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The contribution of transport infrastructure to economic activity: the case of Belgium

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Abstract

A well-developed transport infrastructure may facilitate economic growth and improved the international competitive position of a country. This is more relevant to Belgium because it is a small, open economy which is highly integrated into the world economy. This means that it has a strong potential spill-overs from global economic activities and international trade." Its high degree of openness is dependent on its competitive position and enhanced by the development of transport infrastructure.

In this respect, quantifying the impact of transport infrastructure investment on the economic growth, shedding light on openness degree as a major source of its wealth. Starting from the theories which link transport infrastructure to economic growth, a traditional aggregate growth function is estimated which considers transport infrastructure and openness of economy as specific inputs alongside traditional inputs. The results approve the positive and significant effect of highways and port investments by the government on the Belgian economic development. Openness degree also as a factor in which transport infrastructures contributes to the GDP appeared with positive and significant impact in the period of 1990-2010.

Keywords: transport infrastructure investment, economic growth, openness of economy.

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1 Introduction

The explicit purpose of efficient and productive transport infrastructure is to strengthen the economic activities and development. Well-developed transport infrastructure can facilitate international competitiveness and economic growth. This is more relevant to Belgium than to many other countries because it is a small, open economy which is highly integrated in the world economy with strong potential spill-overs from global economic activities and international trade. Belgium is the most globalised country in the world (KOF Swiss Economic Institute, 2013) and is ranked among the twentieth most competitive nations (Schwab, 2013). It is also ranked fifth for new investment projects in Europe (EY, 2013). Its total exports of goods and services as a percentage of GDP is more than 80% (WTO data) and go mainly to Germany, France, the Netherlands and the rest of the European Union. (KOF Swiss Economic Institute, 2013).

This openness of the Belgian economy and its dependency on the global economy are also important sources of its wealth, which is based on high productivity in global connections. Belgium's unique location in the centre of Western Europe with 80% of Europe's purchasing power is within 500 miles from Brussels (Belgian Foreign Trade Agency, 2014) represents significant opportunities as a gateway to Western Europe. These economic and location characteristics encourage many foreign companies to have subsidiaries in the Belgian market. For such an open economy, regional and global connectivity by efficient and effective transport infrastructure is a major economic resource. It is with regards to this strategic location as a main Western European gateway, that most of land transport infrastructure, waterways, ports and airports are considered as strategic infrastructure for both Belgium and Western Europe.

In this paper the focus will be on the impact of transport infrastructure on economic growth in Belgium using a traditional aggregate growth function. Section 4 discusses the alternative models and methodologies could be applied and the reasons to choose aforementioned model. The rest of this paper is organized as follows. Sections 2 deals with the contribution of transport and transport infrastructure to the economy. Section 3 briefly considers transport infrastructure in Belgium. Section 4 is dedicated to the empirical methodology to quantify the effects of total transport infrastructure and port investment on economic growth. The results for Belgium are presented in section 5 and sections 6 contains the conclusion.

2 The role of transport infrastructure in the economy

Since transport infrastructure is used by both passengers and freight transport at the same time it is important to distinguish between passenger and freight transport in policy measures, this research focuses specifically on freight transport.

Although there are numerous and different opinions concerning the influence of government expenditure on economic growth in the bulk of economic growth literature, but there does not exist an incontrovertible result to rely on. For example, Barro (1990) and Myrdal (1969) rate the investment in public services as productive government expenditures and economic growth booster. On the other hand, some other researchers refer to the crowding out effect and indicate in their investigations that increased government expenditures diminishes private sector investments (e.g. Mahmoudzadeh et al (2013), Landau (1983), Cameron (1982), Buiter (1976)). The benefits and importance of transport infrastructure have been well investigated as a part of public service. Moreover, the magnitude of the impact of a transport system on the national and regional economy is subject to the level of economic development and varies in rural and urban areas. Furthermore, there could be incompatibility between immediate benefits and sustainable growth in some cases. There can be an inconsistency in the scale of its effects over different time periods. However, the main concurrence is that transport infrastructure contributes to economic growth and productivity but not in a constant manner over time.

Transport infrastructure facilitates businesses developments, reduces product price, provide access to global suppliers and consumer markets, and create more cost effective global production process by lowering transport costs and increased accessibility.

