Social Overhead Capital and Economic Output in Pakistan: An ARDL Bound Testing Approach

Furrukh Bashir and Hafeez ur Rehman
University of the Punjab, Lahore

Muhammad Zahir Faridi
Bahauddin Zakariya University, Multan

The present study aims at investigating the effectiveness of social overhead capital related factors on economic output. Three factors related to social overhead capital are chosen in the study those are transportation, communication and education. The study incorporates Unbalanced Growth Theory in which three separate operational models are designed to observe their influence on economic output. Further, Cob – Douglas form of the equations are exercised for elasticities. According to nature of variables, ARDL (Autoregressive and Distributed lag) and ARDL error correction models are selected for reliable and appropriate long run and short run estimates. Using VAR models, 2 is preferred as an appropriate lag length for all the models on the basis of information criterions. ARDL bound test approach to co – integration suggests existence of long run relationships in all models. Long run results may be justified by economic theory and indicate positive influence of investment or capital formation on economic output while labor is found to have inverse impression on economic output. In the study, roads (in kilometers), telephone lines (thousands), transmission hours of radio Pakistan, educational expenditure, higher enrollment and university enrollment are enhancing economic output of Pakistan in the long run. In the long run, railway tracks (kilometers), Revenue PIA flown (thousand kilometers) and number of post offices are inversely related to economic output. Speed of adjustment term indicates that due to short run disturbances, long run equilibrium will be restored by 22 percent annual adjustments on the average.

Keyword: educational expenditure, roads, railways, post offices, telephone lines, higher and university enrollment.
JEL Codes: C22, E23, F63, I25, J21, L91, L92, L96.

Several development economists refer infrastructure as social overhead capital. The most appropriate definition of infrastructure is provided by Hirshman (1958). The social overhead capital means the encompassing of such activities that share technical features such as economies of scale and economic characteristics i.e. spillover from users to nonusers. The social capital plays its prime role in order to expand the size of investment of private sector but in contrast, it contracts as private capital and productive activities expands. In this situation there is a gradual increase in the direct production costs of private sectors and therefore private sector capital output goes down. In this stage, demand for social capital investment happens frequently and such investments are increased.

Social overhead capital contributes to improve quality of productivity and helps in the awareness of potential ability of human capital and creates situation in which such potential can fully utilized. It also takes part directly and indirectly to make better the safety and quality of lives of the people. Telecommunication, electric power supply and intermediate goods which are often used as the productive processes of private sector, these are included within the scope of infrastructure. In this paper, transportation, communication and education is denoted as social overhead capital.

Correspondence concerning this article should be addressed to Furrukh Bashir Ph. D Scholar of Economics, University of the Punjab, Lahore, Pakistan. Email: furrukh_bashir@yahoo.com

Reinikka and Sverson (1999) used data from Ugands's industrial enterprise survey to test the powerful effects of the poor infrastructure that is reflected by an inadequate supply of electricity on firm level and found that unreliable electricity was a deterrent of significant investment. Diao and Yanoma (2003) showed that growth in agricultural sector was a function of high marketing costs, which is largely reflected by poor transport facilities as well as other infrastructure. Estache and Vagliasindi (2007) argued that an insufficient power generation capacity limited growth in Ghana. Lumbila (2005) found that inefficient infrastructure may hinder the growth impact of FDI in Africa.

Education plays a vital and central role in development strategy and capital formation. In Pakistan, education sector has not been encouraging due to poverty and dismal economic situations. There must be reasonable spending on quality and improvement of education such as, teacher's training, curriculum development, supervision, monitoring etc. Therefore more funds must be allocated for this sector. The world has admitted that importance of education cannot be denied even in poverty alleviation. Educational expenditure by government, enrollment in higher or secondary education is considered as focal factors which may lead to more aggregate output of the economy. The education sector can be developed and progressed by combating unemployment, removing social differences, improving tolerance, and setting best practices for women

participation. So, for such purposes there should be government intervention for policy making and its implementation.

Numerous communication mediums may be conferred as indicators of social overhead capital such as Post offices, Courier services, wireless, mobiles and electronic media. Transport system has several modes including roads, railways, waterways etc. Transport and communication are vital for connecting markets and people. Without an efficient transport system and telecommunication, it is extremely difficult to put the economy on the way of higher growth and development. Investment on this system directly affects economic output as producers find the best markets, reduce transportation costs and time. These also generate employment opportunities. So an efficient transport system and telecommunication is pivotal to support any kind of economic activity. A well established transportation and communication systems also have network effects and allow adoption of latest production techniques.

The objective of the study is to explore influence of social overhead capital on economic output of Pakistan for the period from 1972 to 2010. Apart from introduction in section I, the study is organized as follows; Section II reviews some theories presented in the past. Empirical review is discussed in section III. Data Sources, Models and Methodology are explored in section IV. Section V elaborates statistical inferences and pertinent dialogues. Finally, concluding remarks are given in section VI and also it suggests some policy implications.

Theoretical Review

Study of economic output has been carried out by various economists in the past. Keeping their importance, this section summarizes few of them as follows.

According to Kuznets, economic output may be defined as a long term rise in capacity to supply increasingly diverse economic goods to its population, this growing capacity based on advancing technology and the institutional and ideological adjustments that it demand. Smith has regarded capital accumulation as a necessary condition for economic output. Mill has regarded economic development as a function of land, labor and capital. Harrod and Domar assign a key role to investment in the process of economic output. Solow postulates a continuous production function linking output to the inputs of capital and labor which are substitutable.

Balanced growth, therefore, requires balance between different consumer goods industries, and between consumer goods and capital goods industries. It also implies balance between industry and agriculture, and between domestic and exports sector. Further, it entails balance between social and economic overheads and directly productive investments, and between vertical and horizontal external economies. In fine, the theory of balanced output states that there should be simultaneous and harmonious development of different sectors of the economy so that all sectors grow in unison.

Nurkse observes that balanced growth is a good foundation for international trade, as well as a way of filling the vacuum at the periphery. He underlines the importance of improvement in transport facilities and advocates reduction in transport costs, abolition of tariff barriers and creation of custom unions to enlarge the market in the economic and geographic sense. In the words of Lewis, in development programs all sectors of the economy should grow simultaneously, so as to keep a proper balance between industry and agriculture and between production for home consumption and production for export.

Unbalanced output growth; investment should be made in selected sectors rather than simultaneously in all sectors of the economy. No underdeveloped country possesses capital and other resources in such quantities as to invest simultaneously in all sectors. According to Hirshman, investments in strategically selected industries or sectors of the economy will lead to new investment opportunities and so pave the way to further economic development. He maintains that development has of course proceeded with output in a way that it is being communicated from the leading sectors of the economy to the followers, from one industry to another, from one firm to another. He regards development as a chain of disequilibria that must keep alive rather than eliminate the disequilibria of which profits and losses are symptoms in a competitive economy. If the economy is to be kept moving ahead, the task of development policy is to maintain tensions, disproportions and disequilibria. This seesaw advance is induced by disequilibrium that in turn leads to a new disequilibrium and so on ad infinitum.

