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Socio-Economic Impact of Infrastructure Investments

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This paper reviews the existing scientific literature analysing theoretical and practical results of infrastructure impact on social and economic development. There is no unique concept in scientific literature for determining the notion of infrastructure, for distinguishing and measuring its components and various models which provide different results are used for measuring the impact of infrastructure. Lack of unique methodology in academic literature hinders evaluation of the infrastructure investments impact on social and economic development. The authors emphasize different insights on this relationship which provides wide methodological background but there is lack of conceptual methods which could be adjusted for certain countries and life-spans. Characteristic of each country determines the set of infrastructure components and the aspect of impact on social and economic development: economic growth, income inequality, output, regional competitiveness, labour productivity and welfare. The analysis of infrastructure development impact is based on three main factors: definition of infrastructure, determination and measurement of its components, formation of a model for evaluation of the impact. They are crucial for accurate testing of the impact of infrastructure investments. The authors of the paper present scientific approaches on these factors and provide hypothetical test of the impact of infrastructure on the development in the Baltic States: Lithuania, Latvia and Estonia. The issue of infrastructure investments is very important as infrastructure development in these countries is supported by Structural Funds of European Union and other financial mechanisms. The authors of the paper faced the problem of data availability and the results of causal relationship estimations between growth and infrastructure variables in different countries are presented for the period 1995-2007.

Statistical measurement of relationship between infrastructure and economic growth determinants in the Baltic States proved that several variables are not enough to evaluate the impact of infrastructure on development. The full-scale method is a must in order to measure this relationship. Empirical test also proved that the direction of relationship differs in Lithuania and Latvia which are attributed to the same level development and these results contradict the findings in scientific literature. For this reason it is important to acknowledge that the model of infrastructure impact evaluation must involve determinants of regional peculiarity. The authors will continue analyzing these academic issues in their further researches.

Keywords: *infrastructure investment, economic growth, infrastructure impact measurement.*

Introduction

The link between infrastructure investments and development outcomes is one of the most popular topics for debate in recent scientific literature and economic research. The impact of infrastructure on development in scientific literature is analysed from theoretical and empirical points of view and there is variety of concepts and models implemented. Despite popular issue, there is lacking researches about impact of infrastructure on the development of the Baltic States though European Union has committed financial support to infrastructure sector and there are many studies on this area in the “cohesion” countries: Spain, Greece, Ireland and Portugal.

The role of infrastructure is widely analysed as very important to both households and firms: availability and quality of infrastructure result in different decisions to invest and may influence migration, business establishment location. Infrastructure services are used as final consumption items by households and as intermediate consumption item for firms. Availability of infrastructure services significantly influences development of regions and countries. It is the reason why level and quality of infrastructure have direct effect on business productivity and growth, and different investments to infrastructure capital form inequality between regions and countries. The impact of infrastructure investments on country development is an important issue for strategic and development country policy management especially during the period of economic transition.

There is a big number of studies which are devoted to the analysis of the link between infrastructure and development. Researches and estimations are difficult to generalize because authors present different streams of economic science, they analyse different geographical levels and include variable which vary. The work of Aschauer (1989) caused lots of discussions and is criticized in the recent researches. Authors (Prud’homme, 2004, Agénor and Moreno-Dodson, 2006, Yeaple and Golub, 2007, Baldwin and Dixon, 2008, Seethepalli, Bramati, and Veredas, 2008, Straub, Vellutini and Warlters, 2008, Canning and Pedroni, 2008, de Haan, Romp and Sturm, 2007, Grubesic, 2009) are devoting their works using various economic theories, econometric models and analysing data at national or regional level.

Banyte (2008) analyzes infrastructure as the factor that determines successful diffusion and adoption of innovation in the market.

It is difficult to define a single concept of infrastructure and its components, used in scientific literature. There is lack of definition accepted generally, abundance of structure components and relationship between them. There are several researches devoted to the notion of infrastructure (Prud'homme, 2004, Fourie, 2006, Baldwin and Dixon, 2008), its variables (Agénor and Moreno-Dodson, 2006, Seethepalli et al, 2007, Seethepalli, Bramati, Veredas, 2008) and their measurement (Yeaple, Golub, 2007, Straub, Vellutini, Warlters 2008, Canning and Pedroni, 2008, Grubesic, 2009), results of which could be unambiguously used measuring the impact of infrastructure investments on the development of a country. As there is no generally agreed structure of infrastructure variables, authors define sets of components which are consistent with the data and the characteristics of the country they analyse.

Different models of infrastructure and development relationship measurement are found in scientific literature which result in various results (Pilinkiene, 2008). In spite of worldwide interest in the problem of infrastructure impact on development there is no studies carried out in this field neither in Lithuania nor in other Baltic States. Lack of methodological concepts that can be used in the analysis of these countries is becoming an obstacle for evaluation of return of European Union and national investments in infrastructure and their impact on social and economic development.

The aim of the article is to analyze theoretical and empirical aspects of relationship between infrastructure and economic development and to test this link for the Baltic States.

Methods of the research: comparative and logical analysis of the theoretical concepts, methods and conclusions, published in scientific literature, mathematical and statistical analysis, with the help of software package MS Excel.

Authors of scientific literature suggest many definitions of infrastructure sector and its components, they widely interpret the features and functions of infrastructure while the issue of measurement is based mainly on the available data for different regions. Infrastructure is defined as a complex of capital goods which are not consumed directly; they provide services only in combination with labour and other inputs. This description allows to distinguish a wide range of components and to analyse their direct impact on development issues and emphasises the need of specification of infrastructure sector in order to measure its impact. In this article infrastructure is defined as the core physical structure consisting of: transportation infrastructure, water supply and disposal infrastructure, telecommunications infrastructure and power infrastructure, consisting of sub sectors that are defined by a set of physical variables: transportation infrastructure (length of roads, rail tracks, etc.), water supply and disposal infrastructure (resident population connected to wastewater collection and treatment systems), telecommunications infrastructure (number of telephone lines), power infrastructure (power plants, transmission and distribution lines).