Economic development can be influenced by transport infrastructure mainly through two direct and indirect channels (The White House (2014), Goetz (2011), Lakshmanan (2007) and Input Output related analyses (e.g. Wixted, et al (2006), Avonds (2005), Avonds and Gilot (2002)). The first channel - the direct effects - activates the transport sector contribution to GDP by granting easier access to inputs and/or reduced cost of intermediate purchases. The second channel - the indirect effects - works through additional input to other sectors. An advanced transport network provides faster, cheaper, and more reliable and flexible transport services which can contribute to a higher productivity in manufacturing and production. Furthermore it contributes to the concentration of production which results in economies of scale and access to specialized inputs. It also has a strong complementarity with physical and human capital for cluster formation.

All of the aforementioned effects improve the accessibility of firms to better resources including labour markets, to support productive activities particularly in trade-oriented countries (Kawakami and Doi, 2004). Moreover, demand for goods and services increases (Roller and Waverman, 1996), and also the total factor productivity may increase through facilitating just-in-time inventory management, however, there can be spill-over effects resulting in externalities (Lakshmanan, 2007).

Due to some feature aspects of transport infrastructure investment –e.g. sustainable economic development and environmental issues – there remains uncertainty regarding their long term effects under different economic and regional conditions.

As an immediate result of improved transport infrastructure, especially in densely populated area's or large industrial clusters, reduced congestion brings about lower travel time, better and more accessibility and improved distribution systems leading to lower fuel consumption and vehicle depreciation costs, and more reliable freight transport which enables manufacturers to diminish their assembly and delivery costs.

Investment in infrastructure benefits the economy in short run also by creating jobs in different industries *specially those which are difficult to ship overseas. For example road building requires construction workers, grading and paving equipment, gasoline or diesel to run the machines, smaller hand tools of all sorts, raw inputs of cement, gravel, asphalt, surveyors to map the site, engineers and site managers, and accountants to keep tracks of costs* (The White House, 2014).

Public infrastructure investment is found to have some of the highest multipliers of GDP in the short run specifically in developing and low income countries. Therefore, when there is a considerable insufficiency of transport infrastructure high estimated multipliers are expected which trigger off the economic activities in the short run. It might take place through enormous reductions in the internal trade cost. Generally "*assessments of short-term effects from improved transportation typically focus on benefits to and adjustments in transport-providing firms, but the changes made by transport-using firms can generate economy-wide adjustments and redistributions over the long run*" (Lakshmanan and Chatterjee, 2005).

Improved transport infrastructure reduces inventory costs of firms which lead to implementation of just in time strategies and allows for the realisation of economies of scale, together with interregional and global specialization. Furthermore, cheaper transport initiates accessibility to the demand and supply markets, enlarging firms' markets, giving access to various and skilled labour, and cheaper and better neighbouring business services as input. The import and export activities become smoother. Increased import increases local competition which puts the firms under pressure to increase their productivity. Increased export might result under certain conditions in expansion of sales, more employment and higher profits for manufacturers.

In the long run, sustainability in transport technology and infrastructure will stimulate structural changes in national and regional economies, and also facilitate sustainable production systems, dynamic institutions, and integration into the globalization process. (Lakshmanan and Chatterjee, 2005)

Foreign direct investors are seeking regional and national infrastructure investments that improve accessibility to increase returns on investments. This explains the growth of foreign direct investment movements to regions with a well-developed transport infrastructure such as Northern Europe. Tables 1 and 2 provide a summary of the effects of transport infrastructure investment in terms of different points of view and time span.

Table 1 the transport infrastructure effect in different aspects point of view

Macroeconomic impact	Pro-investment point of view: • Considered as productive government expenditure and economic growth initiative.	Negative: • crowding out effects
The magnitude/ Macro level	More significant: • Developing countries. • Urban areas.	Less significant: • Well developed economies. • Under developed economies.
The magnitude/ Micro	More significant: • Transport-related enterprises.	Less significant: Non-transport-related sectors.
Time span	More significant: • Short time.	Less significant: • Moderate to long term.

