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Infrastructure Investment, Institution and Economic Growth: Cross Country Study using Alternative Measures of Institution

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Abstract

This paper examines the impact of infrastructure on economic growth. Since infrastructure investment differs from other forms of investment due to its unique features, it always subjected to institutional involvement. Infrastructure is seen as a factor of production and telephone per capita and electricity power generation capacity are used as infrastructure variables. Corruption Index, Democratic Accountability Index and Political Risk Rating Index are used to capture the quality of the institution. Results finds that electricity generation has a positive contribution to South Asia and all the sample countries while electricity power generation and telecommunication are both jointly significant in Next 11 countries. The paper recommends more investments on infrastructure as infrastructure finds as a boosting factor for growth in sample countries. Apart from infrastructure development, labor is another promising factor for the economic growth. Policies should design to absorb labor into labor force and to generate healthy and literate labor force to cater future market demand.

Key words: Institution, Infrastructure, Economic growth, South Asia, Next 11 Countries

I. Introduction

South Asia is identified as one of the fastest growing regions and accelerates economic growth rate of 7.3% in 2016 reducing its poverty level to 18.8% according to the poverty head count ratio US$1.90 day (2011 PPP). South Asia shelters about 1698 millions of people and among them 40% people lives less than one US $ per day. The regional inherits its own characteristics in terms of economically, socially, culturally and geographically in comparison to the other regions of the world. South Asian economies accelerate a moderate level of Economic growth since 2013.Highest growth is recorded by India and which is classified as BRIC country.

Table 01: GDP growth of South Asian countries

Country	GDP growth (annual)				
	2011	2012	2013	2014	2015
Afghanistan	6.11	14.43	1.95	1.31	1.51
Bangladesh	6.46	6.52	6.01	6.06	6.55
Bhutan	7.89	5.07	2.14	5.45	3.25
India	6.64	5.61	6.63	7.24	7.57
Maldives	8.71	2.49	4.69	6.48	1.51
Nepal	3.42	4.78	4.12	5.38	3.36
Pakistan	2.75	3.5	4.36	4.73	5.53
Sri Lanka	8.4	9.14	3.39	4.87	4.78

Source: Author's calculation based on World Bank Data

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Next 11 countries are Bangladesh, Egypt, Indonesia, Iran, South Korea, Mexico, Nigeria, Pakistan, the Philippines, Turkey and Vietnam. These set of countries are classified as "emerging markets" by showing very high potential to economic growth. Fast growing population enlarges the market share of these economies and addition to the labor force. Another feature of the next 11 countries are growing level of urbanization as people migrate from rural areas to urban centers or sub urban centers. Life expectancy in Next 11 countries are one decade below than that of developed countries.

Table 02

Country	GDP growth (annual %)				
	2011	2012	2013	2014	2015
Bangladesh	6.46	6.52	6.01	6.06	6.55
Egypt	1.81	2.19	2.1	2.22	4.2
Indonesia	6.16	6.03	5.55	5.02	4.79
Iran, Islamic R	3.74	-6.6	-1.91	4.34	4.34
Mexico	4.04	4.01	1.34	2.25	2.54
Pakistan	2.74	3.5	4.36	4.73	5.53
Philippines	3.65	6.68	7.05	6.13	5.8
Vietnam	6.24	5.24	5.42	5.98	6.67
Turkey	8.77	2.12	4.19	3.02	3.98
Nigeria	4.88	4.27	5.39	6.3	2.65

Source: Author's calculation based on World Bank Data

By looking at the table 02 we can understand the economic growth rate of the sample countries record moderate growth rate during last three decades while Iran has hit 6% of growth rate. The countries in the region are facing huge infrastructure gap and the World Bank identified closing down huge infrastructure gap in South Asia as a key potential of achieving Economic growth in order to combat persisting poverty. Infrastructure is seen as an important facilitator in achieving economic growth through increasing productivity as finds in most of the literature.

Infrastructure has been identified as a unique source of economic growth in terms of both economic and social aspects. The contribution of well-developed infrastructure in to economic growth was disclosed and documented by Aschauer (Aschauer 1989).Well designed and improved infrastructure contributes to economic growth in multi facet miens (Sanchez-Robles 1998), (Ramırez 2003) as finds in the literature. Literature proves the direct and positive relationship between infrastructure and production (Sahoo and Dass 2012), (Wang 2002).Healthy infrastructure stimulates economic growth in terms of reducing cost and improving competitiveness. Further, investment in infrastructure reduces poverty by creating job opportunities. Investment in infrastructure therefore contributes to economic growth in two ways – in terms of improving productivity and efficiency and in terms of reducing poverty.

Therefore, infrastructure development comes as a one important determinant in achieving economic growth in developing countries. By understanding the importance of infrastructure, Sri Lankan government inserted infrastructure development in its action plan called "The vision for the better future- Mahinda Chintana". The contribution of infrastructure in to economic growth is well defined in growth literature .Chinese growth experience proves the importance of investment in infrastructure in achieving economic growth (Chatterjee 2005). Sri Lanka has a good welfare system of health and education since 1950s and as a result of that HDI is well ahead of the other countries in South Asia.

Table 03

		HDI Index value				
year	Srilanka	Maldives	India	Bangladesh	Nepal	Pakistan
Y2010	0.736	0.683	0.586	0.546	0.531	0.522
Y2011	0.740	0.690	0.597	0.559	0.536	0.527
Y2012	0.745	0.695	0.600	0.563	0.540	0.532
Y2013	0.750	0.703	0.604	0.567	0.543	0.536
Y2014	0.757	0.706	0.609	0.570	0.548	0.538

Source: UNDP. org data

Previous studies of infrastructure and economic growth is based on either country specific or cross country studies on a large number of countries based on time-series data. Most of the previous studies unable to capture the south Asian landscape. This study covers panel data from 1985-2014 as panel data provides more information. The study focuses on the south Asian countries focusing its inherent problem and compares south Asia with "next 11" countries. South Asian countries are India, Sri Lanka, Pakistan, Nepal, Bhutan, Maldives, Afghanistan and Bangladesh. Bangladesh and Pakistan are South Asian countries and have been classified as "Next 11" countries and therefore Next 11 countries have been taken into study. The Next 11 countries are Bangladesh, Egypt, Indonesia, Iran, South Korea, Mexico, Nigeria, Pakistan, the Philippines, Turkey and Vietnam. Though these countries do not share same economic and geographical features, predicted as highly potential growth countries. Infrastructure investment has its own unique features in comparison to the other investments. The investment in infrastructure is massive and the investment lasts for longtime. Infrastructure stock shows the nature of natural monopoly and tends to have public goods characteristics in general. Following its unique features, infrastructure is intertwining with the institution. In this sense, infrastructure, institution and economic growth can be seen as inter connected flow.