Definition of infrastructure

Notion of infrastructure

It is very hard to find a generally agreed definition of infrastructure even though economists in their early works already stressed that transport infrastructure is crucial for economic development. Infrastructure is usually understood as basic public infrastructure, which forms the foundation for society and economics. As it is mentioned in World Bank report (2004): infrastructure is an umbrella term for many activities, it plays a very important role for industrial and overall economy. Various descriptions of infrastructure and its features create possibilities to analyse infrastructure in different ways which result in different and hardly comparable conclusions. Clear definition of infrastructure is crucial in order to evaluate its possible impact. The authors of the article provide the analysis of scientific literature in order to build the most explicit description of infrastructure for further research.

Economists and urban planners distinguish two types of infrastructure: economic infrastructure and social infrastructure. Economic infrastructure is defined as the infrastructure that promotes economic activity, such as roads, highways, railroads, airports, sea ports, electricity, telecommunications, water supply and sanitation. Social infrastructure (such as schools, libraries, universities, clinics, hospitals, courts, museums, theatres, playgrounds, parks, fountains and statues) is defined as the infrastructure that promotes the health, education and cultural standards of the population – activities that have both direct and indirect impact on the welfare. All of these institutions entail capital goods that have some public use (Fourie, 2006). The author also argues that infrastructure consists of two elements – "capitalness" and "publicness". According to this specification, infrastructure would include goods that have a capital character, but are not necessarily public. Thus, a common feature of infrastructure seems to be that infrastructure goods are strongly used by public. Economists label such goods physical infrastructure, or infrastructure capital.

In scientific literature the role of infrastructure is understood through services which are provided using the assets of physical infrastructure. Infrastructure services, such as power, transport, telecommunications, provision of water, sanitation and safe disposal of waste, are fundamental to all activities of households and to economic production.

Baldwin and Dixon (2008) distinguish three categories of infrastructure assets:

- infrastructure assets that combine with labour to produce capital or intermediate goods;
- infrastructure capital that combines with labour to produce final goods an services;
- infrastructure capital that combines with other forms of capital and improves their productivity, f. e. roads with trucks.

Prud'homme (2004) defines that infrastructure consists of capital goods which are not consumed directly; they provide services only in combination with labour and other inputs. The author names diverse sections of infrastructure sector and services they provide. Table 1 explains the relationship between infrastructure and the associated services.

Table 1

Infrastructure and Associated Services

Service	Associated infrastructure
Transportation	Roads, bridges, tunnels, rail tracks, harbours, etc
Water supply	Dams, reservoirs, pipes, treatment plants, etc.
Water disposal	Sewers, used water treatment plants, etc.
Irrigation	Dams, canals
Garbage disposal	Dumps, incinerators, compost units
District heating	Plant, network
Telecommunication	Telephone exchanges, telephone lines, etc.
Power	Power plants, transmission & distribution lines

Source: Prud'homme (2004)

Authors of scientific researches analyse the role of infrastructure according to the main features of economic infrastructure sector. Prud'homme (2004), Baldwin and Dixon (2008) agree that infrastructure is very long lasting, space specific, infrastructure assets involve long gestation periods, infrastructure assets have few substitutes in short run periods, infrastructure services are very capital intensive and usually associated with market failures. Baldwin and Dixon (2008) according to these features classify infrastructure into three groups: machinery and equipment, buildings and engineering construction.

In order to continue the analysis in this paper, the description of infrastructure has to be made. Summarising the results of the analysis of theoretical infrastructure description, further in this paper authors take into account only the main physical infrastructure and do not analyse social environmental and institutional infrastructure (schools, hospitals, prisons, etc.). Infrastructure is understood as the core physical structure consisting of: transportation infrastructure, water supply and disposal infrastructure, telecommunications infrastructure and power infrastructure. This infrastructure will be called public infrastructure because it creates benefit to a large number of users. The issue of ownership will not be analysed in this paper.

Infrastructure components

The authors of scientific literature on infrastructure provide few arguments for choosing certain asset stock and defining the components of infrastructure. There is no agreed single set of infrastructure variables among researchers: there is a tendency in literature that authors either lump infrastructure's sub sectors together in one category or they study one type of infrastructure, e. g. transportation, and ignore any relationship among different types of infrastructure. In most scientific literature researchers use physical indicators of public infrastructure rather than monetary indicators for the reason to avoid the difficulty of infrastructure evaluation but there is no agreed methodology for the evaluation of infrastructure variables. In order to perform the analysis of possible effect of infrastructure, it is crucial to define the set of components which contain the sector of infrastructure.

Early scientific literature defines infrastructure generally as public capital and does not distinguish it in different sub-sectors: they take a broad view of infrastructure and mostly analyse a single infrastructure indicator and its impact on growth or inequality determinants. This method is implied because according to their estimations number of phone lines, telephone subscribers, power consumption or capacity, length of paved roads or railroads highly correlate with the outcomes analysed. Transport infrastructure is mainly discussed in new economic growth literature.

Authors of recent scientific literature operate a more detailed understanding of infrastructure and they estimate the effect of different infrastructure sub-sectors and try to find the dependence between several variables. According to Agénor and Moreno-Dodson (2006) infrastructure is broadly defined ant it includes transport, water supply and sanitation, information and technology (ICT) and energy. Seethepalli, Bramati, Veredas (2008), Seethepalli et al (2007) and Straub (2008) consider telecom (number of phones lines, number of mobile subscribers), electricity (electric power consumption), roads (kilometers of paved roads, percentage of paved roads), sanitation (percentage of population with access to improved sanitation facilities) and water (percentage of population with access to improved water source) as physical indicators of infrastructure.