Table 2 Summary of temporal effects of transport infrastructure investment

Attributes	Short term/ immediate	Long term	Very long term
Types and forms of effects	• Reduced congestion. • Shorter travel times and lower vehicle operating costs. • Rising demand and output. • Logistical reorganization. • Inventory cost reduction. • Local and regional growth. • Job creation in construction sectors.	• Larger markets for products, labour, and services. • Export expansion. • Entry and exit of firms. • Regional/national integration. • Structural and developmental effects. • Increased reliability. • Industrial clusters formation. • Commercial clusters formation.	• Promotion of globalization processes • Global distribution and production • Global flows of goods, services, capital, and knowledge. • Sustainable regional competitive advantages.
Underlying processes and contextual factors	• Increased competition. • Supply and demand forces.	• Monopolies may emerge. • Economies of scale. • Agglomeration. • Cumulative causation. • Endogenous growth. • Increased competition.	• Confluence of technical and organizational/ institutional changes in transport, communication, and production sectors. • Emerging of new economic geography.
Description and measurement of effects	• Cost-benefit analysis.	• New economic geography theory. • Notion of gains from trade. • Computable general equilibrium Models. • Multivariate Econometric modelling. • Growth models	• Economic history analysis

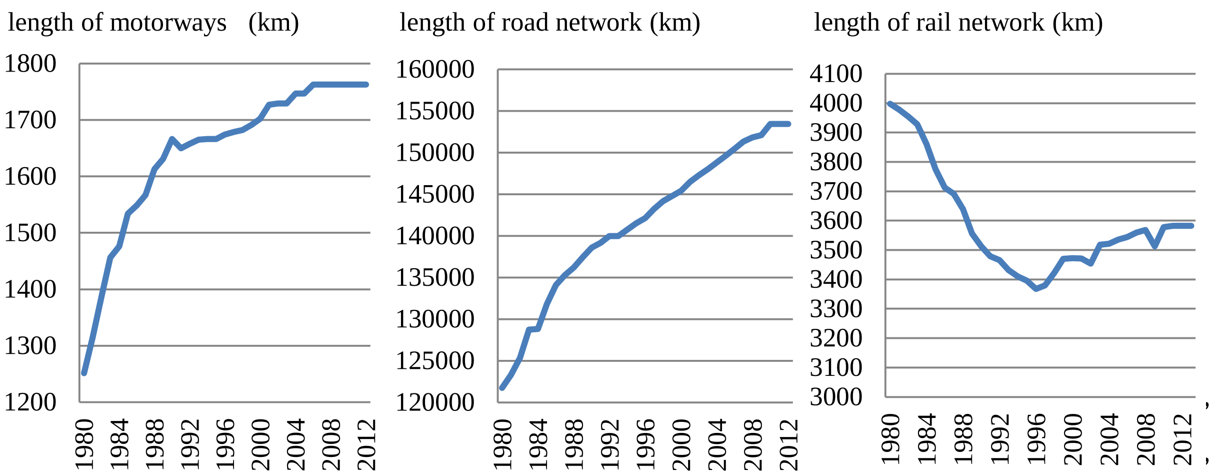
Source: Own complained based on Nazemzadeh, et al (2016), The White House (2014), and Lakshmanan and Chatterjee (2005)

On the other hand there have been arguments over environmental effects of ports, airports and transport which could lower their public popularity (Meersman, *et al*., 2011). Furthermore, the funds needed for transport infrastructure are high. These projects compete for public and private funding with other projects in the field of education, health care, care for an ageing population, environmental protection, etc.