Development can only take place by unbalancing the economy. This is possible by investing either in Social Overhead Capital (SOC) or in Directly Productive Activities (DPA) social overhead capital has been defined as comprising those basic services without which primary, secondary, and tertiary productive activities can not function. In SOC are included investments on education, public health, communication, transportation and conventional public utilities like light, water, power, irrigation and drainage schemes etc. A large investment in SOC will encourage private investment later in Directly Productive Activities (DPA). For example, cheaper supply of electric power may encourage the establishment of small industries SOC investments indirectly subsidies agriculture, industry or commerce by cheapening various inputs which they use or by reducing their costs.

Empirical Review of few Studies

The issues of social overhead capital like education, transportation and communication have been addressed at various stages by many socio-economists and macro-economists as well. A large literature is available on the undertaken issues at national and international levels those are related to different developed and underdeveloped economies. These studies differ from each other on the basis of so many minor points such as collection of data, data range, selection of variables, time period, technique used, etc. In the following sections, some of them are summarized very comprehensively.

Linneker and Spence (1996) have demonstrated positive relationship of changing levels of economic development with isolated construction of M25 motorway in London. Bryan et al. (1997) have examined impact of a major road improvement program on the economic development of North Wales. They identify that road improvement across North Wales are found to be necessary but not sufficient condition for economic development in this peripheral area.

Demurger (2001) has provided links between infrastructure investment and economic growth in China using panel data of 24 provinces. The author concludes that transport facility is a key factor in explaining the growth gap and telecommunication is reducing the burden of isolation in China.

Ozturk (2001) shows the role of education on economic development by adopting theoretical perspective. He concludes that Education enriches people's understanding of world, improves the quality of the lives and leads to broad social benefits to individuals and society. Education raises productivity of the economy and creativity.

Sharp et al. (2002) have examined the relationship between features of community social organization and the existence of two contrasting types of economic development, self development and industrial recruitment in rural places. Social infrastructure is found to be positively associated with existence of self development. Relationship between social infrastructure and industrial recruitment is also significant but more modest.

Wang (2002) has implied that keeping balance between infrastructure expansion and private sector growth is crucial for rapid economic development. Important issue regarding infrastructure is how efficiently the government manages the existing stock. Esfahani and Ramirez (2003) have developed a structural model of infrastructure and output growth. Cross country estimates of the model substantially indicate the contribution of infrastructure services to GDP.

Fan and Zhong (2004) have used traditional source accounting approach to identify the specific role of rural infrastructure and other public capital in explaining productivity difference among regions. They conclude that infrastructure affects rural development through improved agricultural productivity, more non farm employment and rural migration to urban sectors.

Ghosh and Prabir De (2005) have tried to find out the role played by economic and social infrastructure facilities in economic development across Indian states over the last quarter century. The findings suggest the removal of rising regional disparities in both infrastructure and income due to new regional policies under the overall framework of globalization. Bandias and Vemuri (2005) have considered telecommunication infrastructure as the lynch – pin for achieving sustainable economic and social development. They suggest that without appropriate development of information infrastructure, the disparities between rural and remote communities will be further exacerbated.

Boopen (2006) has studied the contribution of transport capital to growth for two different data sets namely for a sample of Sub-Saharan African (SSA) countries and also for a developing states (SIDS) using both cross sectional and panel data analysis. He has determined that ratio of physical output for investment to GDP, labor force and transportation capital give rise to real GDP. Herranz – Loncan (2007) has analyzed the impact of infrastructure investment on Spanish economic growth between 1850 and 1935 using Vector Autoregressive techniques. He concludes positive association of local scope infrastructure investment and growth.

Tella et al. (2007) have investigated the simultaneous relationship between telecommunication and the economic growth in Nigeria. Time series data is gathered for the periods 1993 to 2004. Three Stage least square is adopted as estimation technique for reliable estimates. The form of equation is used as log – log. They have used some of the important variables in their study as GDP, Capital, Labor, number of telephone lines, sum of main lines, and cellular teledensity. Results of the study are finalized as capital, labor, number of telephone; sum of main lines and cellular teledensity all are exerting positive influence on economic growth of Nigeria.

Zahra et al. (2008) have explored the dynamic relationship between telecommunication infrastructure and economic growth using data from 24 lower income, middle income and higher income countries for 18 years period from 1985 to 2003. They have made use of panel data set for dynamic fixed effects and random effects models. Study involves many important variables like growth of current year, growth of last year, gross domestic product of last year, investment of last year, population growth of lower, middle and higher income groups, government consumption, telecommunication infrastructure, and square of telecommunication infrastructure. The study has decided growth of last year, population of lower income country and telecommunication infrastructure as positive factor for growth and growth also tends to decrease due to GDP of last

year, government consumption, investment of last year, population of middle and higher income countries.

Hashim et al. (2009) have illustrated the empirical relationships between telecommunication infrastructure and economic development from Pakistan view point. They have utilized time series data for the period from 1968 to 2007 in their study. A number of important variables are used in their study like teledensity and investment in telecommunication sector. The analysis concludes that teledensity and investment in telecommunication sector, both results in higher economic growth of Pakistan.

Snieska and Simkunaite (2009) have analyzed theoretical and empirical aspects of relationship between infrastructure and economic development and also have tested this link for a Baltic states; Lithuania, Latvia, and Estonia. They have accumulated the time series data from 1995 to 2007 on the variables like Roads, telecoms, sanitations, and GDP per capita. The authors have deduced that Roads are found to be positively related; Telecoms and Sanitation are negatively affecting GDP per capita in Lithuania State. In Latvia and Estonia States, Roads and Telecoms are found to be positively affecting while Sanitation is negatively affecting GDP per capita.

Sahoo et al. (2010) have developed a composite index of a stock of leading physical infrastructure indicators to examine the impact of infrastructure development on output growth of China. In their study, they have pulled together time series data for the period 1975 to 2007. Variables used in their study are GDP, domestic private investment, domestic public investment, total labor force, infrastructure index and per capita real public expenditures on health and education. There are positive effect of domestic private investment, domestic public investment, total labor force, infrastructure index and per capita real public expenditures on health and education on gross domestic product.

Chakraborty and Nandi (2011) have assessed the growth impact of telecommunication infrastructure investment in developing countries by subjecting country specific data on mainline teledensity and per capita growth. Growth affects vary widely across country groupings reflecting different levels of development mainline teledensity and per capita growth strongly reinforce each other for relatively less developed countries.