Grubesic (2009), Straub, Vellutini, Warlters (2008), Yeaple, Golub (2007), Canning and Pedroni (2008) also analyze physical infrastructure indicators and they evaluate indicators for three different sectors – telecom, energy and transport: the main telephone lines or number of telephones, electricity generating capacity, rail route length or paved road length. The use of physical indicators (to their opinion) is more specular variable than monetary expression if investment in infrastructure.

Infrastructure in this paper is understood as a core physical structure. The issue of measurement is very important. Infrastructure is considered in terms of quantity, through the introduction of a variable for its physical stock. Further in this paper infrastructure sector consists of sub-sectors that are defined by a set of physical variables: transportation infrastructure (length of roads, rail tracks, etc.), water supply and disposal infrastructure (resident population connected to wastewater collection and treatment systems), telecommunications infrastructure (number of telephone lines) and power infrastructure (power plants, transmission and distribution lines).

Contribution of Infrastructure to Economic Growth

Socio-Economic Affect of Infrastructure

Recently many studies on infrastructure issue are published and the reason for this is intensive investments of governments to infrastructure sector. Effective infrastructure supply supports economic growth, enhances quality of life and it is important for national security (Baldwin, Dixon, 2008). Researchers analyse the effect of infrastructure on various aspects: regional competitiveness, economic growth, income inequality, output, labour productivity and welfare. There is no one agreed concept of the impact of infrastructure and for this reason the authors of the paper provide the review of literature in order to ascertain the most relevant impact of infrastructure on further analysis.

Bristow and Nellthorp (2000) define three main impacts of infrastructure, describing, that infrastructure has not only visible effect on environment but also directly impacts welfare (by time and cost savings, increasing safety, information network development) and economics (employment, economic growth). Some authors argue, that investments in infrastructure can stimulate organizational and management changes: the construction of the railway system lead to standardized schedules that provided economic benefits beyond the rails themselves (Mattoon, 2004).

Public infrastructure enables geographic concentration of economic resources and provides wider and deeper markets for output and employment (Gu, Macdonald, 2009). It affects input and output markets, helps determine spatial development patterns and provides a large network to individual users at low cost. Public infrastructure can be generally understood as the foundation upon which the economy is built (Macdonald, 2008). The author argues that if the public capital was removed from the economy, it would rapidly collapse.

Nijkamp (1986) argues that infrastructure is one of the instruments to improve development of a region. Though it can influence in a direct or an indirect way socio-economic activities and other regional potentiality as well as production factors. The author stresses that infrastructure policy is conditional policy for regional development: it does not guarantee regional competiveness but it creates necessary conditions for the achievement of regional development goals. Snieska and Draksaite (2007) argue that economy competitiveness of a country is determined by a set of different factors, and indicators of infrastructure are one of them. Snieska and Bruneckiene (2009) identify infrastructure as one of indicators of regional competitiveness within the country. They refer to physical infrastructure (consisting of infrastructure of car transport, ITT, newly built estate, outer reach of a region by land, outer reach of a region by air and water) as an indicator of factors of production conditions regional competitiveness. Martinkus and Lukasevicius (2008) argue that infrastructure services and physical infrastructure are factors which influence investment envinronment on the local level and increase its attractiveness.

Grundey (2008), Burinskiene and Rudzkiene (2009) analyse implementation process of sustainable development policy and they distinguish development of infrastructure as one of the most important dimensions in strategic planning in order to assure sustainable territorial and socio-economic development of a country.

Aschauer (1998) argues that public infrastructure underpins the quality of life: better roads reduce accidents and improve public safety, water systems reduce the level of diseases, waste management improves health and aesthetics of environment. Agénor and Moreno-Dodson (2006) study the link between infrastructure availability and health as well as education of society that proves that infrastructure services are crucial for health and education quality and availability which to a big extent effects welfare. According to the world statistical analysis, households use approximately one third and one half of infrastructure services as final consumption. The other half of infrastructure services corresponds to intermediate consumption, mostly by companies (Foster, Yepes (2005)). Other important thing is that basic services such as water and electricity often occupy a significant fraction of poor households' budgets.

Damaskopoulos, Gatautis, Vitkauskaite (2008) infrastructure attribute to the sources of productivity. The findings of Demetriades and Mamuneas (2000) suggest that public infrastructure capital has significant positive effects on profit, the demand for private inputs and the supply of output in all runs in 12 OECD countries is considered. The results of estimations made by Mentolio, Solé-Ollé (2009) supported the idea that productive public investment in road has positively affected relative provincial productivity performance in Spain.

Macdonald (2008) analysed the impact of public infrastructure on private production level that has been overlooked in other researches and found out that a private infrastructure provided a vital input for private sector production. Companies view public capital as an unpaid factor of production when maximizing profit.

It is very common in recent scientific literature to analyse the relationship between infrastructure and economic growth (Aschauer, Calderón, Servén, Seethepalli, Bramati, Veredas, Agénor and Moreno-Dodson, Rioja, Li and Li, Grubesic, Macdonald, Bougheas, Demetriades, Mamuneas, Fourie, Canning and Petroni, Del Bo and Florio, and others). Authors point out that delivery of services like water, sanitation, transportation and energy directly benefit households and can dramatically improve their welfare and contribute to their productivity. Many of the benefits of infrastructure services accrue to firms: infrastructure through services lowers production costs (transportation and communication services), expands market opportunities (especially transport and telecommunications sub-sectors) that positively affect competitiveness and production and lead to economic growth. Similarly, the goals related to human development (education and health) rely on services that require supportive infrastructure – water and sanitation to prevent disease, electricity to serve schools and health clinics, and roads to access them. It should be said that the relationship of infrastructure to economic development is very heterogeneous and investments to infrastructure stimulate growth and at the same time higher growth often leads to higher demand for infrastructure.