3 Transport, transport infrastructure and economic growth in Belgium

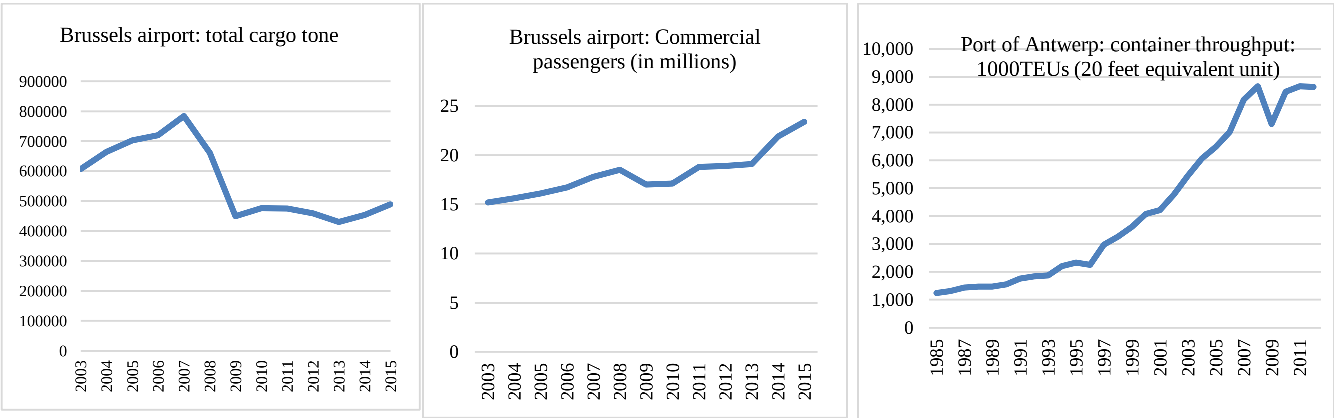
Belgium has a very dense road, motorway and rail network with approximately 13 km per inhabitant. In the 1980s there was an increase in the road and motorway network but the expansion slowed down in the 1990s and stopped in recent years (Figure1). There is also a good network of inland waterways with locks and inland terminals.

Figure 1; Evolution of the length of motorways, roads, and railways in Belgium



Liège and Ostend. Brussels Airport is the country's biggest airport in terms of passenger traffic, whereas Liège is the leading cargo airport. The port of Antwerp is the leading port in Belgium handling both containers and general cargo. Figure 2 illustrates the evolution of Brussels airport (2003-2015) and port throughput of Antwerp (1985-2015) as the main airport and port of Belgium.

Figure 2 Operation of the Brussels airport and Port of Antwerp



Source: BRUtrends2015 (2016)   Source: BRUtrends2015 (2016)   Source: Containerization International (2013) and port of Antwerp (2016)

To be able to handle the very large containerships large investments are needed to keep the port accessible both on the land side and the maritime side.

To have an idea of the importance of the port and airport sector, the National Bank of Belgium calculates the direct and indirect effects of port and airport activities. This is done by means of input-output analysis which uses detailed supply-and-use tables and annual accounts data from the Central Balance Sheet Office.[2] From their results (table 3 and table 4) it is clear that the indirect effects on value added are nearly as big as the direct effects, and the indirect effects on employment are even bigger than the direct effects.

Table 3 Direct and indirect effects of port activities in Belgium (2013)

	Cargo traffic x 1000 tonnes	Investment (current prices) € million	Value added (current prices) € million	Employment FTE
Direct		3,305.70	16,446.30	116,724
Indirect			13,962.20	142,444
Total	280,849	3,305.70	30,408.50	259,168

Source: Van Nieuwenhove (2015)

Table 4 Direct and indirect effects of the air transport cluster and airport activities in Belgium (2012)

	Investment (current prices) € million	Value added (current prices) € million	Employment FTE
Direct	349.1	2,852.00	32,134
Indirect		2,746.80	34,108
Total		5,598.70	66,242

Source: Van Nieuwenhove (2014)

In 2012, air transport and airport activities directly and indirectly generated 1.5 % of Belgian GDP and employed 1.7 % of domestic employment in full-time equivalents (FTEs) either directly or indirectly (Van Nieuwenhove, 2014). The share of port jobs in total Belgian employment came to 2.9 % for direct employment and 6.5 % for total employment in 2013. Port activities contributed 7.7 % to Belgian GDP directly or indirectly (Van Nieuwenhove, 2015).

To quantify the effects of total transport infrastructure and port investment on Belgian economic growth next sections provide the methodological approach applied in this study.

[2] The results are published by the National Bank in its working paper series available at https://www.nbb.be/en/publications-and-research/economicfinancial-publications/working-papers. The most recent one dates from June 2015 and gives the direct and indirect impact of the Flemish ports (Van Nieuwenhove,2015)

4 Methodology and modelling

There are several methods to analyse empirically the impact of transport infrastructure on economic activity and trade. A good overview can be found in Goetz (2011) in terms of theoretical - macro and micro economic analyses, empirical literature, and used measures[1]. He points to the early studies which mainly consider large scale programs, using cost benefit analyses, and those which apply aggregate production function.