Tab 04Ownership of Infrastructure sector by country

Country	Electricity sector	Telecommunication sector	Railway sector
Bangladesh	State monopoly	Public / private owned	State monopoly
Egypt	Private owned	State monopoly	State monopoly
India	State monopoly	Public / private owned	State monopoly
Indonesia	State monopoly	Public / private owned	State monopoly
Iran	State monopoly	State monopoly	State monopoly
Mexico	Public / private owned	Public / private owned	State monopoly
Pakistan	State monopoly	State monopoly	State monopoly
Philippines	State monopoly	Public / private owned	State monopoly
Sri Lanka	State monopoly	State monopoly	State monopoly
Turkey	State monopoly	Public / private owned	State monopoly
Vietnam	State monopoly	State monopoly	State monopoly

Source: Author's compilation of data

This chapter captures the importance of infrastructure and institution along with their production function in terms of achieving growth. Institution is seen as another separate factor of production in the stylish production function as institution is powerful in economic decision making (Alesina & perotti, 1994). Political Institutions are very influential in decision making process and determining the economies in terms of allocating resources and incentives. In this context institution can be seen as a resilient initiator of allocating resources in terms of exploiting economic growth by using tool of power by policy making (Morrison 1992).

Infrastructure being characteristically a public good is under the control of institution. Institution is a major determinant of quality and quantity of infrastructure reducing the infrastructure gap. Therefore infrastructure, institution and economic growth can be identified as tree bands of a chain. The prominence of infrastructure development on economic growth is well recognized in development literature since Aschauer elaborates the significant importance of non-military capital stock as a contributing factor of productivity (Aschauer 1989). Ramirez and Esfahani focus infrastructure and economic growth under the mediation of the institution (Ramirez 2003). Therefore, in the case of infrastructure government plays an important role. By using *indexes of infrastructure physical unit as proxies of infrastructure endowment and investment in infrastructure* (Sanchez-Robles 1998) proves the positive significance of public capital on growth of output.

4.2 Definitions of the concepts

Recently countries are in search of new sources of growth as alternative drivers which are differ from traditional production function. Recently countries spent lot of money in developing infrastructure as a strategy in achieving Economic growth. "This great infrastructure boom will create winners and losers. Losers will squander infrastructure spending on corruption and ineptitude. Winners will create powerful new engines of economic growth for generations to come based on new energy, globally competitive health care and strong education" (Gerisson 2009).

Infrastructure

The definitions are very broad as finds in literature and different papers defines infrastructure in different ways. Infrastructure is defined as "capital devoted to streets and highways, sanitation and sewage, electric, gas, water and utilities" (Holtz-Eakin, 1993).

Infrastructure includes all public services from law and order through education and public health to transportation, communication, power and water supply as well as agricultural overhead capital as irrigation and drainage systems" (Hirschman, 1958)

By following the original work by Ramirez and Hadi (Ramirez, 2003), the paper follows the definition of "capital devoted to streets and highways, sanitation and sewage, electric, gas, water and utilities".

Institution: Most quoted definitions in my literature on defining institution by made of North.

1. "*Institutions are humanely devised constraints that structure political, Economic and social interactions*" (North, 1990).
2. "A *set of rules, compliance procedures and moral and ethical behavioral norms designed to constrain the behavior of individuals in the interest of maximizing the wealth of principals*" (North 1981, pp201-202) (North, Structure and change in Econimic History, 1981)

For the purpose of the research the first definition of institution will be used as the work touches Political (Institution), Economic (Infrastructure) and the Social (Health and education, urbanization) factors. Previous studies have estimated the effects of infrastructure and institution into economic growth but few studies capture south Asia and only one study found in Sri Lankan context and the mentioned study has not taken institution into account. The aim of this exercise is to single out infrastructure as a separate, additional factor of production and compare in terms of "South Asia" and "next11" by capturing institution as a contributing factor to production. This paper attempts to measure the direct impact of the infrastructure investment into economic growth. To answer this question GDP per capita, population growth rate, telephone per capita(fixed and mobile), growth rate of per capita telephone, electricity generation capacity, rail road coverage Km , average years of secondary education, investment as a percent of GDP, Education expenditure, change in terms to trade, Urbanization, life expectancy at birth, population density, Investment as a ratio to GDP, Share of industry in GDP and health expenditure, depreciation, GDP growth rate, Population growth rate, Corruption Index, Democratic accountability and Political Accountability Index will be used to estimate the growth equation. Institution has been taken in to consideration as a factor of production following (Cavello, 2011).

To quantify institution Principal component analysis (PCA) is computed by using Corruption Index, Democratic accountability and Political Accountability Index. The main objective of the fourth chapter is to estimate the contribution of infrastructure into economic growth.

Most of the former studies are country based studies (Aschauer, 1989) or based on large number of country specific studies based on time series data. These studies do not capture inherent problems to south Asia. This study incorporates with Sri Lanka as a country specific study and compares with "South Asia" and "Next 11" countries in term of contribution of infrastructure into economic growth. This is the contribution to literature. The study has taken institutional factor into account and covers of 29 years from 1985-2014. Institution plays a major role in economic decision making. The study found in literature in South Asian context is up to 2005 and does not in cooperate with institutional factor (Sahoo & Dass, 2012). The uniqueness of the chapter is estimating impact of infrastructure and institution in to economic growth. Panel data have been employed as panel data provides various observations on each variable and very informative in describing changes over the time.

4.3 Variables and Data

Labor

To measure the amount of labor, labor force statics were taken into account following ILO definition of labor. Many variables can be found to measure the quality of labor in literature. Here, I will use most widely used variables as finds in literature. The number of schooling years is a common variable that finds in literature and in (Barrow, 2001) the number of schooling years is used as a variable to measure the quality of labor.

Education Expenditure

Expenditure on education is another variable used by most researchers as find in (Landau, 1983)(Barrow, 2001) ((Benhabib, 1994). Importance of education achieving in economic growth well found in literature and my sample of the paper is abundant of human resources. Most important factor of the production for both South Asia and Next 11 is labor force.