The analysis of scientific literature allowed drawing the guidelines for empirical study: this article focuses on the effect of infrastructure to economic growth, the type and strength of this relationship.

Infrastructure and economic growth

The analysis of recent empirical literature has confirmed the significant contribution of infrastructure to economic development but depending on the techniques used the results of estimations are not consistent. Theoretical researchers do not agree about infrastructure's effect on the growth of the country: they use various methods and models for evaluation. The analysis of scientific literature allows summarizing that there is variation in empirical results testing the relationship between infrastructure and economic growth. Not all studies find growth-enhancing effect of infrastructure, in some sources there is evidence of reverse causation found. The authors of the paper analyse the scientific literature in order to form the theoretical background for practical estimates.

The theoretical analysis of the effect of infrastructure on growth and on development outcomes is mostly found in growth theory and the new economic geography literature. Authors (Agénor and Moreno-Dodson, 2006, Fourie, 2006) argue that infrastructure impacts on economic growth primarily in several ways:

- Infrastructure lowers the cost of input factors in production process. This effect is called the direct productivity effect.
- Infrastructure improves the productivity of workers, and this effect is known as the indirect effect.
- Impact of infrastructure on growth is obtained through the initial building and construction period: working places are created in construction and related industries. As infrastructure investments require maintenance, it further boosts the long-term creation of jobs.
- Infrastructure also has positive effect on education and health outcomes: good health and high education of labour force induce economic growth.

Straub (2008) distinguishes additional channel through which infrastructure investments may cause growth effect: economies of scale and scope. The author argues that better transport infrastructure lowers the costs of transportation and leads to economies of scale and better management.

The authors of recent literature estimate the effect of different infrastructure sectors on growth and their estimated results differ. For example, Aschauer (2000) finds that the stock of public infrastructure capital is a significant determinant of aggregate total factor of productivity and that investments in public sector not only improve quality of life but also increase economic growth and returns for private investments; Calderón, Servén (2004) estimated that indicators of telecommunication and energy infrastructure have positive and significant effect on growth, results of Seethepalli, Bramati, Veredas (2008) and others also prove that that infrastructure is important for promoting growth. Macdonald (2008) analyses the relationship between public capital and real gross domestic product (GDP) that he finds complex because public infrastructure is enabling resource. The estimations resulted in proving close relationship between public capital and GDP. Li and Li (2008) argue that infrastructure investment is very important to boost national economic growth and prove this with the results of infrastructure investment and the GDP in China from 1997 to 2006.

According to Mentolio and Solé-Ollé (2009) public investments in transport infrastructure (particular – roads) positively affect productivity of a region. Zou, Zhang, Zhuang and Song (2008) analysed data from China and found that higher economic growth level comes to a greater extent from better transport infrastructure and that public investment on road construction in poor areas is crucial to growth and poverty alleviation.

Calculations of Mamatzakis (2008) provide evidence that justifies recent scientific trends in infrastructure investment, as it is a crucial component of economic performance in Greece. The estimations show that public infrastructure is a cost saving input in most manufacturing industries, as it enhances their productivity growth.

Authors' estimations results of differ for many reasons: authors use different variables and define their quantity in different ways because of lack of statistical data; econometric problems arise while using different models for measuring the impact of infrastructure; performing regional estimates important characteristics are overlooked and the results do not show the real impact of investments in infrastructure. Because the researches on infrastructure are performed in different aspects and they contain different variables, the results obtained are also not unambiguous. The authors of this paper in further section will provide practical evidence of infrastructure affect in the Baltic States and will compare the empirical results with the results of authors mentioned above in further section.

Infrastructure and development: the case of the Baltic States

The analysis of scientific literature allowed to summarise the results and it stimulated to analyse the case of Lithuania, Latvia and Estonia in order to compare the results estimated for other countries.

Further in this article trends of development will be analysed: the relationship between infrastructure sub-sectors and economic growth in particular. According to the classification of World Bank Lithuania and Latvia are attributed as upper-middle-income economies and Estonia is referred to as a high-income country.

Building the data set for further research authors faced the problem of lack of statistical database for public capital stock in the Baltic States and the analysis was limited to three subsectors of infrastructure: transport, communications and sanitation. Due to the practice of researches analysed above, the analysis is based on physical indicators as explanatory variables from Eurostat and World Development Index database:

- paved road length in kilometres per 1000 people;
- fixed line and mobile phone subscribers per 1000 people;
- resident population connected to wastewater collection and treatment.

GDP per capita in Purchasing Power Parity terms is a dependent variable. In pursuance of the comparison of data expressed by different units of measure, variables were normalized. Natural logarithms were taken for all infrastructure variables. Data was analysed over the period 1995-2007. Figure 1-3 show the scatter diagrams between per capita growth and infrastructure sub-sectors from the estimation of linear trend in Lithuania, Latvia and Estonia.

