Introduction

The European Union started a new chapter in its history with publishing the ‘Europe 2020 Strategy’. International competitiveness still remains valid objective of the EU policy, especially in the context of recent financial crisis. Europe has realized that it must overcome a number of challenges if it wishes to remain competitive with the rest of the developed and developing world. The new European strategy ‘Europe 2020’ is aiming at smart, sustainable, inclusive growth with greater coordination of national and European policy. The strategy targets are in turn broken down into the seven flagship initiatives. In line with the ‘Europe 2020 Strategy’ flagship initiatives, the White Paper for transport of 2011 summarizes the main objectives of the European transport strategy. The objectives help to establish a system that underpins European economic progress and offers high quality mobility services, while using resources more efficiently. As a consequence, it is essential to clarify the relationship between investments in transport infrastructure on economic growth and competitiveness. Investments in transport infrastructure have been traditionally evaluated, assuming the equivalence between direct and indirect economic effects [6]. The relationship between infrastructure investment and its wider economic impact, in particular on competitiveness and economic growth is currently not clearly understood and under considerable discussion, especially where it concerns wider economic benefits. In this paper the authors will report some results found in the analysis conducted within the I-C-EU project. It is the FP7 project that aims to clarify the relationship between transport infrastructure investment and its wider economic impacts, in particular competitiveness and economic growth, by exploring the state-of-the-art of the methodology and assessment tools for public and private investments.

Wider economic effects role in assessment of infrastructure projects

Competitiveness has raised more awareness over the past two decades, due to limitations and challenges posed by globalisation and financial crisis. Competitiveness is a term with many definitions. Concept of

---

1 Przemysław Borkowski, assistant professor, Chair of Comparative Research of Transport Systems, Faculty of Economics, University of Gdańsk, 81-824 Sopot, Armii Krajowej str. 119/121, tel. (+48 58) 523 13 41, przemyslaw.borkowski@ug.edu.pl.
2 Barbara Pawlowska, associate professor, Chair of Comparative Research of Transport Systems, Faculty of Economics, University of Gdańsk, 81-824 Sopot, Armii Krajowej str. 119/121, tel. (+48 58) 523 12 81, bpawlowska@ug.edu.pl.
3 Artykuł recenzowany
competitiveness was discussed in [13]. The basic working definition, that is used within the I-C-EU project is: *Competitiveness is the extent to which firms in a particular region can compete with those elsewhere. Critical factors for competitiveness are those that determine the level of productivity in a region in relation to other regions.*

Changes in competitiveness are driven by different factors and measures of impact. Lengyel [12] constructed a ‘Pyramid Model’ of competitiveness, which was enhanced by Gardiner et al [5]. I. Lengyel distinguishes direct and indirect components concerning factors that influence regional competitiveness. Economic output, profitability, labour productivity and employment rates are important factors. But also success determinants with an indirect impact need to be taken into account such as social, economic, cultural and environmental processes. The pyramidal model presented on fig. 1 systematizes the impact factors.

![Pyramid model for regional competitiveness](image)

**Fig.1 Pyramid model for regional competitiveness**

Source: [12; 5]

With regard to the objective of regional development programming and the various characteristics and factors influencing competitiveness, I. Lengyel distinguishes three levels [12]:

- basic categories which measure competitiveness, including income, labour productivity, employment and openness,
- development factors which are factors that have an immediate impact upon the basic categories,
- success determinants, which comprise social and environmental conditions. These have an indirect impact on the basic categories and development factors.

As can be seen in figure 1, GNP, labour productivity and employment rate form the factors that together
describe national or regional competitiveness. These three factors can be derived from statistics or from forecasts made with economic models. Factors critical for competitiveness of regions and nations were examined in Bentancor et al. [2]. Some of these factors are strictly local, some strictly national. For most, however, infrastructure determines the relevant spatial range. Infrastructure is therefore not a source in itself, but rather a *sine qua non* for other factors. One of these factors is accessibility which is closely related to transport infrastructure investments. Accessibility is regarded as one of the driving forces for competitiveness. Changes in accessibility could impact competitiveness, more specifically gross domestic product, labour productivity or employment rate [8].