Health Expenditure

Expenditure on health is another widely used variable (Bloom, 2004) (Mayer, 2001)).Bloom and others proves the importance of health in achieving economic growth. They found the direct significance impact of human capital into economic growth. Healthy work force increases efficiency and productivity and capable of higher wages which is a precondition for economic growth.

The paper occupies "The number of schooling years, Expenditure on education and expenditure on health" as a variable to measure quality of labor. In developing countries labor can be considered as a part of capital because it helps to accumulate capital and it is broadly considered as "the human capital".

Institution

Institution quality and economic growth proves reinforcing relationship over one another as finds in literature. According to Acemouglou countries are blessed in terms of different sources of resources. The quality of the institution paves the path to economic growth. Most of the countries are poor not because of lack of resources, it is because of lack of good decision making by the institution.

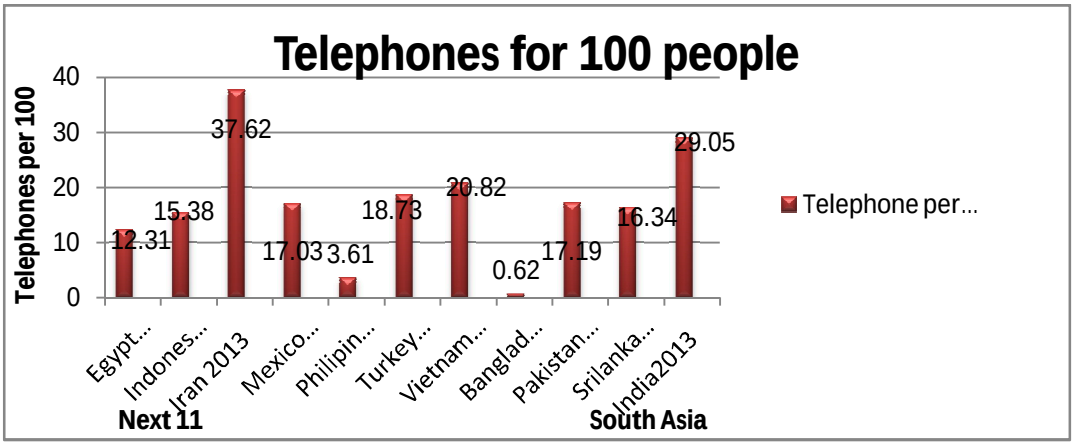
Population

Population is a promising factor for the economic growth as finds in Bloom 2004 and practically proved by Chinese growth miracle, Indian and Mexican growth stories. Increased population means increased labor force in future, from this aspect population is a promising factor for the Economic growth.

Telephone

Telephone infrastructure and economic growth has a positive relationship according to the literature (Sridar, 2007). Especially in terms of developing countries telephone infrastructure increases productivity and welfare which is best proved by "Grameen Village phone" program in Bangladesh. Telephone infrastructure reduces "Fixed costs of acquiring information and variable cost of Participating markets" ((Norton, 1992)

Table 05



Source: Author's calculation on World Bank data

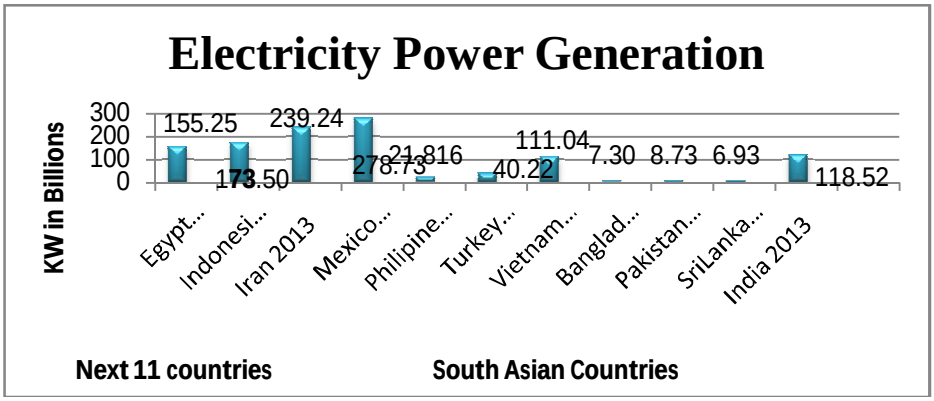
Population density

Most of the studies used population density as a variable to highlight the importance of provision of public expenditure. Highly dense areas are prioritized than rural or lightly dense areas in terms of locating industries. Since the allocation of the provision is decided by the institution it is fair enough to prioritize highly dense areas as the institutional focus is to make accessible to all facilities to each of its citizens. Largely population dense areas are being created by the available infrastructure facilities. Availability of comparatively few number of economic hubs again a main feature of highly populated areas.

Electricity

Electricity has proved to have very significant favorable impact on the livelihood of rural people. Not only for the lighting purposes but also for the uses of the machines allows greater productivity (Songo 2002)

Table 06



Source: Author's calculation on World Bank data

Life expectancy

The expected living years is again a positive factor for the Economic growth. A person leads a long life can be translated as a higher contribution to labor force. Changing life expectancy ratio and economic growth has a positive linkage as finds in (Bloom2004)

Urbanization

Modern Economics argues by stating that Urbanization is a prerequisite for the economic growth. People concentrate around the economic and financial hubs according to the availability of the options. Urbanization is a blessing at the first stage of growth pattern. Urbanization is an unavoidable scenario almost every country may have to practice at the first stage of growth. According to the literature urbanization is a blessing in the early stage of industrialization as urbanization in the early stage provides evidence to the transmission of the economy from agriculture to industrialization. Urbanization as a share of population in urban areas is majorly used variable in infrastructure related work. Technically the infrastructure development aims sectorial or provincial development and along with infrastructure development new economic activities takes place. As a result of that improved infrastructure stimulates urbanization as finds in literature as a part of key drivers of job creation. Therefore urbanization and population density (Population per square kilo meter) is used as variables in the model.

Change in Terms of trade

Terms of trade sums up the ratio relative prices of exports in terms of imports and comes as a ratio in literature. It is a very good measure of trade as well a good indicator of measuring exports competitiveness and economic growth. According to the literature uncertainty in terms of change affects to savings and growth (Mendoza 1997).Change in terms of trade is very sensitive in capital accumulation and economic growth in developing countries according to (Basu 1991).

