The macroeconomic effects of transport infrastructure on economic growth: the case of Central and Eastern E.U. member states

Vlahinić Lenz, Nela; Pavlić Skender, Helga; Zaninović, Petra Adelajda

Economic Research-Ekonomska Istraživanja

ISSN: 1331-677X (Print) 1848-9664 (Online) Journal homepage: www.tandfonline.com/journals/rero20

The macroeconomic effects of transport infrastructure on economic growth: the case of Central and Eastern E.U. member states

Nela Vlahinić Lenz, Helga Pavlić Skender & Petra Adelajda Mirković

To cite this article: Nela Vlahinić Lenz, Helga Pavlić Skender & Petra Adelajda Mirković (2018) The macroeconomic effects of transport infrastructure on economic growth: the case of Central and Eastern E.U. member states, Economic Research-Ekonomska Istraživanja, 31:1, 1953-1964, DOI: 10.1080/1331677X.2018.1523740

To link to this article: https://doi.org/10.1080/1331677X.2018.1523740

Published online: 13 Feb 2019.

ECONOMIC RESEARCH-EKONOMSKA ISTRAŽIVANJA
2018, VOL. 31, NO. 1, 1953–1964
https://doi.org/10.1080/1331677X.2018.1523740

Routledge
Taylor & Francis Group

OPEN ACCESS Check for updates

The macroeconomic effects of transport infrastructure on economic growth: the case of Central and Eastern E.U. member states

Nela Vlahinić Lenz, Helga Pavlić Skender and Petra Adelajda Mirković

Faculty of Economics and Business, Ivana Filipovića 4, University of Rijeka, Rijeka, Croatia

ABSTRACT
This paper empirically investigates the effects of transport infrastructure on economic growth in Central and Eastern European Member States (C.E.M.S.) in the period 1995–2016. During the transition period in C.E.M.S., most investments were focused on the roads, while railways have been lagging for decades. The aim of this paper is to estimate the effects of transport infrastructure (road and rail) on economic growth while controlling with other variables such as population growth, gross fixed capital formation and trade openness. We use panel data analysis with three standard estimators: pooled ordinary least squares, fixed effects and random effects. The results show positive effects in case of all estimated variables, except the railway infrastructure where the effects seem to be negative. The results illustrate the long-standing problem of inefficient and outdated railway infrastructure. These results should be seen in a broader context, especially in the light of the ongoing desire to reduce CO_2 emissions that are to a large extent produced by road transport, while railway transport is more environmentally friendly. This paper supports the European Union's guidelines for the need to invest in railway infrastructure to ensure effective transport in the long term, create competitive advantages, reduce greenhouse gas emissions and thus simulate sustainable economic growth in C.E.M.S.

ARTICLE HISTORY
Received 8 March 2018
Accepted 10 September 2018

KEYWORDS
Transport; transport infrastructure; economic growth; P.O.L.S.; fixed effects; random effects; C.E.M.S. countries

JEL CLASSIFICATION
E60; R42; R48

1. Introduction

Transport and related infrastructure have played a pivotal role in economic growth and development during the last century, and many theoretical and empirical studies have recognised it as an important factor in maintaining and promoting economic growth. Transport infrastructure may be the prerequisite for economic development, while transport and the supporting infrastructure network can be an engine in promoting economic growth. However, the transport infrastructure alone is not sufficient for economic growth. Transport capacities are especially important in the case of

CONTACT Petra Adelajda Mirković petra.adelajda.mirkovic@efri.hr

small open economies such as Croatia and most Central and Eastern European Member States (C.E.M.S.), where an efficient transport system allows for an increase in international trade and thus stimulates economic growth. The share of transportation in the gross domestic product of developed countries accounts for approximately 6–12%. It is considered that today, in the era of globalisation, the competitive advantage of each economy depends, inter alia, on facilitating more efficient transport of people and goods, while the key obstacle can be the lack of efficient and high-quality transport infrastructure.