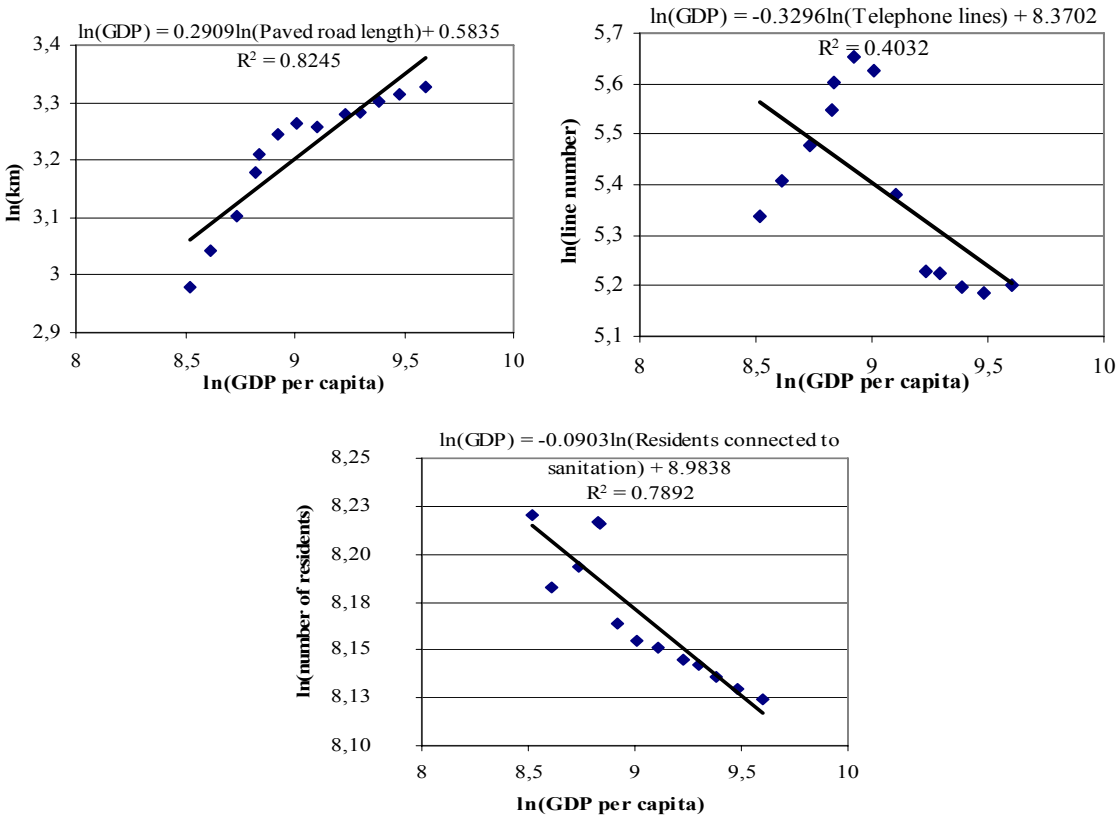

Figure 1. Scatter diagrams: the impact of infrastructure sub-sectors on growth in Lithuania

The univariate linear regression plotted above shows the possible links between growth and infrastructure variables and suggests that in the case of Lithuania the impact only of transportation sub-sector (paved road length variable in particular) on GDP per capita is positive. The relationship between telecom and sanitation subsectors (due to the variables analysed) and GDP per capita is negative.

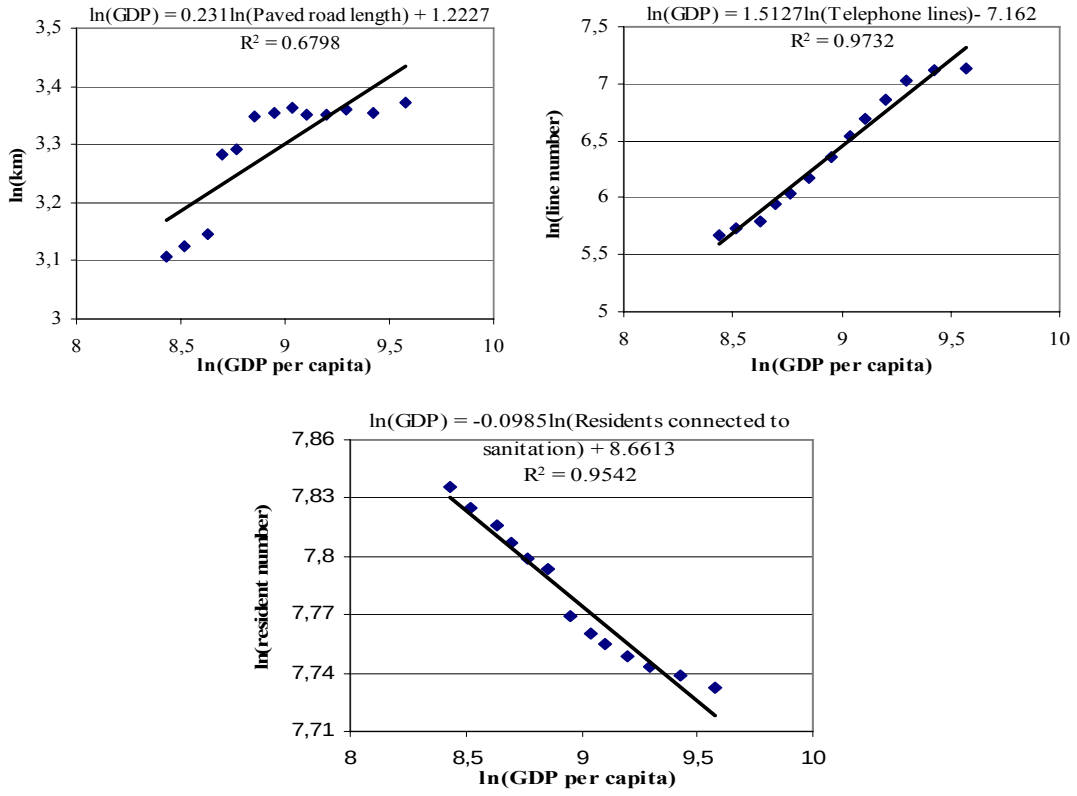

Figure 2. Scatter diagrams: the impact of infrastructure sub-sectors on growth in Latvia

In the cases of Latvia (Figure 2) and Estonia (Figure 3) the situation is different: transportation and telecommunication sectors correlate with growth strongly and in positive direction, and the variable of sanitation sectors has negative trend line in both countries.