According to Basu "imported inputs" more productive in formation of "domestic capital" which is very uncertain on the exports prices.

Share of industry in GDP

The share of the industry sums up the amount of increase in the share of industry in GDP. Generally in all the developing countries the share of industry kept on increasing during last 5 years except for the countries faced with internal crisis and wars.

Increase in the share of industry means the expansion of the industrial sector of the economy. In terms of the developing countries it shows the transmission from the informal to formal sector of the economy. This transformation carries not only one sector; it influences to whole economy.

Investment GDP ratio

This is a good estimator of capital formation of a country in theoretical sounds. Most of the papers used Investment GDP ratio as a variable of capturing capital formation. Investment GDP is classified as one of the new variable of accessing size, quality and structure of the economy as finds in (Levine 2000) Depreciation Rate Since the study focuses on infrastructure, it is unfair if we neglect the importance of depreciation of physical capital investment as all resources subjected to depreciate over the time. It was really hard to find a unique estimator to calculate the rate of depreciation which is an extremely important factor in both macro and micro economic analysis (Schundelen 2000).

Population growth rate

Population growth rate is the increase of population in a country in a given period of time. This captures the death and the birth rates within the period.

GDP growth rate

GDP growth rate is the rate of increase in GDP within a given period of time.

Panel Unit Root test

To achieve meaningful estimation of a model, time series data should be stationary and non-stationary data make misleading parameters (Bandara, 2000). In order to examine of stationary of series, Panel unit root tests were conducted in terms of finding unit root. Levin, Lin & Chu t*, Im, Pesaran and Shin W-stat ,ADF - Fisher Chi-square, PP - Fisher Chi-square tests were done in level, first and the second difference and the results are entered in table 1. According to the unit root test, education, Life expectancy, GDP growth rate, GDP per capita are stationary in level form. Urbanization, change in terms of trade, Share of industry in GDP, Investment GDP ratio, Population Growth, Principal component analysis, Electricity generation, Years of schooling are stationary in the first difference while labor, population and population density is stationary at second difference.

Unit root test

Table 7

	Levin, Lin & Chu t*			Im, Pesaran and Shin W-stat			ADF - Fisher Chi-square			PP - Fisher Chi-square		
	Level	FD	SD	Level	FD	SD	Level	FD	SD	Level	FD	SD
Education Expenditure	0.0001			0.0001			0.001			0.0001		
Health Expenditure	0.9994	1.0001	0.0001	0.9827	0.8387	0.3015	0.8136	0.001	0.001	0.8755	0.001	0.0001
Labor force	0.2375	1.0001	0.0001	0.2546	0.9722	0.0003	0.4415	0.0001	0.001	0.6682	0.001	0.0001
Life Expectancy	0.0001			0.0001			0.0001			0.0001		
Urbanization	0.0001	0.0001		0.0001	0.0001		0.0035	0.0001		0.1012	0.001	
Terms to trade	0.9932	0.0001		0.9478	0.0001		0.7164	0.0001		0.8898	0.001	
Population density	0.3428	0.7084	0.4335	1.0001	0.0013	0.0001	0.9648	0.0001	0.001	0.3766	0.0044	0.0001
Share of industry in GDP	0.3231	0.0001		0.5235	0.0001		0.6758	0.0001		0.8561	0.001	
Investment GDP ratio	0.0462	0.0001		0.0021	0.0001		0.001	0.0001		0.0067	0.001	
Population growth rate	0.5734	0.7854		0.1736	0.0001		0.0397	0.0001		0.0001	0.001	
GDP growth rate	0.0001			0.0001			0.001			0.0001		
pca	0.0001	0.0001		0.0001	0.0001		0.0001	0.001		0.0017	0.0001	
GDP per capita growth	0.0001			0.0001			0.0001			0.0001		
Elecricity generation Capasity	0.4463	0.0001		0.6223	0.0001		0.5927	0.001		0.8364	0.0001	
Telecommunication	0.2803	1.0001	0.0023	0.8759	0.8872	0.0001	0.4015	0.2614	0.002	0.9221	0.0001	0.0001
years of schooling	0.9096	0.0001		0.9714	0.0001		0.9656	0.0001		0.9708	0.0001	

Source: Author's calculation using E views software Level – Level Form FD- First Difference SD- Second difference

4.5 An Econometric model of Economic Growth and Infrastructure

$$Y=f\,(K^{\alpha}\,N^{\beta}\,(QL)^{1-\alpha-\beta}$$

Above given is the production function of the economy where as Y is the aggregate output, K is the non-infrastructure capital and the N is the infrastructure capital while L stands for labor. Q stands for all the other factors that influence production. The production function is to be Cobb Douglas production function with constant returns to scale. The original model assumes Q to be labor productivity.

4.6 Contribution to the original equation

$$Y=f\,(QL)$$

In the original equation Q stands for the technical factor which controls labor capturing "all the other factors that influence production". By following literature, years of schooling, education expenditure and health expenditure is introduced to the equation as the technical factor controlling labor. By following the= definition of human capital, "Human capital is the stock of skills that labor force processes", since the equation incorporates investment in skills in terms of education and health and returns in the form of higher wages. Therefore we can consider the equation as Human capital equation. The contribution of human capital in to economic growth is widely cited in literature.

$$L=f\,(Yrschedexheex)$$

*Yrsch*is used by following positive significance results between years of schooling and GDP per capita Income as finds is Glaser et al (2004).Education expenditure *edex* and health expenditure *heex* are most sited variables in measuring quality of labor as finds in literature. Therefore, years of schooling, education expenditure and health expenditure used to explain technical term Q in the human capital equation. Finally the total production function can be seen as a Infrastructure capital N, Non infrastructure capital K and human capital L.N is infrastructure capital and infrastructure is estimated using power generation – electricity production capacity per capita and telephone per capita following the original equation. The amount of fixed telephone lines has been taken into account in the original equation and I have been employed mobile per capita and fixed phones following (Sahoo & Dass, 2012). In literature mostly sited infrastructure variables are electricity generation, telephone (fixed),Rail density ,paved roads and air transport(Bougheas, (2000): .)(Sahoo & Dass, 2012) Belaz Eargers(2009) as infrastructure variables.