During the transition period, in particular since the beginning of the 1990s, insufficient investments have been made on railways and railway infrastructure in the C.E.M.S., leading to the obsolescence of the transport sector and prioritisation of road transport over the railway. In the last few decades the transport sector has grown dramatically in the European Union (E.U.), with the main increase seen in road transport (European Commission, 2012 in Bonča et al., 2017). E.U. investments in transport infrastructure are one of key, if not the key, mechanisms that can increase economic development and convergence (Crescenzi & Rodríguez-Pose, 2012). The main problems of the rail system of most C.E.M.S. countries include the poor state of infrastructure and fleet, problems that reflect the cargo and passenger transport activities, the lack of efficient rail links with maritime and river ports, and insufficient integration of the national network into the European transport network, which prevents the implementation of system interoperability. Even though pre-accession E.U. funding investments have enhanced connectivity and accessibility in these countries considerably, transportation by rail lags far behind (European Parliament, 2016).

Considering that transport and related infrastructure are of national and strategic interest for each country, we revisit the question by looking at the impact of transport infrastructure, proxied by kilometres of motorways and kilometres of railways, across 11 C.E.M.S. during the period 1995 to 2016. Furthermore, to our knowledge, none of the papers were devoted to C.E.M.S. countries. This is relevant especially because a significant amount of investment was oriented to infrastructure investment for the programming period 2007–2013. The main novelty of our approach lies in contrasting transport infrastructure effects with other factors, such as population growth, gross fixed capital formation and trade openness, which may also play an important role in stimulating economic growth. Furthermore, this work seeks to empirically explore the current state of affairs and to create a framework for further research development. To achieve this aim, we use panel data analysis including three different estimators: pooled ordinary least squares (P.O.L.S.), fixed effects (F.E.) and random effects (R.E.).

The remainder of the paper is structured as follows. The second section continues with the theoretical background and literature review. Data description is given in third section, while the methodology is explained in the fourth section. Section five discusses the results and policy implications, and the sixth section presents concluding remarks.

2. Theoretical background

Transport infrastructure is widely thought to promote growth, thus the impact of transport infrastructure on economic growth was recognised a long time ago in many of the studies mentioned below. Obviously, the link between transport and economic growth has intrigued researchers for decades. According to Rostow (1960), the introduction of railways was a factor in growth and development in the United States, France, Germany, Canada and Russia. In the 1970s, Arrow and Kurz (1970) included the theoretical analysis of the effects of transport infrastructure in growth theories. Krugman (1991) argues that transport accessibility affects global development paths and can boost economic growth, but also create a barrier to it.

Many researchers have analysed the impact of infrastructure on regional competitiveness, economic growth, income inequality, labour productivity, environmental impact and well-being (Baldwin & Dixon, 2008). Mamatzakis (2008) argues that infrastructure is one of the most important components of economic activity in Greece. His predictions show that public infrastructure reduces costs in most manufacturing industries, boosting resource productivity growth. Aschauer's research (1989) suggests that reducing public investment in transport infrastructure causes a significant decrease in productivity growth. He argues that the reduction in U.S. public utility productivity may be crucial in explaining the overall decline in productivity growth rates in the country. Efficient infrastructure supports economic growth, improves quality of life and is important for national security (Baldwin & Dixon, 2008).

Authors argue that infrastructure investments can stimulate organisational and management change; for example, construction of the rail system will lead to standardisation of the schedule, which, besides the rail service alone, leads to revenue growth (Mattoon, 2004). Tsekeris and Tsekeris (2011) discuss that transport investment, especially investment in highway, rail, airport and sea port infrastructure, requires long-term financial commitments. Public infrastructure provides geographic concentration of economic resources and a deeper and wider market for growth of output and employment (Gu & Macdonald, 2009). Transport infrastructure can affect economic growth by changing aggregate demand; for example, building transport infrastructure can create and increase demand for intermediate products from other sectors and stimulate multiplier effects in the economy (Pradhan & Bagchi, 2013). Public infrastructure is generally seen as the foundation on which the economy is built (Macdonald, 2008). Aschauer (1989) argues that public infrastructure is the foundation of quality of life: good roads reduce accidents and increase public safety, the water supply system reduces disease levels, and waste management improves health and the aesthetics of the environment. Agénor and Moreno-Dodson (2006) investigated the link between the presence of infrastructure, health and education in the community, and their results show that infrastructure services are essential to ensuring the quality and accessibility of health and education, which largely enables wealth performance.