Sandoval (2012) examines the successes of recent education reforms and how more efficient social spending could bolster economic growth. The study reveals that education can generate growth over the long term but these benefits are dependent on quality of education, which is evidently not accessed equally by all Brazilian students.

Data Sources, Models and Methodology

This section discusses about sources of data, econometric modeling, and estimation methodology in detail.

Econometric Modeling

The present analysis follows largely Social Overhead Unbalanced growth theory and Solow growth model as well. According to Social Overhead Unbalanced growth, study takes education, transportation and telecommunication sectors for economic growth. Considering Solow growth model, it also incorporates two of the most important variables for output i.e. labor and capital. General model of Solow is specified as follows;

EC = f (lab, cap)

Where, EC denotes the aggregate income or Economic output, lab is representative of labor force, and cap shows capital. The analysis uses three models for separate response of each sector on economy's output. To explore influence of social overhead capital on economic output, the modified models of Solow are mentioned using Cob-Douglas form of equation as follows;

$$EC = \beta_0 Cap^{\beta_1} Lab^{\beta_2} Roads^{\beta_3} Rail^{\beta_4} PIA^{\beta_5} e^{u_{1t}}$$

$$EC = \gamma_0 Cap^{\gamma_1} Lab^{\gamma_2} Tele^{\gamma_3} Post^{\gamma_4} Radio^{\gamma_5} e^{u_{2t}}$$

$$EC = \alpha_0 Cap^{\alpha_1} Lab^{\alpha_2} Hen^{\alpha_3} Uen^{\alpha_4} Edux^{\alpha_5} e^{u_{3t}}$$

In the above described equations, dependent variable (EC) is gross domestic product (GDP) (million rupees at current market prices) is taken as Economic output, Lab illustrates employed labor force of Pakistan in millions as proxy of labor, and gross fixed capital formation in million rupees is used as proxy of capital (Cap). For transportation, study has employed roads in kilometers (Roads), railway kilometers routes in Pakistan (Rail) and Revenue of Pakistan International Airlines flown in thousands kilometers (PIA). Telecommunication infrastructure is shown using number of post offices in Pakistan (Post), telephone lines in thousands (Tele) in Pakistan and transmission hours of radio Pakistan (Radio). Similarly for education, we have taken higher secondary enrollment in thousands (Hen), university enrollment in thousands (Uen) and educational expenditures met by federal government in million rupees (Edux). By taking the log natural of above equations, we have formulated the following models in our study;

$$\ln EC = \ln\beta_0 + \beta_1 \ln Cap + \beta_2 \ln Lab + \beta_3 \ln Roads + \beta_4 \ln Rail + \beta_5 \ln PIA + \mu_{1t} \quad \text{(1a)}$$

$$\ln EC = \ln\gamma_0 + \gamma_1 \ln Cap + \gamma_2 \ln Lab + \gamma_3 \ln Tele + \gamma_4 \ln Post + \gamma_5 \ln Radio + \mu_{2t} \quad \text{..... (1b)}$$

$$\ln EC = \ln\alpha_0 + \alpha_1 \ln Cap + \alpha_2 \ln Lab + \alpha_3 \ln Hen + \alpha_4 \ln Uen + \alpha_5 \ln Edux + \mu_{3t} \quad \text{..... (1c)}$$

$\gamma_0, \beta_0, \alpha_0$ are intercepts, $\gamma's, \beta's, \alpha's$ are elasticities of economy's output with respect to each explanatory variables and $\mu_{1t}, \mu_{2t}, \mu_{3t}$ are error terms.

Data Sources

The study focuses on the impact of social overhead capital on economic output of Pakistan. For that purpose, study uses time series data from the period 1972 to 2010. Data sources are official websites of government of Pakistan. Numeric about capital and labor are taken from Handbook of statistics on Pakistan Economy 2010 published by State bank of Pakistan. Data about roads, railway routes, PIA revenue, number of Post offices, telephone lines and transmission hours of radio Pakistan are collected through 50 years of Pakistan in Statistics and Pakistan Economic survey 2010-2011 issued by Federal bureau of Statistics, Statistical division, government of Pakistan.

Hypothesis

Economic theory hypothesize that labor and capital are factors stimulating economic output. More employed labor and investment within the country will motivate the factors to produce more output. It is priori expected that labor and capital are enhancing economic output of any country. Labor may be inversely affecting economic output if these are unskilled or semi – skilled according to the job.

On the other side, transport infrastructure is the major sector for any economy. A country having well maintained roads is considered as developed country and vice versa. Roads and railway tracks are used in the current study as transport infrastructure and are expected to be positively linked with economic output. In the same way telecommunication infrastructure also can play vital role in economic output. Telecommunication has removed the distances among people, among business persons, among students, teachers etc. Telephone lines and number of post offices (used in the current study as telecommunication infrastructure) are also hypothesized to be positively related to output. On the other side, Educational expenditure and enrollment in education are expected to be positively affecting economic output in Pakistan.

Methodological Discussion

Several co-integration methods have been proposed by many economists in the past two decades. There are two most famous techniques among them those are Engle Granger (1987) and Johansen's (1988, 1991). Engle Granger is regarding bivariate analysis, while Johansen's is used for Multivariate analysis. Most important thing regarding Johansen's co integration technique is that it is in the case in which the underlying variables are integrated of order one. This also involves pre-test of Unit root as well.

Recently developed autoregressive distributed lag (ARDL) developed by Pesaran and Shin (1998), and Pesaran et al. (1999) does not require any pre-testing of variables. But ARDL approach for co integration is applicable irrespective of whether the regressors are integrated of order zeros I (0) or purely integrated of order one I (1) or mutually co-integrated.

Apart from other features of ARDL technique for co integration, it has many other advantages as well; it gives us unbiased and efficient results; it is most favorable in terms of small sample size; it may also used for long run and short run results; and problems associated with omitted variables and autocorrelations are removed already.

