        heteroskedastic with cross-sectional correlation
Correlation:   common AR(1) coefficient for all panels  (0.6502)

Estimated covariances      =        91          Number of obs      =       169
Estimated autocorrelations =         1          Number of groups   =        13
Estimated coefficients     =        10          Time periods       =        13
                                                Wald chi2(9)       =   9557.32
Log likelihood             = -3003.493          Prob > chi2        =    0.0000

------------------------------------------------------------------------------
         gaa |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     private |   1044.679   39.85004    26.22   0.000     966.5747    1122.784
    vehicles |  -11.78414   12.52968    -0.94   0.347    -36.34187    12.77359
      popden |  -17413.31   978.6308   -17.79   0.000    -19331.39   -15495.23
    concrete |   112374.4   4005.471    28.06   0.000     104523.8    120224.9
     asphalt |   54624.08   2318.894    23.56   0.000     50079.13    59169.03
      gravel |   74040.05   2378.791    31.13   0.000     69377.71     78702.4
       earth |  -36735.88   1361.981   -26.97   0.000    -39405.31   -34066.44
         gdp |   1911.853   70.04597    27.29   0.000     1774.565     2049.14
  employment |   13.41126   1.953791     6.86   0.000       9.5819    17.24062
       _cons |  -3.77e+07    4075910    -9.24   0.000    -4.56e+07   -2.97e+07
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The table above illustrates the simultaneous regression of the dependent variable, *gaa*, against the independent variables. Looking at the results it can be noted that most of the independent variables positively impact the funds allocated for road construction per region. Variables which greatly affect the dependent variable include the surface types concrete, gravel, and asphalt. In support of the literature, the number of private business establishments in the region also

contributes to the provision of more roads in the area. Furthermore, GDP per capita and the employment positively impacts the official budget allocated for road construction. All three variables positively contribute to the economic growth because they are all economic activities. Therefore, the higher the economic activity, the more investments it will attract.

This is another scenario of centers attracting investments again since these are the seats of economic activities. Only population density and the number of registered vehicles seem to negatively affect the funds allocated for road provision, though the number of registered vehicles proves to be insignificant at this point. The reason why population density has a negative relationship could be attributed to the fact that when a particular periphery region decreased its population density, it could be deemed that the cause of such event is the migration of the population to the center regions. As a remedy, the government provides additional funding to regions that experienced a decline in population density, in order to attract investments and eventually bring the people who migrated to the center back to the periphery. As for the earth's coefficient being negative, this simply means that there is no allocation for additional earth road lengths and maintenance since it is lowest in quality in all the surface types. The earth road is never an option for centers but can be for peripheries with regards to initial usage only.

In terms of the effect of the various surface types on official budget allocated, it can be noted that all except earth contribute positively to the increase in the apportionment of funds for road construction. Concrete is shown to have the biggest impact on the dependent variable, followed by gravel and then asphalt. This observation is consistent with the properties of the different road types. Since concrete is the best type of material that is used for maintaining the quality of roads, an increase in the availability of this particular material will encourage the government to allot a larger portion of funds for roads, considering that concrete is the highest quality thus entailing higher cost. This, however, is followed by gravel. This observation seems odd because gravel and earth are two kinds of unpaved roads. However, by looking at the raw data it can be noticed that apart from NCR, a number of regions have gravel as the main surface type of roads. In this case, though concrete and asphalt may have higher quality, gravel is still opted for because it is less expensive as compared to the two other surface types. This fact may be applicable for regions that lack the necessary resources to amass concrete and asphalt for their road provisions.

VIII. Conclusion

Based on the results gathered, the paper finds that almost all the independent variables positively impact the roads provided in a region. Some of the independent variables that greatly contributed to the dependent variable include GDP, private business establishments, and number of employed individuals. The results for the other regressions, which also include the official budget for road expenditure as a dependent variable, remain consistent with the literature. However, it can be noted that population density in most of the results has a negative relationship with the dependent variable, both for total roads constructed and the official budget allocated as dependent variables.

In addition, the centre periphery model proves to hold in the Philippine setting. Based on the results obtained from the study, it can be observed that there is a large disparity between the NCR

and the other regions, especially the ARMM region. Because of this inequality between regions, the growth of these periphery areas is stunted (or overshadowed) by the growth experienced by the center regions one of which is NCR. The DPWH should implement stricter measures in investing for programs per region. All of the regions should get what they aptly deserve. Though it may not be in the exact same denominations, at the very least, the budget allocated for such expenditures should be proportional to the region in question.

IX. Recommendation

The paper addresses the widespread issue of unequal road distributions among the regions in the Philippines. It is not enough that this matter is raised, it is essential that the policymakers are made aware so that proper actions can be implemented to alleviate the current situation. This section aims to provide possible solutions to the evident misallocation of hard infrastructure, particularly roads.

It is important to address the problem of population concentration in center regions, for it is deemed that higher population density yields less road provision in the peripheral regions. The current condition of the Philippines is that people are crowded in the central regions. They stay in regions with the hope of finding better job opportunities (e.g. migration to Manila). These phenomena results to overcrowding in the centers. It has been a common misconception that centers should be focused on when it comes to infrastructure provision. In the case of the Philippines, regions such as NCR are capable of supporting its population through providing adequate infrastructure. However, based on the results gathered in the study other peripheral regions are competent enough to accommodate added infrastructure which can help boost their economic status. The government must take advantage of this capability by allocating infrastructure to those regions to make them more attractive to potential investors. This can lead to rural migration which could help the periphery regions in terms of output and growth.

The results regarding the quality of roads indicate that the centre (NCR) has abundant concrete roads while most peripheral areas have gravel roads. It shows the presence of inequity in road construction among regions. This result coincides with the centre-periphery model where the centre is indeed given more priority. The government is advised to augment road conditions in the peripheral areas by constructing roads with better surface types.

Regarding the number of vehicles, it is not significant when the official budget is being studied since additional road construction is not the only option of addressing traffic congestion. Other ways include road pricing which is in the form of toll fees and traffic management which includes investments in traffic lights and enforcers. Therefore, the government can choose not to consider the number of vehicles as a determinant though it can allocate road infrastructure for such reason.

As for GAA, the higher the targeted GDP, the more the official budget and roads allocated. GDP is the most significant representation of economic activity. Therefore, this represents that centers have more share of the allocations particularly that of quality roads. The government should try allocating quality roads to peripheries surrounding the centers before actually venturing into the

furthest of the peripheries. In that way, the centers can still benefit from the mentioned allocation. In other words, the government can target a higher GDP for peripheral regions, signifying its intention to make that region prosper and be more productive.

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