Demetriades and Mamuneas (2000) argue that infrastructure has a significant positive impact on income, demand for private production and product delivery in 12 O.E.C.D. countries. Montolio and Solé-Ollé (2009) confirmed that public investments in road infrastructure have positively impacted the relative increase in labour productivity in the Spanish regions. Snieska and Bruneckiene (2009) identify infrastructure as one of the regional competitiveness indicators of a country. This refers to physical infrastructure (road infrastructure, telecommunications, new-built real estate, land access, land and air) as indicator of production factors and competitive conditions in the region.

Martinkus and Lukasevicius (2008) argue that infrastructure services and physical infrastructure are factors that can influence the investment climate at the local level and raise the level of attractiveness of the region. Nijkamp (1986) argues that infrastructure is one of the tools of regional development. It can directly or indirectly affect socio-economic activities and other regional capacities, as well as production factors. The author emphasises that infrastructure policy is a prerequisite for regional development policy: it does not guarantee regional competitiveness, but creates the necessary conditions for achieving the goals of regional development. More recently, Badalyan et al. (2014) investigated the relationship and the direction of causality between transport infrastructure, infrastructure investment and economic growth, using a vector error correction model in the case of Armenia, Turkey and Georgia. Their results show that gross capital formation and road/rail goods transported have a positive and statistically significant impact on economic growth in the short run, and show the existence of bidirectional causality between economic growth and infrastructure investment, and between road and rail passengers carried and infrastructure investment in both the short and long run. Ismail and Mahyideen (2015) empirically explore the effects of transport infrastructure on international exchange and economic growth in Asia, and the results have shown positive effects on the rise in international exchange as well as on economic growth. Furthermore, Purwanto et al. (2017) analyse the relationship between transport infrastructure investment and its wider economic impacts, namely competitiveness and economic growth, and recommend methodology improvements. Mohmand et al. (2016) use the unit root, cointegration, and Granger Causality model to estimate the causal linkages between economic growth and transportation infrastructure existing at national and provincial level. Their results suggest that there is no causality between the two variables in the short run, at the national level; however, a unidirectional causality from economic development to infrastructure investment exists in the long run.

In the case of Croatia, an EIZ (2014) study shows that there is a causal link between transport infrastructure, transport services and the level of international exchange. Infrastructure should be viewed as the building blocks of each economy, which provide support to produce goods and services and is not part of the production process.

Since macroeconomic growth theories explicitly do not include the concept of infrastructure systems, although infrastructure plays a very important role in economic development, Carlsson et al. (2013) have explored the role of infrastructure in macroeconomic growth theories and confirmed that certain economic functions of infrastructure may be represented in existing macroeconomic models, so new economic geography (growth) enables the presentation of transport infrastructure due to a more spatial approach.

However, some studies (for example Devarajan et al., 1996; Canning & Pedroni, 2008; Nketiah-Amponsah, 2009; Yu et al., 2012; Crescenzi & Rodríguez-Pose, 2012) argue that transport infrastructure alone is not sufficient for reaching higher gross domestic product (G.D.P.) and that infrastructure endowment is a relatively poor predictor of economic growth. It seems that the vast body of evidence is far from being conclusive, and that the role of transport infrastructure depends on different circumstances. Therefore, it is important to be aware of other drivers of economic growth because they have important implications on the transport infrastructure's impact on economic growth.

3. Data and descriptive statistics

In this research, panel data analysis has been used for 11 Central and Eastern European EU Member States (C.E.M.S.) in the period 1995–2016. The C.E.M.S. countries analysed in the paper are, from north to south: Estonia, Latvia, Lithuania, Poland, the Czech Republic, Slovakia, Hungary, Slovenia, Croatia, Romania and Bulgaria. The original sample included Malta and Cyprus; however, those countries were excluded from the estimation since they have no railway network established. We selected C.E.M.S. countries for our analysis for the following reasons: first, all of them experienced the transition towards market economies; second, they have been receiving significant E.U. funding to be invested in transport infrastructure since they are new E.U. Member States; and third, there is a gap in the literature investigating these countries.