ARDL Bound test approach for long run relationships

We will follow two steps procedure to estimate long run relationship among variables. An initial investigation of the existence of long run relationship may be found by the following (2a, 2b, 2c) unrestricted error correction regression for both of our models (1a, 1b, 1c) at an appropriate lag length (u).

$$\Delta \ln EC = \left[\begin{array}{l} \delta_0 + \sum_{j=1}^{u} \delta_{1j} \Delta \ln EC_{t-j} + \sum_{j=0}^{u} \delta_{2j} \Delta \ln Cap_{t-j} + \sum_{j=0}^{u} \delta_{3j} \Delta \ln Lab_{t-j} + \sum_{j=0}^{u} \delta_{4j} \Delta \ln Roads_{t-j} \\ + \sum_{j=0}^{u} \delta_{5j} \Delta \ln Rail_{t-j} + \sum_{j=0}^{u} \delta_{6j} \Delta \ln PIA_{t-j} + a_0 \ln EC_{t-1} + a_1 \ln Cap_{t-1} + a_2 \ln Lab_{t-1} + \\ a_3 \ln Roads_{t-1} + a_4 \ln Rail_{t-1} + a_5 \ln PIA_{t-1} + \omega_{1t} \end{array} \right]$$

(2a)

$$\Delta \ln EC = \left[\begin{array}{l} \lambda_0 + \sum_{j=1}^{u} \lambda_{1j} \Delta \ln EC_{t-j} + \sum_{j=0}^{u} \lambda_{2j} \Delta \ln Cap_{t-j} + \sum_{j=0}^{u} \lambda_{3j} \Delta \ln Lab_{t-j} + \sum_{j=0}^{u} \lambda_{4j} \Delta \ln Tele_{t-j} \\ + \sum_{j=0}^{u} \lambda_{5j} \Delta \ln Post_{t-j} + \sum_{j=0}^{u} \lambda_{6j} \Delta \ln Radio_{t-j} + b_0 \ln EC_{t-1} + b_1 \ln Cap_{t-1} + b_2 \ln Lab_{t-1} + \\ b_3 \ln Tele_{t-1} + b_4 \ln Post_{t-1} + b_5 \ln Radio_{t-1} + \omega_{2t} \end{array} \right]$$

(2b)

$$\Delta \ln EC = \left[\begin{array}{l} \sigma_0 + \sum_{j=1}^{u} \sigma_{1j} \Delta \ln EC_{t-j} + \sum_{j=0}^{u} \sigma_{2j} \Delta \ln Cap_{t-j} + \sum_{j=0}^{u} \sigma_{3j} \Delta \ln Lab_{t-j} + \sum_{j=0}^{u} \sigma_{4j} \Delta \ln Hen_{t-j} \\ + \sum_{j=0}^{u} \sigma_{5j} \Delta \ln Uen_{t-j} + \sum_{j=0}^{u} \sigma_{6j} \Delta \ln Edux_{t-j} + c_0 \ln EC_{t-1} + c_1 \ln Cap_{t-1} + c_2 \ln Lab_{t-1} + \\ c_3 \ln Hen_{t-1} + c_4 \ln Uen_{t-1} + c_5 \ln Edux_{t-1} + \omega_{3t} \end{array} \right]$$

(2c)

The Wald test or F – Statistics is followed for the existence of co integration. The null hypothesis for no co–integration among variables in equation 2a is $[H_0 : a_0 = a_1 = a_2 = a_3 = a_4 = a_5 = 0]$ against the alternative hypothesis $[H_1 : a_0 \neq a_1 \neq a_2 \neq a_3 \neq a_4 \neq a_5 \neq 0]$. This can be denoted by $\langle \ln EC \mid \ln Cap, \ln Lab, \ln Roads, \ln Rail, \ln PIA \rangle$. For equation 2b, Null hypothesis $[H_0 : b_0 = b_1 = b_2 = b_3 = b_4 = b_5 = 0]$ is for no co-integration and alternative hypothesis is $[H_1 : b_0 \neq b_1 \neq b_2 \neq b_3 \neq b_4 \neq b_5 \neq 0]$ denoted by $\langle \ln EC \mid \ln Cap, \ln Lab, \ln Tele, \ln Post, \ln Radio \rangle$ and null hypothesis for model 2c is

$[H_0 : c_0 = c_1 = c_2 = c_3 = c_4 = c_5 = 0]$ against the alternative hypothesis $[H_1 : c_0 \neq c_1 \neq c_2 \neq c_3 \neq c_4 \neq c_5 \neq 0]$ denoted by $\langle \ln EC \mid \ln Cap, \ln Lab, \ln Hen, \ln Uen, \ln Edux \rangle$. Two sets of critical values are provided by the Pesaran et al. (2001) to compare the calculated F – statistics to conclude long run relationship. This procedure is called bound testing (Pesaran et al. (2001).

If the computed value of F – statistics or Walt test is greater than the upper critical bound, a conclusive decision can be furnished regarding co integration not to be familiar with the order of integration of the regressors. For instance, if the estimated F – statistics falls inside the upper and lower critical bounds of critical values (proposed by Pesaran et al., 2001), then the null hypothesis of no co integration cannot be rejected without knowing the order of integration of the underlying regressors. If the order of integration of regressors is I (0), I (1) or both, there will be long run relationship among the core variables. Otherwise if order of integration is I (2), then long run relationship does not exist and variable having I (2) should be dropped from the study to encompass reliable estimates.

Ng and Perron (NP) Unit Root Test

Ng and Perron (2001) construct four test statistics that are based upon the GLS detrended data Y_t^d. These test statistics are modified forms of Phillips and Perron Z_α and Z_t statistic, the Bhargava (1986) R_1 statistic, and the Elliot, Rothenberg, and Stock Point Optimal (ERS) statistic. First define the term;

$$\kappa = \sum_{t=2}^{T} (Y_{t-1}^d)^2 / T^2$$

The modified statistics may be written as,

$$MZ_\alpha^d = (T^{-1}(Y_T^d)^2 - f_0)/2\kappa$$

$$MZ_t^d = MZ_\alpha \times MSB$$

$$MSB^d = (\kappa / f_0)^{1/2}$$

$$MP_T^d = \begin{cases} (\bar{c}^2\kappa - \bar{c}T^{-1}(Y_T^d)^2 / f_0 \\ (\bar{c}^2\kappa + (1-\bar{c})T^{-1}(Y_T^d)^2 / f_0 \end{cases}$$

$$\text{if } X_t = \{1\} \quad \Big\}$$
$$\text{if } X_t = \{1, t\} \Big\}$$

Social Overhead Capital in the Long run

We have discovered long run relationship up to this point, for long run estimates of the models, two steps procedure will be followed again. At first, lag length of the model will be selected using Akaike Information Criterion (AIC) Schwarz Bayesian Criterion (SBC). For annual data, maximum lag length has been recommended as 2 lags by Pesaran and Shin (1999). Long run estimates of Model I, Model II will be evaluated using the following ARDL (m, n, p, q, r, s) models;

$$\ln EC = \left[d_0 + \sum_{j=1}^{m} d_1 \ln EC_{t-j} + \sum_{j=0}^{n} d_2 \ln Cap_{t-j} + \sum_{j=0}^{p} d_3 \ln Lab_{t-j} + \sum_{j=0}^{q} d_4 \ln Roads_{t-j} + \sum_{j=0}^{r} d_5 \ln Rail_{t-j} + \sum_{j=0}^{s} d_6 \ln PIA_{t-j} + \upsilon_{1t} \right] \quad (3a)$$