For Belgium, there is the aforementioned approach of the National Bank using input-output-analysis. The Belgian Federal Planning Office also has a model to study the relationship between transport and economic activity, but this is more directed to the evaluation of policy measures such as the introduction of a road tax, and less to the evaluation of the impact of infrastructure investment (Van Steenbergen, et al, 2011). Each large infrastructure investment project in Belgium requires a social cost-benefit analysis (SCBA) which should also contain the impact of the project on the economy. However, as the SCBA is most of the time executed by a private consulting company, the full model or instrument for calculating the economic impact is often not available.

An alternative way to study the impact of transport infrastructure on economic activity, is by using aggregate economic growth models. There are several issues and ambiguities which should be taken into account when investigating empirically the relation between transport infrastructure and economic growth:

- the way in which transport infrastructure affects economic growth is not necessarily a direct and unidirectional one; there are reasons to assume that transport infrastructure has an impact on international trade which itself has an impact on economic growth which will generate funds for expansion of the transport infrastructure, etc.
- there exist a large amount of empirical growth models with often very different sets of explanatory variables and often diverging conclusions concerning the impact of transport infrastructure investment;
- The impact from infrastructure to economic growth is expected to be stronger for developing economies than for developed economies; for the latter it are mainly ground-breaking innovations or very large scale developments that may have an impact on economic growth
- it is suggested that transport infrastructure will have an impact on economic growth in the long run and not in the short run

- outcomes of empirical investigations are determined by data availability, the variables used in the specifications, the degree of disaggregation and the statistical methods used.

Tong, et al (2014) give a good overview of the recent research on the relation between economic activity and transport infrastructure. They also point out that the possible feedback between economic activity, international trade and transport infrastructure requires a simultaneous modelling approach. The natural starting point for such an approach is a Vector Auto-Regression (VAR) model which allows also to test for the presence of feedback. Additionally, the economic theory is only minimally used in the inferential process in VAR models. This is because "*any vector of time series has a VAR representation under mild regularity conditions and this makes them the natural starting point for empirical analyses*" (Pesaran and Shin, 1996).

When the time series are not stationary and require differencing, a vector-error-correction model (VECM) might be a better representation of the short and long run feedback and interrelations between economic activity, trade and transport infrastructure. One of the major drawbacks of the VAR and especially of the VECM methodology is that they require sufficiently long time series in order to give stable and reliable results. The alternative is to consider a single equation approach, which is acceptable if there is no feedback from trade and economic activity on transport infrastructure. This can be tested by the traditional Granger approach which is in fact a predictability test.

In line with Tong, et al (2014) the lag-augmented vector-auto-regression (LA-VAR) method suggested by Toda and Yamamoto (1995) is applied. This method is especially useful when the variables are non-stationary and integrated, and the dataset is too limited to estimate an appropriate VECM.

The basic variables under consideration for this analysis are economic output (GDP), imports and exports (TRADE), the total length of the road and rail network (TOTKMS), the private capital stock (CAPSTOCK) as an indication for physical capital, and employment (EMP)[3]. The problem is that the number of variables that can be incorporated in the VAR-model is restricted by the limited number of observations for some of the variables in our dataset. Therefore the final VAR model considered for the Toda and Yamamoto (1995) test for Granger causality focuses on the three main variables GDP, TRADE and TOTKMS. The other variables are incorporated as exogenous variables. The final VAR-model looks as follows

[3] A full description of the dataset and the stationarity tests can be found in appendix (Table 7).

$$X_t = \alpha_0 + \alpha Z_t + \sum_{i=1}^{k} \beta_i X_{t-i} + \varepsilon_t$$

where X_t is a vector containing ($lnGDP_t$, $lnTRADE_t$, $lnTOTKMS_t$), α_0 is a (3x1) vector of constants, Z_t is a vector of the exogenous variables including a trend variable (T, lnEMP, lnCAPSTOCK), α is a (3x3) matrix of coefficients, β_i are (3x3) matrices of coefficients, and ε_t is a (3x1) vector of innovations with covariance matrix Ω_{3x3}. The optimal lag length is either 1 or 2 according to the criterion under consideration (table 5).