The economic model employed in this paper includes six variables: Economic Growth (EG), Population Growth (POP), Infrastructure Investment (GFCF), Trade Openness (OPEN), Railway Transport Infrastructure (RAIL) and Road Transport Infrastructure (ROAD), and has the following format:

$$EG = f\ (POP,\ GFCF,\ OPEN,\ RAIL,\ ROAD) \qquad (1)$$

In our analysis we use G.D.P. as a proxy variable for economic growth. As a standard set of control variables which have an impact on economic growth (Barro & Lee, 2013, Ismail & Mahyideen, 2015, Keho, 2017), we use the following three variables: variable population growth, then variable gross fixed capital formation as a proxy for infrastructure investment, and a third variable, trade openness. For transport infrastructure we follow Pradhan and Bagchi (2013); as a proxy variable for railway infrastructure we use length of total railways, while as a proxy variable for road transport infrastructure we use length of total road network, where both variables are expressed in kilometres. All data are obtained from the Eurostat Database (2017).

Table 1 contains descriptive statistics of all used variables in the model.

Descriptive statistics consist of seven columns where the most important is the fourth column, which shows the standard deviation (σ) of each variable between and within the observed countries. According to the data presented in Table 1, it can be seen that the standard deviation, for example the variation between observed countries is higher than the variation within countries, which is reasonable because our sample is heterogeneous. It is quite interesting that in the case of the variable *rail*, the variation between observed countries is more than 10 times higher than within countries, whereas in the case of the variable *road* the variation between and within countries is much smaller, indicating that the road infrastructure within the observed

Table 1. Descriptive statistics.

Variable	Units	Category	Mean	St. Dev.	Minimum	Maximum
gdp	mil. EUR	overall	58825.47	78879.96	2829	430037.8
gdp		between		72555.98	5648.214	272993.9
gdp		within		36682.12	−105452.7	215869.4
pop	absolute values	overall	8268950	1.03e + 07	376433	3.87e + 07
pop		between		1.07e + 07	403086	3.82e + 07
pop		within		337493.6	6762588	9714668
gfcf	mil. EUR	overall	13575.99	17046.76	435.3	86396.1
gfcf		between		15526.54	1174.914	55572.1
gfcf		within		8202.54	−23041.01	44669.77
open	ratio	overall	1.218494	.5117014	.4367842	3.264139
open		between		.478885	.7190229	2.584769
open		within		.2222736	.6307528	1.897865
rail	kilometres	overall	6028.499	5797.434	925	23986
rail		between		6031.518	1079.92	21013.05
rail		within		473.5529	4246.451	9001.451
road	kilometres	overall	451.4231	378.7293	0	1883.9
road		between		290.9813	0	935.745
road		within		254.6779	−149.3219	1399.578

Source: Authors' calculation.

Table 2. Correlation coefficients.

	pop	*gfcf*	*open*	*rail*	*road*
pop	1.0000				
gfcf	0.9580	1.0000			
open	−0.5135	−0.4424	1.0000		
rail	0.9025	0.9094	−0.4847	1.0000	
road	0.8406	0.8358	−0.4489	0.8194	1.0000

Source: Authors' calculation.

countries is much more similar than the rail infrastructure. Certainly, the descriptive statistics itself are not enough to be able to draw conclusions with certainty. The original sample consisted of 13 countries, the 11 mentioned in the data description and Malta and Cyprus. However, Malta and Cyprus were excluded from the estimation as they have no railway network established.

Table 2 shows the measures of strength and direction of the linear relationship between two variables, i.e., correlation coefficients.

According to the presented data, a moderate negative relationship is evident between the variables trade openness and population growth, as well as between trade openness and gross fixed capital formation, and trade openness and road and railway infrastructure. The correlation coefficients of the variables transport infrastructure and population growth and transport infrastructure and gross fixed capital formation have a strong positive linear relationship.

4. Methodology

The aim of this research is to investigate the effects of infrastructure on economic growth. The panel data can be used to look at the unobserved factors which affect the dependent variable which consist of two types: constant and varying over time (Wooldridge, 2016). To empirically test the effects of transport infrastructure, the following econometric model has been estimated, based on the economic model from Equation (1):

$$gdp_{it} = \beta_0 + \beta_1 pop_{it} + \beta_2 gfcf_{it} + \beta_3 open +_{it} \beta_4 rail_{it} + \beta_5 road_{it} + \lambda_t + a_i + u_{it}, \tag{2}$$

where depended variable is gross domestic product (*gdp*), used as a proxy for economic growth while population growth (*pop*), gross fixed capital formation (*gfcf*) and road and railway are used as regressors. Variable λ_t denotes the unobservable time effect, a_i denotes the unobservable time invariant individual effect and u_{it} is the remainder stochastic disturbance term (Baltagi, 2005). The i denotes the cross-sectional unit (country) and t the time period (year).