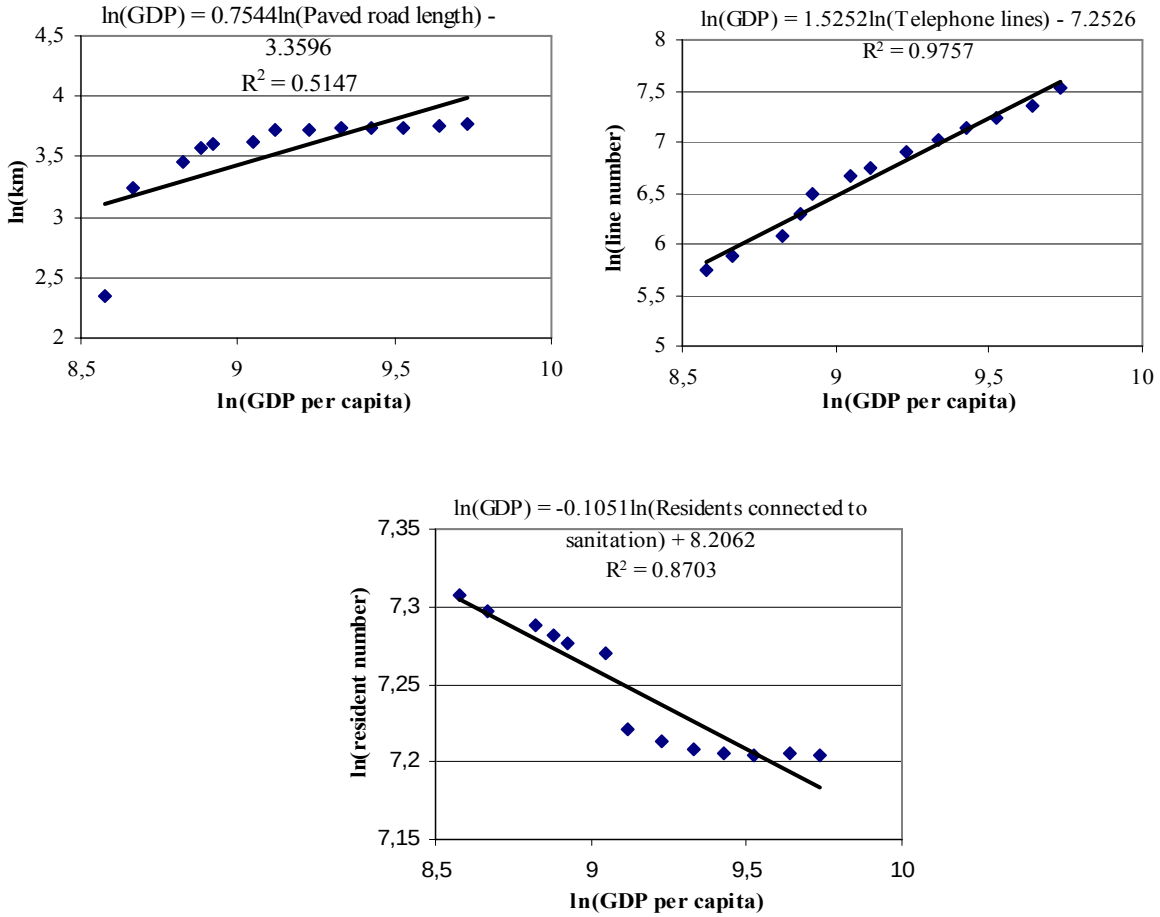

Figure 3. Scatter diagrams: the impact of infrastructure sub-sectors on growth in Estonia

Table 2 provides correlation matrixes between dependant and explanatory variables used in the analysis. Correlation is estimated between various subsectors and the results show the relationship between them. The first column in all the tables suggests that there is high correlation between growth and infrastructure variables. The issue of statistical significance is also important for the estimates of Lithuania and Estonia. Even though Lithuania and Latvia are attributed as upper-middle-income economies, the relationship of growth and infrastructure variables differs.

Results of correlation matrixes show that there is a strong likelihood of multicollinearity which indicates that the relationship estimated may be not as significant as the estimates of regression show. There is perfect multicollinearity if the correlation between two independent variables is equal to 1 or -1, but it is rare in practice. Results in Table 2 show that correlation between several variables is close to these values. It is important to consider independent variables individually but not in the model at the same time in order to avoid the problem of significance.

Table 2

Correlations between dependent and explanatory variables (p-values in parenthesis)

Lithuania

	GDP, per capita	*Roads*	*Telecoms*	*Sanitation*
GDP, per capita	1			
Roads	0.91 (0.00001)	1		
Telecoms	-0.55 (0.01970)	-0.29 (0.33147)	1	
Sanitation	-0.84 (0.00005)	-0.79 (0.00123)	0.60 (0.03013)	1

Latvia

	GDP, per capita	*Roads*	*Telecoms*	*Sanitation*
GDP, per capita	1			
Roads	0.82 (0.00052)	1		
Telecoms	0.99 (0.00000)	0.82 (0.00062)	1	
Sanitation	-0.98 (0.00000)	-0.88 (0.00008)	-0.98 (0.00000)	1

Estonia

	GDP, per capita	*Roads*	*Telecoms*	*Sanitation*
GDP, per capita	1			
Roads	0.72 (0.00577)	1		
Telecoms	0.99 (0.00000)	0.77 (0.00215)	1	
Sanitation	-0.93 (0.00000)	-0.72 (0.00551)	-0.94 (0.00000)	1

The pattern of correlation in Lithuania differs, only the length of roads positively correlates with GDP per capita, variables of telecom and sanitation have inverse correlation with GDP. The variable of telecom has low inverse relationship with road length and sanitation variable is highly negatively correlated with paved road length but has high positive correlation with telecom variable. The estimations of relationship between GDP per capita and telecoms, road length and telecoms and sanitation and telecoms is statistically not significant and needs more analysis.