The importance of institution was well recognized through infrastructure related literature (Cavello, 2011)(De, 2010) and (Knack, 1995)The importance of institution on infrastructure is due to the unique characteristics of infrastructure of having economies of scale and the massive nature of investment that separates from other types of investments. Therefore infrastructure and institution are closely connected as mainly infrastructure investments are decided by the institution and directed by the institution. In practice, the growth experience of South Korea, Taiwan and China records the importance of institution and it has been a boosting driver of achieving Economic growth even though the countries different from the stock of labor and capital. These experience show us even though they are democratic or one party dictatorship, the institution is the driver to achieve Economic Growth as finds in Glaser et al(2004).Therefore following (Cavello, 2011) the production function can be written as ,

$$Y = f(k, p, \theta)$$

Whereas production is a function of K- private capital, P- Public capital and θ-Institution. Since there is a close relationship between institution and infrastructure following (Cavello, 2011) the production function can be written as,

$$Y= \theta\, K^{\alpha}\, N^{\beta}\, (QL)^{1-\alpha\beta}$$

By introducing θ – institution in to production function. To quantify institution Political Risk Rating, Democratic Accountability is used by following (Cavello, 2011).Corruption is another widely used variable as finds in literature in quantifying institution. Apart from above two variables corruption is also taken in to account to following(De, 2010).

$$Y= \theta\ K^{a}\ N^{\beta}\ (QL)^{1-a-\beta} \quad \text{----------(1)}$$

In the equation N^{β}which stands for infrastructure capital is very important as the expected important role of infrastructure revolves around β.To calculate the value of β, the production function should be written in log level.

$$Yy= (1-a-\beta)\ q+aY_K+ \beta Y_N \quad \text{----------(2)}$$

Here q will be the growth rate of technical factor which is explained by the years of schooling, education expenditure and health expenditure. Yy is the growth rate per capita of all variables.

$Yy=Y/L$ is the per capita growth, $Yk=K/L$ per capita non infrastructure growth and $Y_N = N/L$is the per capita infrastructure growth. With the help of this equation, we can measure the importance of each factor of production namely labor (L), per capita non infrastructure growth (K) and per capita infrastructure growth (N). The original work points out two main problems associates with in this stage. (1) Non infrastructure Capital stock –It is hard to measure non infrastructure Capital as it includes both physical and non-physical capital. The second problem pronounced here is infrastructure growth may be depending on GDP growth. Because of this "simultaneous problem" would arise. The solution for the simultaneity is the "Steady state" where K – non infrastructure capital and N – infrastructure capital has no changes. We can write the equation for the capital accumulation as (share of output allocated to capital accumulation) as follows.

$$Y_k = S_kY/\ k-\delta-\iota \quad \text{----------(2.1)}$$

S_kY is the non-infrastructure capital accumulation and $k-\delta-\iota$ is the convergence rate, where k is the non-infrastructure capital, δ is the GDP growth rate and the ι is the labor force growth rate.

Infrastructure accumulation equation can be written as, (share of output allocated to infrastructure accumulation,

$$Y_n= S_nY\ /\ n-\ \delta-\iota \quad \text{----------(2.2)}$$

Whereas $Y_n$infrastructure capital formation is (S_nY) and in ($n-\ \delta-\iota$) is the convergence rate where , n is the non-infrastructure capital and δ is the growth rate and ι labor growth rate. We consider a model where savings, growth, GDP growth, Non infrastructure capital, and infrastructure capital are constant and therefore all per capita variables increase at the same time. Therefore the equation can be explained as below,

$$S_kY/Y^* = S_nY/Y^* = q^*+\iota+\ \delta \quad \text{---------- (2.3)}$$

The long run growth rate will be q^* and we assume q^* is constant.

And infrastructure capital output ratio is

Following Solow model where we find $S = S_i$, growth of factor i can be interpret as,

$Y_i = q^*+(q+\ \iota+\delta)G_i$ whereas i= K,N and G is the gap between the initial state and the steady state.

$S_i – S_i^*\ /\ S_i$ is changing according to G_i. Investment rate changes according to the imbalances of the resources and the institution can decide the amount of the allocation of money on each sector according to the timely needs and according to the regional requirements as finds in their national agenda. Therefore the equation again can be written as,

$(Si - S_i^*) / S_i = g_i(X) G_i \qquad i = K, N$

Whereas X remains as preference and technology variable. Summarizing all,

$Y_i = q^* + (q^* + \iota + \delta)(\iota + g_i(x))G_i \qquad i=K,N$ ----------(2.4)

The equation implies the responding rate of investment according to the allocation of the government funds and the adjustment rate is $(q^* + \iota + \delta)(\iota + g_i(x))G_i$ according to the conditions of the country.

The model of the chapter four totally based on the following equation.

$Y_y = (1-\beta)\, q^* + (1-\alpha-\beta)(q-q^*) + \beta Y_{n+} (q^* + \iota + \delta) + (\iota + g_i(x))\, \alpha G$---------- (2.5)

4.7 Econometric Model

Data

It is expected to estimate the model based on the equation 2.8 which is about the average infrastructure effect of per capita GDP based on the data of 11 countries consisting South Asia and Next 11 countries upon the availability of data. Data is from 1985-2013 considering Telephone and electricity generation as infrastructure variables following Ramirez 2003.Therefore as finds in the original work , the equation will be,

$$Y_y = \beta_i Y_t + \beta_p Y_p + (1-\beta_t-\beta_p) q^* + (1-\alpha-\beta_t-\beta_p)(q-q^*) + (q^* + \iota + \delta) + (\iota + g_k(x_k))\alpha G_k$$

$\alpha G_k = \beta_t \log t + \beta_p \log p - (1-\alpha) \log Y + (1-\alpha-\beta_t-\beta_p) \log Q + \alpha \log S_k^* - \alpha \log((q^* + \iota + \delta)$------(2.6)

The data for Growth of GDP per capita, Population growth rate, Initial telephones per capita, growth rate per capita telephones, Private ownership I telecommunication sector, power production per capita, private ownership in power sector, average years of secondary education, Education expenditure, Health expenditure ,terms of trade are from the world Bank data. Democratic Accountability, Corruption and Political Risk rating are from PRS Data set.

Urbanization as a share of population in urban areas is majorly used variable in infrastructure related work. Technically the infrastructure development aims sectorial or provincial development and along with infrastructure development new economic activities takes place. As a result of that improved infrastructure stimulates urbanization as finds in literature as a part of key drivers of job creation. Therefore urbanization and population density (Population per square kilo meter) is used as variables in the model.