The standard approach in panel data analysis (linear model) includes three different estimators: P.O.L.S., F.E. and R.E.

Although it is *a priori* assumed that the F.E. model is the most suitable for the analysis, the paper examines the economic model with all three different estimators: P.O.L.S., which applies only if the countries are homogeneous (economic and political structure which might affect the observed variables, respectively generate the observations of the observed variables, but cannot be measured explicitly and are contained in the error), F.E. and R.E.

These models were selected based on previous empirical research using fixed and random effects to assess the effects of transport infrastructure on international trade (Ismail & Mahyideen, 2015) and the effect of vertical separation on the success of railway system (Laabsch & Sanner, 2012).

The F.E. estimator is used when estimating the effects that vary over time, considering that individual panel unit specificities are correlated with one or more regressors. Namely, each unit (country) has its own specifics that do not change over time (i.e., geographic position, culture, language, etc.) and it is expected that these characteristics will be correlated with regressors, i.e., independent variables.

The F.E. estimator removes specificities by time demeaning, resulting in estimates of the time varying variables only. On the other hand, if we assume that individual specificities are independent of regressors, the R.E. estimator is appropriate. Technically, we use the Hausman test to decide which estimator is more suited to the data in hand and, as is usually the case in empirical research, the Hausman test rejects H_0, that is, that R.E. is consistent and efficient as well as F.E. and therefore we should stick with F.E. Since we are working with a relatively small sample, we show the results of all three estimators to see whether the results are consistent.

5. Results and discussion

The estimated results of P.O.L.S., F.E. and R.E. are reported in Table 3. The first column shows the results of the test with the P.O.L.S. estimator, the second column presents the results of the estimator F.E. and the third column shows the results of the estimator R.E.

According to the obtained results, in the case of the estimators P.O.L.S. and R.E., all the variables are significant, while in the case of F.E. only the variable trade openness is not significant. The results of the regression highlight significant and positive effects on economic growth of all observed variables except the variable railway.

Table 3. Results of the analysis.

Variables	(1) P.O.L.S. *gdp*	(2) F.E. *gdp*	(3) R.E. *gdp*
pop	0.00403***	0.00914**	0.00880***
	(0.000391)	(0.00340)	(0.000889)
gfcf	3.991***	3.521***	3.577***
	(0.212)	(0.317)	(0.232)
open	16,228***	10,458	11,817*
	(4,255)	(7,655)	(6,865)
rail	−5.454***	−14.77***	−13.49***
	(0.936)	(1.746)	(1.433)
road	14.54***	13.63*	14.16*
	(3.285)	(7.273)	(7.249)
Constant	−18,555***	−2,880	−9,357
	(6,400)	(41,195)	(7,296)
Time fixed effects	Yes	Yes	Yes
Observations	217	217	217
R-squared	0.979	0.972	0.953
Number of Country	11	11	11

Robust standard errors in parentheses.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
Source: Authors' calculation.

Population growth, gross fixed capital formation and trade openness have positive effects on economic growth, while in the case of railway infrastructure, all three estimators show significant ($p < 0.01$) and negative effects of railway infrastructure on economic growth in the observed period for the 11 C.E.M.S. countries.

As has been indicated, the assessment of the impact of transport infrastructure on economic growth should take into consideration other important growth drivers. Our results confirm the link between economic growth and a combination of human resources, investments, road infrastructure endowment and trade openness. Road infrastructure in the C.E.M.S. is relatively modern and highly developed, and our findings show that the total road network has a positive and significant coefficient at least at the 5% significance level, depending on estimator. Some other studies (for example Ismail & Mahyideen, 2015) have also concluded that long road networks lead to easier access to the work place, thus boosting productivity and consequently economic growth. Developed road infrastructure also allows other economic activities such as trade and tourism, which have important effects on G.D.P. growth in all C.E.M.S. In a way, these results are even underestimated because, according to Crescenzi and Rodríguez-Pose (2012), the road infrastructure variable does not capture its wider impact on economic performance. The reason is that the Keynesian multiplying effects during the construction phase have not been included in the data. The road infrastructure network data are based solely on the quantity (kilometres) of infrastructure actually built and currently in use, and are not complemented by any expenditure data. Since official statistics only record new infrastructure after final completion, our proxy captures mainly the *ex-post* impact of transport infrastructure on economic activity. Still, our research results confirm a significant and positive impact of road infrastructure on economic activity and growth.