The analysis of correlation between growth and infrastructure in Latvia and Estonia gave similar results. The length of roads and telecoms positively correlate with economic growth and sanitation has inverse correlation with GDP. The estimations of Latvia are statistically significant and in the case of Estonia the relationship between road length and economic growth and road length and sanitation face statistical significance issues. Empirical test proved that relationship between infrastructure and economic growth variables in Lithuania and Latvia differ even though these countries are attributed to the same country group.

The analysis and estimations provided above are not sufficient in order to conclude about the impact on infrastructure and development of a country. Different results for the same income level countries show contradiction with the results in scientific literature and it is obvious that further deeper analysis and estimations need to be performed in order to distinguish the affect of infrastructure development on economic growth.

Conclusions

1. The lack of a unique methodology in academic literature hinders evaluation of the infrastructure investments' impact on social and economic development.
2. Definition of infrastructure and its structure, methods of variable measurement and the model of relationship evaluation are the main factors for accurate testing of the impact of infrastructure investments.
3. Empirical test proved that the model of infrastructure impact evaluation must involve determinants of regional peculiarity.
4. Statistical measurement of relationship between infrastructure and economic growth determinants in the Baltic States proved that several variables are not enough to evaluate the impact of infrastructure on development. Full-scale method is a must in order to measure this relationship. The authors of the paper will continue the analysis of the problem by creating a model for the evaluation of infrastructure impact on the country development trends.

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Investicijų į infrastruktūrą socialinis ir ekonominis poveikis

Santrauka

Didėjančios vyriausybės ir finansinių institucijų investicijos į infrastruktūros plėtrą paskatino mokslininkus ir politikus susidomėti, kokia yra šių investicijų įtaka šalių vystymuisi. Tai yra itin svarbus strateginis klausimas, ypač formuojant besivystančių šalių plėtros koncepcijas, paskatinęs atlikti daug mokslinių ir ekonominių tyrimų. Infrastruktūra yra vienareikšmiškai pripažįstama gyvybiškai svarbia ekonomikos ir visuomenės gyvybingumo prielaida, be kurios būtų neįmanoma valstybei egzistuoti. Infrastruktūros prieinamumas ir jos teikiamų paslaugų kokybė yra svarbi tiek namų ūkiams, tiek verslo atstovams, kadangi būtent šie veiksniai daro poveikį sprendimams pasirinkti investicijų vietą ir taip nulemti verslo kūrimo bei migracijos tendencijas. Infrastruktūros paslaugos yra galutinis vartojimo produktas gyventojams ir tarpinis vartojimo produktas verslo įmonėms ir taip daro tiesioginį poveikį verslo produktyvumui ir augimui. Šio sektoriaus plėtra daro didelį poveikį regionų ir šalių netolygiam vystymuisi, jų konkurencingumo ir investicinio patrauklumo skirtumams.

Tačiau vienareikšmiškai teigti, kad infrastruktūros plėtra skatina ekonominį ir socialinį šalies vystymąsi, būtų sudėtinga, kadangi mokslinėje literatūroje yra pateikiami įvairūs infrastruktūros ir jos sektorių apibrėžimai ir skirtingai vertinamas jos poveikis socialinei ir ekonominei veiklai.

Investicijų į infrastruktūrą poveikio problema yra itin analizuojama pasauliniu ir Europos lygiu, tačiau Baltijos šalyse ji yra mažai nagrinėta. Europos Sąjungos ir kitų finansinių mechanizmų finansinė parama infrastruktūros plėtrai atitinka vieną svarbiausių šalių vystymosi prioritetų, kadangi tolygi infrastruktūros plėtra užtikrina sąlygas plėtoti šalies verslą, socialinę gerovę ir gyvenimo kokybę. Tačiau, priešingai nei kitose Europos Sąjungos šalyse (Ispanijoje, Graikijoje, Airijoje ar Portugalijoje), Lietuvoje, Latvijoje ir Estijoje ryšys tarp investicijų į infrastruktūrą ir šalies vystymosi mokslinėje literatūroje nėra plačiai analizuojamas.

Mokslinėje literatūroje „infrastruktūrai“ ir jos funkcijoms apibrėžti yra vartojama daugybė apibūdinimų. Nors ši problema yra plačiai paplitusi, tačiau pasigendama vieningos metodologijos, kuri leistų vieningai ir tiksliai įvertinti infrastruktūros plėtros poveikį socialiniam ir ekonominiam šalių vystymuisi.

Mokslinio darbo tikslas – išanalizuoti teorinius ir empirinius ryšio tarp infrastruktūros ir ekonominio vystymosi aspektus ir patikrinti teorines hipotezes įvertinant Baltijos šalių situaciją.

Tyrimo metodai – lyginamoji ir loginė mokslinėje literatūros pateiktų koncepcijų, metodų, rezultatų ir išvadų analizė, matematinė ir statistinė analizė pasinaudojant programiniu MS Excel paketu.

Mokslinėje literatūroje pateikiami įvairūs infrastruktūros apibrėžimai, remiantis atskirų šalių ir regionų specifika, vertinama šio sektoriaus struktūra ir taikoma daug matematinių modelių nustatyti ryšį tarp infrastruktūros ir vystymosi tendencijų. Kadangi nėra sukurtos vieningos infrastruktūros poveikio vertinimo metodologijos, labai sudėtinga apibendrinti mokslinius rezultatus. Straipsnio autoriai, atlikę mokslinės literatūros analizę nustatė, kad, siekiant tiksliai įvertinti infrastruktūros veiksnių poveikį šalies vystymuisi bei išvengti įvairių interpretacijų, būtina išsamiai apibrėžti infrastruktūrą ir ją sudarančius sektorius, parinkti tinkamiausią infrastruktūros komponentų ir ryšio tarp jų vertinimo metodą.