Table 5 VAR Lag Order Selection Criteria

Endogenous variables: LNGDP LNTRADE LNTOTKMS
Exogenous variables: C T LNEMP LNCAPSTOCK
Sample: 1979 2013 Included observations: 28

Lag	LogL	LR	FPE	AIC	SC	HQ
0	273.3294	NA	1.58e-12	-18.66638	-18.09544	-18.49184
1	306.1554	49.23910*	2.96e-13	-20.36824	-19.36909*	-20.06279
2	317.3400	14.38016	2.70e-13*	-20.52429*	-19.09692	-20.08793*
3	324.6670	7.850337	3.48e-13	-20.40478	-18.54921	-19.83752

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

Table 6 LA-VAR Granger Causality Test

Sample: 1979 2013
Included observations: 28

VAR(2)				VAR(1)			
Dependent variable: LNGDP				Dependent variable: LNGDP			
Excluded	Chi-sq	df	Prob.	Excluded	Chi-sq	df	Prob.
LNTRADE	5.207375	2	0.074	LNTRADE	0.17756	1	0.6735
LNTOTKMS	2.112476	2	0.3478	LNTOTKMS	0.489489	1	0.4842
All	6.639418	4	0.1562	All	0.542819	2	0.7623
Dependent variable: LNTRADE				Dependent variable: LNTRADE			
Excluded	Chi-sq	df	Prob.	Excluded	Chi-sq	df	Prob.
LNGDP	5.940152	2	0.0513	LNGDP	0.134896	1	0.7134
LNTOTKMS	1.810187	2	0.4045	LNTOTKMS	0.399177	1	0.5275
All	6.804852	4	0.1466	All	0.779701	2	0.6772
Dependent variable: LNTOTKMS				Dependent variable: LNTOTKMS			
Excluded	Chi-sq	df	Prob.	Excluded	Chi-sq	df	Prob.
LNGDP	0.16372	2	0.9214	LNGDP	0.039216	1	0.843
LNTRADE	1.370991	2	0.5038	LNTRADE	0.038657	1	0.8441
All	5.018109	4	0.2854	All	0.040402	2	0.98

The Toda and Yamamoto (1995) test for Granger causality is applied to the VAR model with 2 lags and to the model with 1 lag. Table 6 shows that the results differ for both specifications, but it is clear that there is no feedback from GDP and TRADE on TOTKMS, whereas the causality between GDP and TRADE depends upon the chosen lag structure of the VAR.

Because of the limited number of observations and the fact that there is no feedback from GDP and TRADE on TOTKMS, a single equation co-integration approach is used to estimate the possible long run and short run impacts of transport infrastructure on economic growth. As in Egert, et al, (2009) the starting specification is based on a traditional growth model where transport infrastructure is considered as a separate, additional factor of production and which gives in a general form

GDPCAP=f (TREND, KCAP, INFCAP, HUM, EMP, INV, POPG, OPEN)

with

GDPCAP	GDP per capita
TREND	trend to capture technological change
KCAP	capital stock per capita
INFCAP	total transport infrastructure per capita
HUM	human capital
EMP	employment
INVGDP	rate of investment
POPG	population growth
OPEN	rate of openness measured by the rate of the sum of imports and exports to GDP

In a first model the transport infrastructure was approximated by the total length of the road and rail infrastructure per capita (TOTKMSCAP), in a second model the per capita length of motorways (MWCAP), non-motorways (ROADSCAP) and rail (RAILCAP) were considered as separate variables, and finally also the rate of investments in port infrastructure (P_INV) was introduced as an indicator for the availability of gateways for international trade.

As the variables and their logarithms are integrated of the first order, the model has to be specified in first differences. If there is a co-integrating relation (or more than one co-integrating relation) among all or some of the variables, the appropriate representation is an error-correction-model (ECM) which can be represented in a general way as:

$$\Delta X_t = \alpha \Delta y_t + \beta \Delta z_t + \gamma (X_{t-1} - \delta y_{t-1}) + \varepsilon_t$$

where X is the endogenous variable, y and z are vectors of exogenous variables, ε is a stochastic error term, α and β are coefficients measuring the short run impact of y and z on X, δ is a vector of coefficients measuring the long run impact of y on X, and γ is a coefficient measuring the error correction effect ($-1<\gamma<0$). To estimate the coefficients of this single equation ECM one can use the Engle and Granger two-step procedure (Engle and Granger,1987) where the long run relation is estimated using dynamic ordinary least squares (DOLS), or fully modified ordinary least squares (FMOLS) or canonical co-integration regression (CCR).