4.8 Composite Index To quantify institutional quality as defined by θ in the equation, political accountability, democratic accountability and corruption is used.

1. Democratic Accountability (From 1 least responsive to 6 highly responsive) - Political risk Service website and Worldwide Governance Index data

2. "**Political Accountability Index (From 100 least risk to a low of 0 highest risks)-** Political risk Service website and Worldwide Governance Index data

3. Corruption Index (From 1 – highly corrupted to 6 least corrupted) - Political risk Service website and Worldwide Governance Index data

Once these variables introduced alone to the growth equation the variables are not significant. Therefore these three variables were decomposed in to one variable by using principal component analysis (PCA).

In literature it has found little support to occupy principal component analysis to decompose few number of repressors. In my analysis I have being occupying only three explanatory variables to decompose in to one variable to quantify institutional quality. Kelechi supports to solve the problem of few repressors in his work (Kelechi, 2012).According to his work PCA is strong enough to capture analyzing of few explanatory variables. In his study he focused only on three explanatory variables. By following Kelechi 2012, I used PCA in decomposing of political accountability, democratic accountability and corruption.

Descriptive statistics of data

In table 06, the mean value of Political Accountability Index is the highest 41.47667 .Maximum is again Political Accountability Index 61 and minimum is 1 representing both corruption Index and Democratic Accountability Index.

Table 08

	CORRUPTION	DA	PAI
Mean	1.733333	3.266667	47.41667
Median	1.75	3	50
Maximum	3	5	61
Minimum	1	1	28
Std. Dev.	0.728352	1.015882	9.849469
Skewness	0.521035	-0.215981	-0.633705
Kurtosis	1.995013	3.090258	2.133535
Jarque-Bera	28.81877	2.677642	32.40999
Probability	0.000001	0.262155	0
Sum	572	1078	15647.5
Sum Sq. Dev.	174.5333	339.5333	31916.96
Observations	330	330	330

Source: Author's calculation by using Eviews software

Corruption –Corruption Index DA-Democratic Accountability Index PAI –Political Accountability Index

Contract enforcement is a popular indicator developed by Knack and Keeper (1995).It highlights the institutional quality in policy making attacking investors. The other popular indicator is ethno linguistic heterogeneity (ELH) according to Easterly and Levine (1997) which is very important again in policy making. In literature ethno linguistic heterogeneity mostly associates with trust among the society and interest group. Democratic accountability is replaced with ELH. Democracy facilitates avoiding conflicts as finds in literature and it can ensure expressing "political demands". Openness is another variable comes in the original work proxied by exchange rate black market premium and landlocked. In my analysis I had no complete data set for my sample countries on exchange rate black market premium. Out of my sample of 11 countries, 6 countries are categorized as next 11 countries and India is named as BRICs among the four largest emerging economies in the world. By this grounds, I believe the landlocked variable provide little support to growth equation.

When it comes to the depreciation rate, it should be calculated. In my research there is little support of the methodology of calculation of depreciation rate. In the original work by Ramirez 2003, the depreciation rate is assumed as 0.4 due to "…*the presence of two additive parameters* q^* *and* δ *as the arguments of log function in the expression make the solution algorithm relatively unstable and hampers its convergence. For this reason we fixed the value at 0.04*" (Ramirez, 2003). SchudenIn in his work estimates physical capital depreciation rate in Indonesia. Cutting-edge his work he estimated physical capital depreciation rate as 0.08-0.14 in Indonesia (Schündeln, 2013). Indonesia is a country in my sample and following his work I assume depreciation rate for the sample countries as 0.08.The model is based on the endogenous growth theory which scrutinizes the importance of internal resources rather than the external factors in achieving economic growth.

4.11 Summery statistics of variables in the growth equation Table 09

	Mean	Median	Maximum	Minimum
	3.627908	2.880881	17.64341	0.82737
Capital formation	1.42E+09	5.62E+08	3.78E+10	1000000
Corruption	1.87E+09	7.10E+08	3.78E+10	4.72
Democratic Accountability	0.026874	0	0.475211	-0.404239
Education Expenditure	119.8283	65.0766	1052.499	4.845
Electricity generation	3.225698	3.098282	53.93264	-64.99726
Depreciation rate	5.146576	5.064937	57.81783	-64.04711
GDP growth rate	71182379	34699285	4.88E+08	16.6878
Health expenditure	32151343	75.205	1.57E+08	18.297
Population density	3.496753	3	6	1
Population	55.3914	57.5	75	27
Private participation in power generation	27.10846	24.06535	60.78199	12.89079
Mobile phones and fixed telephones	3.42E+08	84857475	4.95E+09	16127000
Telephone per capita	67.74651	67.77735	76.53266	56.1152
GDP per capita growth rate	244.1959	177.3354	1207.324	36.44023
Institution quality log	1.838978	1.800792	3.247371	-1.609576
Institution quality PCA	6.20E+10	2.02E+10	6.30E+11	17142769
Investment GDP ratio	46.75829	43.33427	165.0942	2.416257
labor force	18950511	4.040491	1.53E+09	-13.12672
Life expectancy	2.449675	2.5	4	1
Population growth rate	1.52E+10	6.92E+09	7.87E+10	46322706
Private participation in telephone	5.57E+08	36669179	1.16E+10	-4.02E+10
Political Accountability Index	31.62701	31.33944	48.06074	20.05066
Terms of trade change	9.182333	4.389213	38.33395	0.169228
Share of industry in GDP	3.73E+09	1.04E+09	6.23E+10	1000004
Urbanization	6.11E+10	2.03E+10	6.18E+11	8.13E+08
Years of Schooling	6.49026	7	8	4

Source: Author's calculation

It is expected to estimate the model based on the equation 2.8 which is about the average infrastructure effect of per capita GDP based on the data of 11 countries consisting South Asia and Next 11 countries upon the availability of data. Data is from 1985-2013 considering Telephone and electricity generation as infrastructure variables following Ramirez 2003.Therefore as finds in the original work , the equation will be,

$$Y_y = \beta_i Y_t + \beta_p Y_p + (1-\beta_t-\beta_p)q^* + (1-\alpha-\beta_t-\beta_p)(q-q^*) + (q^* + \iota + \delta) + (\iota + g_k(x_k))\alpha G_k$$

$$\alpha G_k = \beta_t \log t + \beta_p \log p - (1-\alpha) \log Y + (1-\alpha-\beta_t-\beta_p) \log Q + \alpha \log S_k^* - \alpha \log((q^* + \iota + \delta)$$

Table 15 contains the results of estimated per capita income growth equation. The sample is divided in to four groups. Sri Lanka, South Asia, Next 11 countries and the all countries of the sample together to patterned the importance of the infrastructure investment in to economic growth. The first Colum contains the results of the general production function under four categories of the countries. In the second columns, the institutional quality was introduced into the equation controlling normal production function in column number one. The institutional quality was measured under principal component analysis. The infrastructure variables introduced into the equation at the third column which is electricity power generation and telecommunication.