Infrastruktūros ir jos struktūros apibrėžimą mokslininkai dažniausiai pateikia atsižvelgdami į turimus statistinius duomenis ir analizuojamos šalies specifiką. Tyrimai parodė, kad dažniausiai išskiriami ir analizuojami du infrastruktūros tipai: ekonominė ir socialinė infrastruktūra. Analizuojant infrastruktūros poveikį ekonominiam vystymuisi, vertinama ekonominė infrastruktūra. Taip pat vertinami du infrastruktūros elementai: turtas ir viešoji nauda. Remiantis šia klasifikacija, mokslininkai dažniausiai infrastruktūrą vertina kaip fizinį turtą, kuris yra plačiai naudojamas visuomenės. Infrastruktūros poveikis suprantamas per paslaugas, kurios yra teikiamos naudojantis fizine infrastruktūra. Tai įrodo, kad infrastruktūra yra tiesiogiai susijusi su kapitalo ir darbo ištekliais ir negali būti nuo jų atskirta. Šio straipsnio autoriai, analizuodami infrastruktūros poveikį šalies vystymuisi, infrastruktūrą apibrėžia kaip fizinę infrastruktūrą, kurią sudaro transporto, vandentiekio ir kanalizacijos, telekomunikacijų bei energijos sektorių infrastruktūra. Straipsnyje analizuojami šie infrastruktūros sektoriai: transportas, energetika, telekomunikacijos, vandentiekis ir kanalizacija. Mokslinės literatūros analizė parodė, kad tikslingiausia vertinti fizines infrastruktūros komponentų vertes (kelių ir geležinkelio ilgį, telefono linijų ar abonentų skaičių, vartotojų, prisijungusių prie kanalizacijos, skaičių, elektros energijos pagaminimo ir suvartojimo kiekį ir kt.), kadangi finansinė investicijų į infrastruktūrą išraiška dažniausiai neatspindi realios situacijos.

Mokslininkai, vertindami infrastruktūros įtaką, analizuoja įvairius kintamuosius: tyrimuose vertinama, koks infrastruktūros poveikis produktyvumui, pajamų netolygumui, ekonominiam augimui, gyvenimo kokybei, šalies ir regiono konkurencingumui, aplinkai ir kt. Šiame straipsnyje autoriai pateikia infrastruktūros ir ekonominio augimo ryšio analizę. Mokslinėje literatūroje nėra vienareikšmiško įrodymo, kad investicijos į infrastruktūrą skatina ekonominę plėtrą: mokslininkų skaičiavimų rezultatai yra skirtingi, kadangi naudojami skirtingi veiksniai, jų kiekiai vertinami nevienodomis metodikomis, susiduriama su statistinės informacijos trūkumu ir ekonometrinių skaičiavimų įvairove. Dažniausiai, lyginant atskirų šalių skaičiavimo rezultatus, autoriai nepateikia šalies specifiką nurodančių veiksnių įvertinimo ir dėl to rezultatai ne tokie patikimi. Rezultatų įvairovė paskatino patikrinti teorinės analizės metu iškeltą hipotezę apie teigiamą investicijų į infrastruktūrą poveikį Lietuvos, Latvijos ir Estijos ekonominiam augimui. Kadangi autoriai susidūrė su statistinės informacijos trūkumu, buvo įvertinti trys infrastruktūros sektoriai (transportas, telekomunikacijos ir vandentiekis) ir jų poveikis bendrajam vidaus produktui (toliau – BVP) nuo 1995 iki 2007 m. laikotarpiu. Ryšio nustatymui pavaizduoti buvo panaudota tiesinė regresija, o tarpusavio ryšio stiprumui įvertinti – koreliacija.

Gauti statistiniai rezultatai parodė, kad infrastruktūros veiksnių ir BVP ryšys Lietuvoje, Latvijoje ir Estijoje skiriasi. Nors Lietuva ir Latvija priskiriamos tai pačiai ekonominio išsivystymo šalių grupei, tačiau infrastruktūros veiksnių ir BVP ryšio kryptys nebuvo vienodos, nustatyta skirtinga koreliacija tarp pačių infrastruktūros veiksnių. Tai prieštarauja daugeliui mokslinės literatūros autorių teiginių, kad besivystančių šalių ekonominiam augimui infrastruktūros sektorių plėtra turi vienareikšmiškai teigiamą poveikį. Nors Estija priskiriama prie aukštesnes pajamas uždirbančių šalių grupės, tačiau ryšio tarp infrastruktūros veiksnių ir BVP kryptis ir stiprumas atitiko skaičiavimus Latvijoje. Šie rezultatai parodė, kad keletos veiksnių nepakanka siekiant tiksliai įvertinti tarpusavio ryšio stiprumą. Tam reikalingas sudėtingas ir daugiau kintamųjų apimantis matematinis metodas. Taip pat pasirenkant ir vertinant infrastruktūros komponentus svarbu įvertinti analizuojamų šalių regioninį išskirtinumą, kadangi vienareikšmiškas veiksnių palyginimas nėra tikslingas ir informatyvus. Autoriai toliau tęs iškeltos mokslinės problemos analizę: sukurs išsamų ryšio tarp infrastruktūros veiksnių ir ekonominio augimo vertinimo modelį, kurį empiriškai pagrįs Lietuvos, Latvijos ir Estijos pavyzdžiais. Sukurtas ryšio tarp investicijų į infrastruktūrą ir ekonominės plėtros vertinimo modelis leis nustatyti šalies vystymuisi įtaką darančius infrastruktūros veiksnius ir įvertinti tarpusavio ryšio stiprumą bei pobūdį. Modelio empirinio pagrindimo rezultatai leis apskaičiuoti investicijų į infrastruktūrą naudą šalies mastu. Tai bus pagrindas galimiems strateginiams sprendimams priimti.

Raktažodžiai: *investicijos į infrastruktūrą, ekonominis augimas, infrastruktūros poveikio vertinimas, socialini ir ekonominis vystimasis.*

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