5 Results

Initially all the relevant variables were considered, but a number of them did not appear with a significant impact on GDP per capita in the short and the long run. Furthermore some of the variables were highly correlated resulting in unreliable and illogical estimates. Another issue is the fact that other types of infrastructure such as electricity and telecommunications, may also affect economic growth. As no long data series could be found for them, a number of proxy variables were considered such as the electricity consumption and government spending on non-transport infrastructure but they were not significant. Finally three models were chosen, the results of which are presented in table 7.

Table 7 Estimates of the impact of transport infrastructure on economic growth in Belgium using Error Correction Models with FMOLS for annual data

Model 1
D(lnGDPCAPt) = 0.0059° + 0.084°°D(lnINVGDPt) + 0.37°D(lnOPENt) + 0.59°D(lnTOTKMSCAPt) - 0.46°[lnGDPCAPt-1 – (8.04° + 0.0031°°°TREND +0.09°°lnINVGDPt-1 + 0.55°lnTOTKMSCAPt-1 + 0.54°lnOPENt-1)] sample: 1980-2012 adj.R^2=0.78 logL=111.76 stand. error=0.0080 AIC=-6.673 DW= 1.83
Model 2
D(lnGDPCAPt) = 0.0075° + 0.101°D(lnINVGDPt) + 0.42°D(lnOPENt) + 0.26°D(lnMWCAPt) + 0.39°°D(lnRAILCAPt) - 0.64°[lnGDPCAPt-1 – (10.20° + 0.0054°TREND + 0.19°lnINVGDPt-1 + 0.43°lnMWCAPt-1 + 0.47°lnRAILCAPt-1 + 0.51°lnOPENt-1)] sample: 1980-2012 adj.R^2=0.77 logL=113.95 stand.error=0.0076 AIC=-6.746 DW=1.84
Model 3
D(lnGDPCAPt) = 0.0062°° +0.14°°°D(lnINVGDPt) + 0.36°D(lnOPENt) - 0.96°[lnGDPCAPt-1 – (11.21° + 0.0091°TREND + 0.17°lnINVGDPt-1 + 0.30°lnOPENt-1 + 0.021°°lnP_INVt-1 + 1.14°lnMWCAPt-1)] sample:1990-2012 adj.R^2=0.76 logL=75.09 stand.error=0.0089 AIC=-6.462 DW=1.69
° significant at 1% °° significant at 5% °°° significant at 10%

Both model 1 and model 2 were estimated using the same sample period (1980-2012), whereas for model 3 the sample period was much shorter (1990-2012) due to the lack of data on government port infrastructure before 1990. In none of the models the physical capital stock, the human capital stock and or population growth had a significant impact on GDP per capita which is in line with the findings of Egert, et al, (2009). The investment rate (INVGDP) and the openness of the economy measured by the ratio of the sum of exports and imports to GDP (OPEN) have a significant impact in all the models with coefficients which are clearly smaller than one. The elasticity of openness is larger than the elasticity of the rate of investment. The time trend which is a rough indicator for the impact of technological progress has a positive impact but is small. In model 1 the length of the total transport network per capita has a positive impact with an elasticity of .55 in the long run and .59 in the short run.

In model 2 the per capita length of roads, motorways and rail were introduced as separate variables but only the motorways and of the railways have a significant impact both in the short and the long run with a somewhat higher elasticity for railways. The coefficients of the investment rate, the openness and the time trend do not differ considerably from the ones in the first model.