On the other hand, railway infrastructure does not have positive effect on economic growth. Railway infrastructure in C.E.M.S. is outdated and inefficient, and according to the European Parliament transport analysis in 2016, there are gaps and bottlenecks in connectivity and travel time in C.E.M.S. railway systems. Data show that travel times in the old member states (EU15) are two to four times faster than in the C.E.M.S. Furthermore, the North–South connection through the three Baltic States constitutes a railway gap. Ports and their railway connections to the hinterland are dealing with the limitations at both ends of the Baltic–Adriatic corridor, while several railway cross-border bottlenecks are recorded between most of C.E.M.S. countries and between C.E.M.S. and EU15 countries. It is not surprising that the results of our analysis report a negative and significant coefficient ($p < 0.01$) in the case of all three estimators.

Significant resources have been invested in transport and related infrastructure in C.E.M.S., especially in the pre-accession period, and the E.U.'s policies and funds have focused on revitalising and improving transport infrastructure. However, railways and rail infrastructure have been lagging behind for decades in these countries while most of the investments have been focused on the construction and modernisation of the motorways. The results of the analysis confirm that the actual state of the railway transport infrastructure in the C.E.M.S. should be improved, especially in the light of the ongoing desire to reduce CO_2 emissions that are to a large extent produced by road transport, while railway transport is more environmentally friendly. This paper supports the E.U.'s guidelines for the need to invest in railway infrastructure to ensure the effective transport of passengers and goods in the long term, create competitive advantages, reduce greenhouse gas emissions and thus simulate sustainable economic growth in C.E.M.S. countries.

6. Conclusion

The role of transport and transport infrastructure in the economic growth and competitiveness of a country has been recognised in many studies, but it is still an ongoing topic in scientific circles as some research results have been inconclusive. Generally, it is considered that in the era of globalisation, economic progress of the economy, among other things, depends on the efficiency of passenger and goods transport, while the lack of inadequate transport infrastructure remains an important obstacle.

Having in mind this wider context, the motivation of this paper is to empirically investigate the effects of transport infrastructure on economic growth in the C.E.M.S., taking into account the set of variables that shape the relationship between transport infrastructure and economic dynamics. This study has examined the effects of transport infrastructure on economic growth in C.E.M.S. using data for the 1995–2016 period. Using three standard estimators (i.e., P.O.L.S., F.E. and R.E.), this study has concluded that in the case of all three estimators the results are significant and show that road infrastructure, gross fixed capital formation, population growth and trade openness have positive effects on economic growth, while rail infrastructure has negative effects on G.D.P. growth. Variable population growth in the case of P.O.L.S. and R.E. was significant and positive, while in the case of F.E. was insignificant.

This analysis is deemed to be indicative in the effective design and implementation of transport policies in the whole E.U., and particularly in C.E.M.S. countries. Although significant resources have been invested in transport and related infrastructure in C.E.M.S., especially in the pre-accession period, railways and rail infrastructure have been lagging behind for decades in these countries because the majority of the investments have been focused on the construction and modernisation of motorways. The results of the analysis confirm that the actual state of the railway transport infrastructure in the C.E.M.S. should be improved, especially in the light of the ongoing desire to reduce CO_2 emissions that are to a large extent produced by road transport, while railway transport is more environmentally friendly. Our research supports the E.U.'s guidelines for the need to invest in railway infrastructure in order to ensure the effective transport of passengers and goods in the long term and promote sustainable economic growth in C.E.M.S. countries.

Research work contributes to the recognition of the role of the transport system in national and regional economy, and provides a framework for further research that can be complemented by the inclusion of other variables that support the need for investment in railways, such as environmental protection and energy efficiency.

Acknowledgment

The authors are grateful to the paper reviewers for their valuable suggestions which shaped a better version of the paper.

Disclosure statement

No potential conflict of interest was reported by the author.

Funding

This work was supported by the [University of Rijeka] under Grant [13.02.1.3.05.]; [University of Rijeka] under Grant [ZP UNIRI 2/17]; and [University of Rijeka] under Grant [UNIRI 5/17].