$$\ln EC = \left[e_0 + \sum_{j=1}^{m} e_1 \ln EC_{t-j} + \sum_{j=0}^{n} e_2 \ln Cap_{t-j} + \sum_{j=0}^{p} e_3 \ln Lab_{t-j} + \sum_{j=0}^{q} e_4 \ln Tele_{t-j} + \sum_{j=0}^{r} e_5 \ln Post_{t-j} + \sum_{j=0}^{s} e_6 \ln Radio_{t-j} + \upsilon_{2t} \right] \quad (3b)$$

$$\ln EC = \left[f_0 + \sum_{j=1}^{m} f_1 \ln EC_{t-j} + \sum_{j=0}^{n} f_2 \ln Cap_{t-j} + \sum_{j=0}^{p} f_3 \ln Lab_{t-j} + \sum_{j=0}^{q} f_4 \ln Hen_{t-j} + \sum_{j=0}^{r} f_5 \ln Uen_{t-j} + \sum_{j=0}^{s} f_6 \ln Edux_{t-j} + \upsilon_{3t} \right] \quad (3c)$$

In the above long run equations (3a, 3b, 3c), d's, e's and f's are long run elasticities.

Social Overhead Capital in the Short run

After examining long run estimates, short run coefficient can also be examined by constructing an error correction model using following forms;

$$\Delta \ln EC = \left[g_0 + \sum_{j=1}^{m} g_1 \Delta \ln EC_{t-j} + \sum_{j=0}^{n} g_2 \Delta \ln Cap_{t-j} + \sum_{j=0}^{p} g_3 \Delta \ln Lab_{t-j} + \sum_{j=0}^{q} g_4 \Delta \ln Roads_{t-j} + \sum_{j=0}^{r} g_5 \Delta \ln Rail_{t-j} + \sum_{j=0}^{s} g_6 \Delta \ln PIA_{t-j} + \psi_1 ECM_{t-1} + \varepsilon_{1t} \right] \quad (4a)$$

$$\Delta \ln EC = \left[h_0 + \sum_{j=1}^{m} h_1 \Delta \ln EC_{t-j} + \sum_{j=0}^{n} h_2 \Delta \ln Cap_{t-j} + \sum_{j=0}^{p} h_3 \Delta \ln Lab_{t-j} + \sum_{j=0}^{q} h_4 \Delta \ln Tele_{t-j} + \sum_{j=0}^{r} h_5 \Delta \ln Post_{t-j} + \sum_{j=0}^{s} h_6 \Delta \ln Radio_{t-j} + \psi_2 ECM_{t-1} + \varepsilon_{2t} \right] \quad (4b)$$

$$\Delta \ln EC = \left[k_0 + \sum_{j=1}^{m} k_1 \Delta \ln EC_{t-j} + \sum_{j=0}^{n} k_2 \Delta \ln Cap_{t-j} + \sum_{j=0}^{p} k_3 \Delta \ln Lab_{t-j} + \sum_{j=0}^{q} k_4 \Delta \ln Hen_{t-j} + \sum_{j=0}^{r} k_5 \Delta \ln Uen_{t-j} + \sum_{j=0}^{s} k_6 \Delta \ln Edux_{t-j} + \psi_3 ECM_{t-1} + \varepsilon_{3t} \right] \quad (4c)$$

Here in the above equations (4a, 4b, 4c), Δ is first difference operator, g's, h's and k's are the short run Elasticities and ψ's are the speed of adjustment if with negative sign converges towards long run dynamics.

Statistical Inferences and Pertinent Dialogues

The existing investigation carries out the generally functional practice i.e. Autoregressive and Distributive Lag (ARDL) for long run consequences. ARDL requires initially the selection of lag length assuming a variety of approaches for instance sequential modified LR test statistics (LR), Final Prediction Error (FPE), Akaike Information Criterion (AIC) and Hannan Quinn Information Criterion (HQ). The outcome of

these approaches confirms that the appropriate lag length for ARDL should be 2 for both of models (1a, 1b, 1c) as obvious from table 1.

Table 1
VAR Lag Order Selection Criteria

Lag	LR	FPE	AIC	HQ
		Model – 1a		
0	NA	2.50e-10	-5.083952	-4.991856
1	402.5631	2.67e-15	-16.55678	-15.91211
2	64.60446*	1.49e-15*	-17.30268*	-16.10544*
		Model – 1b		
0	NA	4.94e-10	-4.400680	-4.308584
1	492.1583	2.67e-16	-18.86001	-18.21534
2	70.14256*	1.18e-16*	-19.83667*	-18.63943*
		Model – 1c		
0	NA	5.98e-09	-1.907106	-1.815010
1	425.1983	3.01e-14	-14.13444	-13.48977
2	74.68936*	1.10e-14*	-15.30055*	-14.10330*

* indicates lag order selected by the criterion calculated using EViews-7
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
HQ: Hannan-Quinn information criterion

The foremost movement concerning to ARDL long run results is the assessment of co-integration using ARDL bound testing approach. For bound tests, evaluation of equations 2a, 2b and 2c are necessitated. Outcome of equations 2a, 2b and 2c are reported in table 2 declaring the long run relationships for all the models (Model 1a, Model 1b, Model 1c). For Model 1a, Model 1b, Model 1c; F – Stats are respectively 3.60, 5.69 and 6.16. These lie above the upper bound. Unit root test may be conducted for examining stationary levels of variables under consideration.

Table 2
Bound test approach to Co integration

Bound Test Models	F-Stats	Lag	Prob.	Bound Critical I (0)	Bound Critical I (1)	Conclusion
$\langle \ln EC \mid \ln Cap, \ln Lab, \ln Roads, \ln Rail, \ln PIA \rangle$	3.60***	2	0.07	2.26	3.35	Co integration
$\langle \ln EC \mid \ln Cap, \ln Lab, \ln Tele, \ln Post, \ln Radio \rangle$	5.69*	2	0.00	3.41	4.68	Co integration
$\langle \ln EC \mid \ln Cap, \ln Lab, \ln Hen, \ln Uen, \ln Edux \rangle$	6.16*	2	0.00	3.41	4.68	Cointegration

Note: Bound critical values are taken from the article of Pesaran et al. (2001), Table C1. iii: Case III: Unrestricted intercept and no trend. *, ** and *** certify that co-integration exists at 1, 5 and 10 percent level of significance respectively having k (no of regressors) equal to 5. F-Stats are calculated using EViews-7.

Table 3 explains the unit root test results for all the variables using Ng and Perron stats. It endorses that all the variables are either integrated of order zero [I(0), lnRail, lnTele, lnHen] or order one [I(1), lnEC, lnLab, lnCap, lnRoads, lnPIA, lnPost, lnRadio, lnUen, lnEdux].