With the introduction of institution in to growth equation health expenditure, life expectancy, urbanization are significant in next 11 countries and in all sample countries share of industry in GDP, life expectancy and urbanization is significant. In the third column infrastructure variables have been introduced to the equation. After the introduction of infrastructure in to the growth equation population density and electricity power generation is positively significant in South Asian Countries. In Next 11 countries Health expenditure, Life expectancy at birth, Investment GDP ratio are positively contributes to economic growth. Infrastructure variables are not significant once they are individually entered into the equation. Therefore electricity power generation and telecommunication per capita are jointly introduced in to the third equation and jointly effect is significant. Urbanization was removed from next 11 sample countries as per the high colinearity. In all countries in the sample life expectancy, population density, share of investment in to GDP and electricity generation capacity is positively significant.

All together the F stat of the equations are high meaning the variables all together have a positive impact on the GDP per capita growth though they are individually not significant. Electricity power generation is a positively contribution to the economic growth. In the original work electricity power generation is significant and sahoo (2012) and Belaz Eagertz (2011) reports the positive significance of electricity power generation in to economic growth.

Life expectancy is a promising tool in achieving growth according to Bloom (Bloom D. E., 2000).In the article they argue by stating health and income reinforcing each other and according to new findings health, income and growth are intertwined. *A healthy population is a prerequisite for growth as much as a result of it."-Dr. Gro Harlemrundtl and Director General, WHO 1998-2003.*According to Zang and Zang (Zhang, (2005):), life expectancy is positively significant to savings, growth and secondary school enrollment. According to their work coefficient is 0.0902 meaning life expectancy provides strong positive relationship with the GDP growth while other factors keeping constant. Urbanization is one of the recent phenomenon came into scenario after the industrial revolution according to the literature. It is common scenario and in developing countries it has urbanization is quiet new experience with the technological transfers and the globalization. When resources are concentrates comparatively couple of locations practically they will turn out to be Economical hubs. Based on this assumption, urbanization is a blessing to Economic development in the early stage of development according to Henderson (Henderson, 2003).

The share of the industry is comparatively low in comparison to the developed countries. Reason behind the argument is developing countries are still passing the pave of early stage of development and they still experience transformation stage from agriculture to Industrializationas finds in Rostov growth theory. Shifting from primary stage to industrialization was well documented in literature (James, 1973).According to James 1973, the grater the share of industry becoming larger the growth acceleration speeds.

Table 10: Per capita growth equation

		1			2				3			
	SL	SA	N11	All sample	SL	SA	N11	All sample	SL	SA	N11	All sample
Education Expenditure(Yrs of edu)	3.46E-03	3.41E-13	-1.15E-10	-0.21697	5.42E-10	-4.81E-13	-8.35E-11	-0.28029	2.18E-08	-0.74233	-7.87E-11	-0.31312
	0.512	*0.8277*	*0.0543*	*0.0595*	*0.8954*	*0.7431*	*0.146*	*0.4951*	*0.005*	*0.019*	*0.1671*	*0.4476*
Health Expenditure	2.162693	-0.863395	0.202688	0.004098	561.9309	-0.491447	0.13477	0.00471	790.0747	-0.74233	0.114226	0.01268
	0.0773	*0.0014*	*0*	*0.7818*	*0.9635*	*0.0154*	*0*	*0.07501*	*0.0034*	*0.019*	*0*	*0.4355*
Labor force	-0.01068	-0.104034	-0.786394	-0.501097	-0.573034	-0.133683	-0.43451	-0.49463	-1.6047	-0.08851	-0.48425	-0.53338
	0.7145	*0.2133*	*0.001*	*0.0002*	*0.7918*	*0.0823*	*0.0059*	*0.0002*	*0.211*	*0.3065*	*0.0023*	*0.0002*
Life Expectancy	-1.975158	0.903759	19.40618	5.160272	-116.6064	3.897132	15.58214	5.690077	-82.9203	1.805396	12.14353	7.2436
	0.3654	*0.7915*	*0*	*0.0068*	*0.4802*	*0.2056*	*0*	*0.00367*	*0.4791*	*0.6329*	*0*	*0.0004*
Urbanization	-0.041879	0.792292	1.10E-11	0.245384	-2.523399	0.168431		0.25883	-31.7854	0.010204		0.221085
	0.5161	*0.0322*	*0*	*0.047*	*0.5992*	*0.4085*		*0.0367*	*0.0011*	*0.9664*		*0.0977*
Terms to trade	0.128194	-0.176066	-0.634491	-0.101365	-75.45154	0.141108	-0.32691	-0.11603	132.5705	-0.66417	-0.37732	-0.20653
	0.8184	*0.3788*	*0*	*0.2128*	*0.0822*	*0.2345*	*0.0022*	*0.1567*	*0.0839*	*0*	*0.0005*	*0.0332*
Population density	Omited	2.611414	-0.629324	0.661483						2.462914	0.069468	0.518571
		0	*0.0196*	*0.0338*						*0*	*0.7717*	*0.0073*
Share of industry in GDP	-1.168938	-0.668079	0.047108	2.066215	12.40839	-0.022492	0.035268	2.081167	-1.24057	0.03213	0.04872	2.043222
	0.0464	*0.6723*	*0.0034*	*0.0003*	*0.7653*	*0.9878*	*0.4556*	*0.0003*	*0.046*	*0.3397*	*0.3034*	*0.0003*
Investment GDP ratio	-0.012958	1.350592	-1.823399	-0.675524	-0.633441	1.25992	-1.32324	-0.64071	-1.95793	-0.62463	1.468847	-0.63631
	0.3198	*0.1146*	*0*	*0.0291*	*0.524*	*0.1256*	*0*	*0.039*	*0.0046*	*0.0578*	*0.0018*	*0.0492*
$(q^{*} + \iota + \delta)$	0.003613	0.776155	0.963743	0.956414	1.118141	0.794804	0.959679	0.957664	0.329202	-0.03989	0.425406	0.959921
	0.4244	*0*	*0*	*0*	*0.1229*	*0*	*0*	*0*	*0.1345*	*0.0338*	*0.0402*	*0*
Institution Variable												
Institution					0.415757	0.019781	-0.67921	-0.32691	-1.37088	-0.00111	-0.47114	-0.02598
					0.2479	*0.6916*	*0.3115*	*0.2111*	*0.0457*	*0.965*	*0.4834*	*0.006*
Infrastructure variables												
Elecricity generation Capasity									-78.2916	1.428545		0.173392
									0.0075	*0*		*0.0303*
Telecommunication									10.83002	-1.04542		0.028669
									0.2475	*0*		*0.7836*
Electricity+telecommunication											0.425406	
											0.0402	
R2	0.917273	0.921722	0.985018	0.976525	0.928349	0.930555	0.986219	0.976681	0.990946	0.976167	0.986535	0.977279
Adjusted R2	0.849587	0.911937	0.984204	0.97553	0.840776	0.920885	0.985391	0.975589	0.969821	0.972671	0.985647	0.976011
F-stastic	13.55195	118.0509	1430.698	981.7237	10.60087	96.23483	1190.586	894.7831	46.90821	81.0393	1111.219	770.903
Prob (F stat)	0.000094	0	0	0	0.000713	0	0	0	0.00006	0	0	0
Number of observations	330	330	330	330	330	330	330	330	330	330	330	330