ORCID

Nela Vlahinić Lenz http://orcid.org/0000-0002-2317-0446
Helga Pavlić Skender http://orcid.org/0000-0001-6668-4124
Petra Adelajda Mirković http://orcid.org/0000-0002-0741-4826

References

Agénor, P.-R., & Moreno-Dodson, B. (2006). Public infrastructure and growth: new channels and policy implications. *Banca D'Italia, Italia*, 403–448. Retrieved from: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2005043. doi:10.2139/ssrn.2005043

Arrow, K., & Kurz, M. (1970). *Public Investment, the Rate of Return and Optimal Fiscal Policy*. Baltimore. MD: The Johns Hopkins University Press.

Aschauer, D. A. (1989). Is public expenditure productive?. *Journal of Monetary Economics*, *23*(2), 177–200. doi:10.1016/0304-3932(89)90047-0

Badalyan, G., Herzfeld, T., & Rajcaniova, M. (2014). Transport infrastructure and economic growth: Panel data approach for Armenia, Georgia and Turkey. 142nd Seminar, May 29-30, 2014, Budapest, Hungary. *Review of Agricultural and Applied Economics*, *17*(02), 22. doi: 10.15414/raae.2014.17.02.22-31

Baldwin, J. R., & Dixon, J. (2008). Infrastructure Capital: What is it? Where is it? How much of it is there? *Canadian Productivity Review*, 16, Ottawa: Statistics Canada. doi:10.2139/ssrn.1507883

Barro, R., & Lee, J. (2013). A New Data Set of Educational Attainment in the World, 1950–2010. *Journal of Development Economics*, *104*, 184–198.

Baltagi, B. H. (2005). *Econometric Analysis of Panel Data*, (3rd Ed.). New York: John Wiley & Sons Inc.

Bonča, S., Udovč, A., & Rodela, R. (2017). A social marketing perspective on road freight transportation of fresh fruits and vegetables: a Slovene case. *Economic Research-Ekonomska Istraživanja*, *30*(1), 1132–1151. doi:10.1080/1331677X.2017.1314820

Canning, D., & Pedroni, P. (2008). Infrastructure, Long-Run Economic Growth and Causality Tests for Cointegrated Panels, *The. Manchester School*, *76*(5), 504–527. doi:10.1111/j.1467-9957.2008.01073.x

Carlsson, R., Otto, A., & Hall, W., I. (2013). The role of infrastructure in macroeconomic growth theories. *Civil Engineering and Environmental Systems*, *30*(3-4), 263–273. doi: 10.1080/10286608.2013.866107

Crescenzi, R., & Rodríguez-Pose, A. (2012). Infrastructure and regional growth in the European Union. *Papers in Regional Science*, *91*(3), 487–615. ISSN 1056-8190. doi:10.1111/j.1435-5957.2012.00439.x

Demetriades, P. O., & Mamuneas, T. P. (2000). Intertemporal Output and Employment Effects of Public Infrastructure Capital: Evidence from 12 OECD Economies. *The Economic Journal*, *110*(465), 687–712. doi: 10.1111/1468-0297.00561

Devarajan, S., Swaroop, V., & Zhou, H. (1996). The Composition of Public Expenditure and Economic Growth. *Journal of Monetary Economics*, *37*(2-3), 313–344. doi:10.1016/0304-3932(96)01249-4

EIZ (2014). Kako probuditi rast hrvatskog gospodarstva, Ekonomski institut Zagreb, Zagreb.

European Commission. (2012). *EU transport in figures: Statistical pocketbook 2012*, Luxembourg: Publications Office of the European Union. http://ec.europa.eu/transport/facts-fundings/statistics/doc/2012/pocketbook2012.pdf [Google Scholar].