In the third model the rate of government investment in port infrastructure is introduced together with transport infrastructure. The reduced sample size implies a strong reduction of the degrees of freedom which has consequences for the results. The investment rate, the openness and technological change have an impact in both the short and the long run. The kilometres of motorway per capita and the rate of government port infrastructure investment have only an impact in the long run. However the value of some of the coefficients should be interpreted with care. The elasticity of the length of motorways per capita is larger than one (1.14) and the error correction adjustment coefficient (-0.96) is not significant different from -1. This indicates that the ECM might not be the most appropriate representation for this model which is probably due to the limited number of observations.

The contribution of aforementioned transport elements to the economic development takes place through network effects, improvements in performance, increased reliability and productivity, and increased access to the market.

6 Conclusion

Investments in transport infrastructure can stimulate economic activity, especially in small open economies such as the Belgian ones. There are a number of theories to support this view, but others question the impact of transport infrastructure investments on economic growth in developed countries. This paper identified and quantified the role of transport infrastructure and transport infrastructure investment for developments in national and regional economy. Development in transport infrastructure enlarge markets for labour and other input factors in which firms are able to receive labour from broader regions with wider ranges of qualities, improving labour supply and lowering its costs. On the other hand, transport developments open up new markets for economic activities. Such economic effects can be captured by the "new economic geography" theory. In this line of thought, this paper has emphasized on importance of FDIs and the presence of a global company for cluster performance dynamism. However, FDI attracting a global company is not occurring automatically: certain regional characteristics such as advanced transport infrastructure, presence of logistics firms, universities engaging in industry-related research and specialized labour should be considered as high local capabilities.

The empirical part starts from the traditional aggregate economic growth theory to investigate the role of transport infrastructure for the Belgian economy. One of the issues for a small, open economy is that there may be feedbacks between economic growth, international trade activity and transport infrastructure. A LA-VAR test for Granger causality indicates that there is no feedback from economic activity and trade to the size of the length of the total road and rail network for Belgium during the sample period.

The three models estimated with a single equation co-integration technique (FMOLS) support for Belgium the theories that transport infrastructure has a positive impact on GDP per capita besides some of the traditional drivers of growth: the investment rate, the openness of the economy and technological change.

The choice of the models and the methodology was determined to some extent by the data availability. Although the estimated impacts are acceptable, they can be improved in terms of robustness by considering a vector error correction model which allows for simultaneous treatment of economic growth and international trade but requires a sufficiently large sample size. Additionally other infrastructure should be incorporated in the analysis. Some proxies such as electricity consumption, internet subscriptions, and airport activity were considered but did not have a significant impact. Moreover, using a panel data approach would help to check whether the results for Belgium in this contribution are unique or can be generalized for other countries.

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Appendix: Dataset and the stationarity tests

To provide a consistency in data coverage the sample size is from 1979 to 2012, the annual data series of GDP per capita and transport infrastructure related data are provided by OECD at 2005 value. Port infrastructure investment data are collected from Flemish Port Commission in the period of 1989 – 2012 at 2012 value. Although the base years of two aforementioned series are different, this does not change the analysis significantly since the aim was to apply real variables in the model.

Table 8 variables used in the models and their order of integration based on the augmented Dickey Fuller test

variable name	definition	unit	sample	source	order of integration of logarithm of the variable
GDP	Gross domestic production	Dollar	1979-2012	OECD	1
GDPCAP	GDP per capita	Dollar	1979-2012	OECD	1
TRADE					
OPEN	rate of openness measured by the rate of the sum of imports and exports to GDP	Dollar	1979-2012	OECD	1
INVGDP	rate of investment to GDP	Dollar	1979-2012	OECD	1
P_INV	Port infrastructure investment government to total investment	Dollar	1989-2012	Flemish Port Commission	1
TOTKMS	Summation of length of roads, motorways, rails	kilometre	1979-2012	OECD	1
TOTKMSCAP	Summation of length of roads, motorways, rails to population	kilometre	1979-2010	OECD	0
ROAD	Length of other roads	kilometre	1979-2012	OECD	1
ROADCAP	Length of other roads to population	kilometre	1979-2012	OECD	1
RAIL	Railway -Length of lines, by number of tracks	kilometre	1979-2012	OECD	0
RAILCAP	Railway -Length of lines, by number of tracks to population	kilometre	1979-2012	OECD	0
MW	Length of motorways	kilometre	1979-2012	OECD	0
MWCAP	Length of motorways to population	kilometre	1979-2012	OECD	0

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