P values are in Italics

Source: Author's calculation

Literature historically supports population density in facilitating infrastructure attainment. Highly populated areas had given much attention in providing rail road's and other infrastructure facilities, which is as part of public policy (Glover, 1975).Gerald and Edwin defines population density as determinant for economic growth (Carlino, (1987)).

4.9 Policy Recommendations

Infrastructure has become an essential factor for production as well as lead comfortable day to day life. Therefore the demand for the infrastructure is increasing and providing good infrastructure in return is challenging as infrastructure expenditure itself is massive and time consuming. Spending heavily on infrastructure has an opportunity cost as my sample countries are still passing through transformation stage.

Infrastructure investment should be increased in South Asia except Sri Lanka and Next 11 countries as the results prove the positive relationship between infrastructure investment and GDP growth. Since investment in infrastructure has alternative options, the countries can encourage private participation in investment by providing competitive effect to infrastructure sector.

Apart from this human capital plays a significant role in these countries. The percentage of education expenditure and health expenditure should not be reduced. Human capital is a blessing to labor force and can inject the tax earnings from labor force to maintain infrastructure through which infrastructure can turn in to reliable and resistant resource.

4.10 Conclusion

Countries are seeking new sources of growth to achieve economic growth. Most of the developing and the less developed countries try to follow the growth models followed by developed countries. Some countries improve infrastructure capital to achieve economic growth as a facilitator of investment. In that sense, improving infrastructure is seen as a strategy in achieving economic growth by most of the countries and followed the same strategy by some developing countries. Even Sri Lanka follows the path of improving infrastructure in terms of achieving economic growth regardless of observing the characteristics of the developed countries using infrastructure capital as strategy of achieving economic growth. Before, following up such an expensive growth strategy countries should evaluate the drivers of infrastructure. Since its uniqueness of being economies of scale from other investments, massiveness of the investment, network externalities and long lasting nature provides the opportunity to institution intervention. In this sense, institution plays a major role in infrastructure investment. Therefore, Institution, infrastructure and economic growth are intertwined. The study explores the role of infrastructure achieving economic growth in South Asian and Next 11 countries by using panel data from 1985-2014.The uniqueness of the study is capturing the role of infrastructure alone with the South Asian and Next 11 context. The study formulates an index to capture the quality of the institution in achieving infrastructure led growth.

My sample countries are developing countries classified by the World Bank. South Asian region has its own characteristics and only four countries were selected due to availability of data. These economies still consist remnants of the informal sectors which are still being slowly absorbed in to formal sector. These countries are rich in labor force and results implicate labor force oriented economic growth for these countries. Health expenditure, life expectancy, Urbanization, population density, Share of industry in GDP is positively significant and they provide contribution to achieve economic growth to sample of countries in my research.

Definitions

Index= Democratic Accountability + Political Accountability Index + Corruption Index

Democratic Accountability (From 1 least responsive to 6 highly responsive)- Political risk Service website and Worldwide Governance Index data

A measure of corruption within the political system that is a threat to foreign investment by distorting the economic and financial environment, reducing the efficiency of government and business by enabling people to assume positions of power through patronage rather than ability, and introducing inherent instability into the political process.

Political Accountability Index (From 100 least risk to a low of 0 highest risks)- Political risk Service website and Worldwide Governance Index data

A means of assessing the political stability of a country on a comparable basis with other countries by assessing risk points for each of the component factors of government stability, socioeconomic conditions, investment profile, internal conflict, external conflict, corruption, military in politics, religion in politics, law and order, ethnic tensions, democratic accountability, and bureaucracy quality. Risk ratings range from a high of 100 (least risk) to a low of 0 (highest risk), though lowest de facto ratings generally range in the 30s and 40s.

Corruption Index (From 1 – highly corrupted to 6 least corrupted)- Political risk Service website and Worldwide Governance Index data

A measure of, not just whether there are free and fair elections, but how responsive government is to its people. The less responsive it is, the more likely it will fall. Even democratically elected governments can delude themselves into thinking they know what is best for the people, regardless of clear indications to the contrary from the people.

Capital Formation- World Bank data

Gross capital formation (constant LCU)

Gross capital formation (formerly gross domestic investment) consists of outlays on additions to the fixed assets of the economy plus net changes in the level of inventories.

Fixed assets include land improvements (fences, ditches, drains, and so on); plant, machinery, and equipment purchases; and the construction of roads, railways, and the like, including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings. Inventories are stocks of goods held by firms to meet temporary or unexpected fluctuations in production or sales, and "work in progress." According to the 1993 SNA, net acquisitions of valuables are also considered capital formation. Data are in constant local currency.

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