European Parliament (2016). Research for TRAN committee: Connectivity and Accessibility of Transport Infrastructure in Central and Eastern European EU Member States. Retrieved from: http://www.europarl.europa.eu/committees/en/supporting-analyses-search.html

Eurostat database (2017). Retrieved April 4, 2017, from: http://ec.europa.eu/eurostat/data/database

Gu, W., & Macdonald, R. (2009). The Impact of Public Infrastructure on Canadian Multifactor Productivity Estimates. *The Canadian Productivity Review*, Research paper, 21, 3–31. doi:10.2139/ssrn.1511698

Ismail, N. W., & Mahyideen, J. M. (2015). *The Impact of Infrastructure on Trade and Economic Growth in Selected Economies in Asia, ADBI Working Paper 553* (pp. 3–28). Tokyo: Asian Development Bank Institute. Retrieved from: https://www.adb.org/sites/default/files/publication/177093/adbi-wp553.pdf

Keho, Y. (2017). The impact of trade openness on economic growth: The case of Cote d'Ivoire. *Cogent Economics & Finance*, *5*, 1332820. doi:10.1080/23322039.2017.1332820

Krugman, P. (1991). *Geography and trade*, Leuven: Leuven University Press. doi:10.2307/144207

Laabsch, C., & Sanner, H. (2012). The Impact of Vertical Separation on the Success of the Railways. *Intereconomics – Review of European Economic Policy*, *47*(2), 120–128. Retrieved from: https://archive.intereconomics.eu/year/2012/2/the-impact-of-vertical-separation-on-the-success-of-the-railways/

Macdonald, R. (2008). *An Examination of Public Capital's Role in Production*. *Economic Analysis Research Paper Series* (50), Ottawa: Statistics Canada. doi:10.2139/ssrn.1371042

Mamatzakis, E. C. (2008). Economic performance and public infrastructure: an application to Greek manufacturing. *Bulletin of Economic Research*, *60*(3), 307–326. doi:10.1111/j.1467-8586.2008.00279.x

Martinkus, B., & Lukasevicius, K. (2008). Investment environment of Lithuanian resorts: Researching national and local factors in the Palanga case. *Transformations in Business & Economics*, *7*(2), 67–83.

Mattoon, R. H. (2004). Infrastructure and State Economic Development: A survey of the issues (I-G). Economic Conference.

Montolio, D., & Solé-Ollé, A. (2009). Road investment and regional productivity growth: the effects of vehicle intensity and congestion. *Papers in Regional Science*, *88*(1), 99–118. doi:10.1111/j.1435-5957.2008.00167.x

Mohmand, Y. T., Wang, A., & Saeed, A. (2016). The impact of transportation infrastructure on economic growth: empirical evidence from Pakistan. *Transportation Letters*, *9*(2), 63–69. doi:10.1080/19427867.2016.1165463

Nijkamp, P. (1986). Infrastructure and Regional development: A multidimensional policy analysis. *Empirical Economics*, *11*(1), 1–21. doi:10.1007/bf01978142

Nketiah-Amponsah, E. (2009). Public spending and economic growth: evidence from Ghana (1970–2004). *Development Southern Africa*, *26*(3), 477–497. doi:10.1080/03768350903086846

Pradhan, R. P. I., & Bagchi, T. P. (2013). Effect of transportation infrastructure on economic growth in India: The VECM approach. *Research in Transportation Economics*, *38*(1), 139–148. doi:10.1016/j.retrec.2012.05.008

Purwanto, A. J., Heyndrickx, C., Kiel, J., Betancor, O., Socorro, M. P., Hernandez, A., … Fiedler, R. (2017). Impact of Transport Infrastructure on International Competitiveness of Europe. *Transportation Research Procedia*, *25*, 2877–2888.

Rostow, W. W. (1960). *The Stages of Economic Growth*. Cambridge, UK: Cambridge University Press. doi:10.1017/cbo9780511625824.011

Snieska, V., & Bruneckiene, J. (2009). Measurement of Lithuanian Regions by Regional Competitiveness Index. *Inzinerine Ekonomika- Engineering Economics*, *1*, 45–57.

Tsekeris, T., & Tsekeris, C. (2011). Demand Forecasting in Transport: Overview and Modeling Advances. *Economic Research-Ekonomska Istraživanja*, *24*(1), 82–94. doi:10.1080/1331677X.2011.11517446

Yu, N., De Jong, M., Storm, S., & Mi, J. (2012). Transport Infrastructure, Spatial Clusters and Regional Economic Growth in China. *Transport Reviews*, *32*(1), 3–28. doi:10.1080/01441647.2011.603104

Wooldridge, J. M. (2016). *Introductory econometrics: a modern approach*, 6th Ed. Mason, Ohio: South-Western Cengage Learning.