Table 3
Ng and Perron test Statistics

Variables	MZ_α TS	MZ_α CV	MZ_t TS	MZ_t CV	MSB TS	MSB CV	MPT TS	MPT CV	Conclusion
Ng and Perron test Statistic at Level by including Intercept									
lnEC	1.32		1.04		0.79		48.77		---*
lnCap	0.14		0.07		0.53		21.35		---*
lnLab	1.38		0.93		0.67		37.44		---*
lnRoads	0.32	-13.80	0.28	-2.58	0.89	0.17	49.61	1.78	---*
lnRail	-0.89		-0.43		0.47		15.25		I (0)*
lnPIA	0.05		0.04		0.72		33.00		---*
lnTele	-0.42		-0.26		0.62		23.58		----*
lnPost	-1.22		-0.66		0.54		16.28		---*
lnRadio	5.12		2.45		0.47		34.13		---*
lnHen	0.93		0.81		0.87		53.92		---*
lnUen	2.68		2.91		1.08		107.72		---*
lnEdux	1.45		1.79		1.23		111.77		---*
Ng and Perron test Statistic at Level by including Intercept and Trend									
lnTele	-16.52	-14.20	-2.57	-2.62	0.15	0.18	7.22	6.67	I(0)***
lnHen	-18.79	-17.30	-3.06	-2.91	0.163	0.168	4.86	5.48	I(0)**
Ng and Perron test Statistic at 1st Difference by including Intercept									
lnEC	-15.29		-2.75		0.179		1.65		I (1)*
lnLab	-16.45		-2.85		0.17		1.52		I (1) *
lnCap	-15.50	-13.80	-2.71	-2.58	0.17	0.174	1.85	1.78	I (1) *
lnRoads	-18.26		-3.01		0.16		1.36		I (1) *
lnPIA	-15.91		-2.81		0.17		1.55		I (1)*

lnPost	-2.20	-5.70	-1.00	-1.62	0.45	0.27	10.70	4.45	---***
lnRadio	-17.27	-13.80	-2.91	-2.58	0.16	0.17	1.47	1.78	I(1)*
lnUen	-18.02		-2.99		0.16		1.39		I(1)*
lnEdux	-1.34	-5.70	-0.79	-1.62	0.59	0.27	17.58	4.45	---***
Ng and Perron test Statistic at 1st Difference by including Trend and Intercept									
lnPost	-17.52	-14.20	-2.91	-2.62	0.15	0.18	2.15	6.67	I (1) ***
lnEdux	-17.47		-2.91		0.16		5.44		I(1)***

Null Hypothesis: Series has a Unit root.

Results are calculated using EViews-7. TS denotes Test Statistics and CV indicates Critical Values.

* Critical Values are taken at 1 percent level of significance

** Critical Values are taken at 5 percent level of significance

*** Critical Values are taken at 10 percent level of significance

Long run Estimates

ARDL long run results are computed using equations 3a 3b, and 3c, and values of coefficients, standard errors and probability values are given in table 4 for all the models (Model 1a, Model 1b, and Model 1c). Capital is assumed to have considerable influence on economic output as apparent from our results as well. In this study, it is found to be one of the significant causes of increase in economic output of Pakistan [Tella et al. (2007), Zahra et al. (2008), Hashim et al. (2009), Sahoo et al. (2010)]. On the average, in the long run one percent rise in capital formation leads to 0.72, 1.03, and 0.90 percent rise in GDP. The coefficients are significant at 1 percent level of significance as well. If more investment is turned out in the economy, it leads to more industrialization. Due to more industries, more output will be produced with fewer labor inputs. Industrialization means more involvement of newest technologies and machineries; economy moves from labor intensive technology to capital intensive technology. With new technological innovations, a lot of output may be produced at cheaper cost.

In third world countries like Pakistan, where most of the population is uneducated, unskilled or semiskilled are left from their jobs or they can't show the required progress in output as demanded or they may not operate on newly equipped machineries due to more industrialization. Surprisingly, employed labor force has turned out to have inverse stimulus on economic output of Pakistan in both the models 1b, and 1c with significant coefficients at 5 percent level of significance. Due to semiskilled or unskilled labor, productivity and output are not enhanced and it results in lower economic output. Due to one percent increase in employed labor force, economic output of Pakistan will decline by 0.60 and 95 percent on the average annually in the long run. For model 1a, coefficient of employed labor has positive sign with insignificant coefficient value [Tella et al. (2007), Sahoo et al. (2010)].

Transport infrastructure is also having noteworthy share in economic output as other sectors have. A country containing well established transport infrastructure may invite lot of foreign investors and foreign direct investments as well and it generates more output levels. In transportation, roads, railways and Pakistan International Airline are of great importance. Well established roads may provide facility for cheaper carriage. If roads will be available up to industries, they can attract foreign customers easily. They can increase demand for their products and also can make available supply at lesser time, therefore it leads to higher economic output. Our study supports this phenomenon and provides positive effect of roads on economic output [Linneker and Spence (1996), Bryan et al. (1997), Esfahani and Raimrez (2003), Boopen (2006), Herranz – Loncan (2007), Snieska and Simkunaite (2009), Sahoo et al. (2010)]. Coefficient of roads is statistically significant at 1 percent level implying that one percent more constructed roads may be foundation of 0.44 percent rise in output of economy (economic output) on the average in the long run.

Quite reverse, railway tracks in Pakistan are also having significant impression on economic output but with negative coefficient value. In fact, in Pakistan, railway department is suffering from severe losses from several years. Railway cannot even meet its own expenditures (Fuels, Maintenance of tracks, Salaries, etc) from its own generated revenue. Govt. of Pakistan has to fulfill its large amount of deficits each year. That's why it has inverse effect on economic output of the Pakistan. Due to one percent rise in railway tracks, output will decline by 3.1 percent.

Pakistan International Airline (PIA) is an asset for Pakistan's economy in a way that it fastens the transportation means. Unfortunately, in Pakistan, PIA is failed to even meet their expenditures of fuels, salaries etc. In our study, PIA is inversely contributing to the aggregate output of economy in the long run with significant coefficient value at 1 percent level of significance. Results imply that aggregate output declines by 0.79 percent in case of 1 percent rise in revenue of PIA.

As regards with telecommunication infrastructure, telephone lines, post offices and transmission hours of Radio Pakistan have their own importance in augmenting economic output. These are the only sources for connecting people and removing the distances among people. How fast people will communicate to each other, they can share their demands, place their orders at right time, verify the quality of the products very efficiently. As expected, telephone lines and transmission hours of radio reveal positive correlation with economy's output [Demurger (2001), Tella et al. (2007),

Zahra et al. (2008), Snieska and Simkunaite (2009)]. But the coefficients are statistically insignificant. On the other side, post offices are indirectly associated to economic output with significant coefficient value implying that aggregate output will decline by 1.66 percent on the average in the long run due to one more percent post offices in Pakistan. Due to courier services in Pakistan, attention of citizens is transferred to TCS or DHL. People hesitate to use Pakistan Post offices due to their inefficiencies in terms of delay delivery of postages or due to less trained or less efficient staff.

Social overhead capital considers that education has effective role for the promotion of economic output. In the present study, higher and university enrollments are taken with educational expenditures. Study reveals that enrollment at higher and university levels and educational expenditures are essential variables for economic development. The results of the study also support the economic phenomenon that is education leads to higher output [Sharp et al. (2002), Sahoo et al. (2010), Ozturk (2001), Sandoval (2012)]. All educational variables have positive and significant influence on aggregate output. These suggest that one percent rise in higher enrollment; university enrollment and educational expenditure lead to aggregate output to increase by 0.62, 0.37 and 0.17 percent respectively. Higher educational attainment leads skilled labor used for capital intensive technology and therefore it is cause of additional productivity.

The analysis has found significant impact of all other excluded variables on aggregate output as depicted by values of constant. Values of constant uncovers that all other excluded variables have on the average 36.92, 12.25 and 1.94 percent connection with GDP of Pakistan in the long run on the average. These are also statistically significant at 1, 10 and 1 percent levels regarding Models 1a, 1b and 1c respectively.

Table 4
ARDL Long run results

Regressors	Model – 1a (lnEC)	Model – 1b (lnEC)	Model – 1c (lnEC)
lnCap	0.719 (0.130) [0.000]	1.036 (0.2065) [0.000]	0.901 (0.154) [0.00]
lnLab	0.225 (0.285) [0.438]	-0.608 (0.293) [0.049]	-0.957 (0.461) [0.047]
lnRoads	0.441 (0.149) [0.008]	---	---
lnRail	-3.102 (1.118) [0.011]	---	---
lnPIA	-0.794 (0.283) [0.011]	---	---
lnTele	---	0.151 (0.165) [0.372]	---
lnPost	---	-1.664 (0.548) [0.006]	---
lnRadio	---	0.527 (0.376) [0.173]	---
lnHen	---	---	0.624 (0.272) [0.030]
lnUen	---	---	0.379 (0.168) [0.033]
lnEdux	---	---	0.175 (0.068) [0.017]
Constant	36.92 (11.316) [0.004]	12.259 (6.935) [0.089]	1.944 (0.607) [0.003]
Lag lengths	(1,2,2,2,2,1)	(1,1,2,1,0,1)	(2,0,2,0,0,0)

Note: Long run results are calculated using Microfit 4.1. Coefficients are given without brackets, standard errors are provided in round brackets while in square brackets, probability values are reports.

Short run Dynamics

Short run results are also matched with the long run results. In the short run, economic output, capital, telephone lines, transmission hours of radio, higher enrollment, university enrollment and educational expenditure of last year are positively related to economic output. Employed labor force and post offices of last year; and employed labor force and capital of two years before are reducing economic output in the short run on the average. Error correction term is having meaningful interpretations that if there will be any disturbances in the short run, long run equilibrium will be restored after taking 0.22, 0.22 and 0.28 percent annual adjustments on the average.

Table 5
ARDL Error Correction Model

Regressors	Model – 1a D(lnEC)	Model – 1b D(lnEC)	Model – 1c D(lnEC)
D(lnEC(-1))	---	---	0.210 [0.152]
D(lnLab(-1))	-0.444 [0.001]	-0.359 [0.001]	-0.268 [0.024]
D(lnLab(-2))	-0.305 [0.111]	---	---
D(lnCap(-1))	0.203 [0.015]	0.442 [0.000]	0.458 [0.000]
D(lnCap(-2))	-0.309 [0.000]	-0.276 [0.000]	-0.383 [0.000]

D(lnRoads(-1))	-0.007 [0.797]	---	---
D(lnRoads(-2))	-0.045 [0.152]	---	---
D(lnRail(-1))	0.188 [0.484]	---	---
D(lnRail(-2))	1.034 [0.004]	---	---
D(lnPIA(-1))	-0.099 [0.123]	---	---
D(lnTele(-1))	---	0.179 [0.007]	---
D(lnPost(-1))	---	-0.373 [0.025]	---
D(lnRadio(-1))	---	0.397 [0.543]	---
D(lnHen(-1))	---	---	0.175 [0.015]
D(lnUen(-1))	---	---	0.106 [0.014]
D(lnEdux(-1))	---	---	0.049 [0.039]
D(Constant(-1))	8.41 [0.004]	2.754 [0.166]	0.545 [0.005]
Speed of Adjustment	-0.228 [0.013]	-0.224 [0.009]	-0.281 [0.000]
Lag lengths	(1,2,2,2,2,1)	(1,1,2,1,0,1)	(2,0,2,0,0,0)
R – Squared	0.824	0.801	0.766
Adj. R – Squared	0.699	0.72	0.688
F – Statistic	9.871 [0.000]	14.667 [0.000]	11.06 [0.000]
D.W Statistic	2.37	2.43	2.63

Note: Short run results are calculated using Microfit 4.1. Coefficients are given without brackets and probability values are reported in square brackets.

Concluding Remarks and Policy Suggestions

The objective of the study is to analyze the influence of social overhead capital on economic output on Pakistan. For that purpose, the research is conducted on transportation, communication and education to trace out the impact of social overhead capital. Based on characteristics of variables, Autoregressive and Distributive Lag model (ARDL) is used for long run and short run estimates. Using VAR lag order selection criteria, we have come to know that 2 is an appropriate lag length for all of our models. Bound test to co-integration confirms the long run relationships for all models.

Long run estimates present that capital formation, roads, telephone lines, transmission hours of radio, educational expenditures, higher and university enrollments are increasing economic output of Pakistan on the average. While post offices, revenue of PIA, railway tracks, and capital are reducing economic growth in the long run. Short run results are also consistent with long run demonstrating that due to disequilibrium in the short run, results will be converged towards long run equilibrium by taking 22 percent annually adjustments on the average.

At the end, the study suggests some policies to higher authorities that transportation infrastructure should be developed to promote exports. Railway and PIA departments should be given proper attention considering major sectors of any economy. System of Post offices should also be enhanced so that cheaper provision of postage may be entertained. Considering Social Infrastructure, the study also recommends that Educational expenditures as percentage of GDP should be increased every year so that young generation can have better and cheap educational opportunities and whole society can move towards progress quickly.

References

Asteriou, D. (2005). Applied Econometrics: A modern approach using EViews and Microfit, Palgrave Macmilan.

Bandias, S. and Vemuri, S. R. (2005). Telecommunications infrastructure facilitating sustainable development of rural and remote communities in Northern Australia. *Telecommunications Policy,* 29(2-3), 237 – 249.

Bhargava, A. (1986). On the theory of testing for Unit Roots in observed time series. *Review of Economic Studies,* 52, 369 – 84.

Boopen, S. (2006). Transport Infrastructure and Economic growth: Evidence from Africa using dynamic panel estimates. *The empirical economics letters*, 5(1), 37 – 52.

Bryan, J., Hill, S., Munday, M. and Roberts, A. (1997). Road infrastructure and economic development in the periphery: the case of A55 improvements in North Wales. *Journal of Transport Geography,* 5(4), 227 – 237.

Chakraborty, C. and Nandi, B. (2011). 'Mainline' telecommunications infrastructure, levels of the development and economic growth: Evidence from a panel of developing countries. *Telecommunications Policy,* 35(5), 441 – 449.

Demurger, S. (2001). Infrastructure Development and Economic Growth: An Explanation for regional disparities in China? *Journal of Comparative Economies,* 29(1), 95 – 117.

Diao, X., and Yanoma, Y. (2003). Exploring regional dynamics in Sub-Saharan African agriculture. IFPRI DSGD Discussion Paper 2.

Engle, R. F. and Granger, C. W. J. (1987). Co-integration and Error Correction: Representation, Estimation, and Testing. *Econometrica,* 55(2), 251 – 276.

Esfahani, H. S. and Ramirez, M. T. (2003). Institutions, infrastructure and economic growth. *Journal of Development Economics,* 70(2), 443 – 477.

Estache, A., and Vagliasindi, M. (2007). Infrastructure for Accelerated Growth for Ghana: Needs and Challenges. Background Paper, Country Economic Memorandum, World Bank, Washington, DC.

Ghosh, B. and Prabir De (2005). Investigating the linkages between infrastructure and regional development in India: era of planning to globalisation. *Journal of Asian Economies,* 15(6), 1023 – 1050.

Govt. of Pakistan (2000). 50 years of Pakistan in Statistics, Federal Bureau of Statistics, Statistical Division.

Govt. of Pakistan (2011). Handbook of Statistics on Pakistan Economy 2010, State bank of Pakistan.

Govt. of Pakistan (2011). Pakistan Economic Survey, Federal Bureau of Statistics, Statistical Division.

Gujarati, D. N. and Porter, D. C. (2009). Basic Econometrics, 5th Edition.

Hashim, S., Zaman, K., Munir, A. and Khan, A. (2009). Telecom Infrastructure and economic development of Pakistan: An empirical Analysis. *International research journal of Arts and Humanities*, 37, 147 – 156.

Herranz – Loncan, A. (2007). The spatial distribution of Spanish transport infrastructure between 1860 and 1930. *Annals of Regional Science,* 41, 189 – 208.

Hirschman, A. O. (1958). The Strategy of Economic Development. New Haven: Yale University Press.

Hirshman A. O. (1958). The Strategy of Economic Development, Westview Press.

Jhingan, M. L. (2009). The Economics of Development and Planning. 38th Revised and Enlarged Edition.

Johansen, S. (1988). Statistical analysis of co-integrating vectors. *Journal of Economic Dynamics and Control,* 12, 231 – 254.

Johansen, S. (1991). Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive models. *Econometrica,* 59(6), 1551 – 1580.

Kuznets, S. (1955). Economic Growth and Income Inequality. American Economic Review, 65, 1 – 28.

Linneker, B. and Spence, N. (1996). Road transport infrastructure and regional economic development: The regional development effects of the M25 London orbital Motorway. *Journal of Transport Geography,* 4(2), 77 – 92.

Lumbila, K. (2005). What Makes FDI Work? A Panel Analysis of the Growth Effect of FDI in Africa. Africa Region Working Paper Series No.80, The World Bank.

Ng, S. and Perron, P. (2001). Lag Length Selection and the Construction of Unit Root Tests with Good Size and Power. *Econometrica*, 69, 1519-1554.

Nurkse, R. (1953). Problems of Capital Formation in Underdeveloped Countries. Oxford: Basil Blackwell.

Ozturk, I. (2001). The Role of Education in Economic Development: A Theoretical Perspective. *Journal of Rural Development and Administration*, 33(1), 39 – 47.

Pesaran, H. H. and Shin, Y. (1998). Generalized impulse response analysis in linear multivariate models. *Economics Letters,* 58(1), 17 – 29.

Pesaran, H. M. and Shin, Y. (1999). Autoregressive Distributed Lag Modelling approach to Cointegration Analysis. Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium (Cambridge: Cambridge University Press).

Pesaran, M. H., Shin, Y. and Smith, R. J. (1999). Structural analysis of vector error correction models with I(1) exogenous variables. *Department of Applied Economics Working Paper, University of Cambridge.*

Pesaran, M. H., Shin, Y. and Smith, R. J. (2001). Bound testing approaches to the analysis of level relationships. *Journal of Applied Econometrics,* 16, 289 – 326.

Reinikka, R. and Svensson, J. (1999). How Inadequate Provision of Public Infrastructure and Services Affects Private Investment. The World Bank, Policy Research Working Paper Series: 2262.

Sahoo, P., Dash, R. K. and Nataraj, G. (2010). Infrastructure development and economic growth in China. *Institute of Developing economies,* IDE Discussion paper # 261, 1 – 25.

Sandoval, L. (2012). The effect of education on Brazil's Economic development. *Global Majority E – Journal*, 3(1), 4 – 19.

Sharp, J. S., Agnitsch, K., Ryan, V. and Flora, J. (2002). Social Infrastructure and community economic development Strategies: the case of self-development and industrial recruitment in rural Lowa. *Journal of Rural Studies,* 18(4), 405 – 417.

Snieska, V. and Simkunaite, I. (2009). Socio-economic impact of infrastructure investments. *Inzinerine Ekonomika – Engineering economics*, 3, 16 – 25.

Solow, R. M. (1956). A contribution to the theory of economic growth. *Quarterly Journal of Economics*, 70, 65-94.

Tella, S. A., Amaghionyediwe, L. A. and Adesoye, A. (2007). Telecommunication infrastructure and economic growth: Evidence from Nigeria. *UN-IDEP and AFEA Joint Conference in Dakar Senegal*, 1 – 28.

Wang, E. C. (2002). Public infrastructure and economic growth: a new approach applied to East Asian economies. *Journal of Policy Modeling,* 24(5), 411 – 435.

Zahra, K., Azim, P. and Mahmood, A. (2008). Telecommunication Infrastructure Development and Economic growth: A Penel data Approach. *Pakistan Development Review*, 47(4), 711 – 728.

Zhong, X. and Fan, S. (2004). Infrastructure and regional economic development in rural China. *China Economic Review,* 15, 203 – 214.

Received: August 8, 2012
Revision Received: July 20, 2013