In determining the effects of a transportation project, we typically distinguish between direct and indirect effects and what are often referred to as additional or wider economic impacts. The direct effects of a transportation project appear in the market where the transport intervention takes place (primary markets)\(^4\). On the other hand, the indirect effects appear in other markets (secondary markets) whose products or services have a complementarity or substitutability relationship with the primary market and where there is some distortion that prevents the price from being equal to the marginal social cost. Finally, all other impacts produced on the global economy are grouped under the heading of wider economic impacts [2].

The literature on wider economic impacts of transport infrastructure is broad, complex and difficult to be organized within limited borders. Nevertheless it could be tried to do so by dividing this effects into four main strands: (1) regional effects, (2) effects on labour markets, (3) agglomeration economies, and (4) imperfect competition.

Firstly, regional effects focus on how the introduction of an infrastructure may modify the flows between and the economic performance of two regions, which will crucially depend on the mobility of production factors (capital and/or labour), besides other determinants. These effects are analysed at macro and meso level directly linked with the impact of infrastructure on economic growth and main macro magnitudes, such as employment and productivity.

Secondly the effects of transport infrastructure on labour markets focus on the mechanisms that function in those markets when transport costs are reduced. This is also related to regional effects and agglomeration economies, however the analysis concentrates on the changes that take place in the labour market.

Agglomeration economies are effects on the spatial dimension of the economic activity that arise from the proximity of agents with independency of whether the increasing returns are related to consumer/supplier linkages, entrepreneurial spillovers or labour market pooling [2]. Nevertheless they may be considered over three different dimensions: regarding technological or knowledge spillovers, the concentration of economic agents and also of demand.

Impact of transport infrastructure on imperfect competition is also linked with previous ones. Once the infrastructure increases the competition level, agglomeration may arise again and increases in productivity

\(^4\) When a new infrastructure, or the improvement of an existing one, reduces transport costs, the effects are transmitted to firms, which increase their profits, or to consumers, who travel at a lower generalized price or consume cheaper goods due to the transport cost reduction.
may be generated through the labour market.

In the I-C-EU project, the 25 transport infrastructure projects across Europe for which the CBA is publicly available [2] were chosen trying to get a balance between the geographical areas covered and the type of transport infrastructure. The 12 case studies in the I-C-EU database were recognized as ones that included the assessment of wider economic impacts. The list of case studies is shown in Table 1.

Tab. 1. Projects including wider economic impacts

<table>
<thead>
<tr>
<th>Project number</th>
<th>Project name</th>
<th>Type of effects considered</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Amsterdam Orbital</td>
<td>Existing businesses; office locations; on the number of businesses appearing; on regions within the agglomeration of Amsterdam</td>
</tr>
<tr>
<td>3</td>
<td>HSL Zuid</td>
<td>Improvement in the business climate, especially concerning the back-office activities of the European companies’ headquarters; Macroeconomic effects;</td>
</tr>
<tr>
<td>8</td>
<td>A20 Baltic Sea Motorway</td>
<td>Regional economic benefits: • Employment impacts, directly related to building the infrastructure. • Employment impacts, resulting from the additional transport infrastructure provided. Benefits granted to projects affecting structurally weak regions; benefit linked to the improvement of the international accessibility.</td>
</tr>
<tr>
<td>9</td>
<td>Magdeburg Waterway Crossing</td>
<td>Regional economic benefits • Employment impacts, directly related to building the infrastructure. • Employment impacts, resulting from the additional transport infrastructure provided. Benefits granted to projects affecting structurally weak regions; benefit linked to the improvement of the international accessibility.</td>
</tr>
<tr>
<td>10</td>
<td>Öresund Bridge</td>
<td>Labour market; housing market; economic benefits;</td>
</tr>
<tr>
<td>16</td>
<td>Container Terminal Altenwerder, Hamburg</td>
<td>Benefit of employment effects linked to the construction of the container terminal; benefit of preserved employment due to avoided cargo shift to competing ports; benefit of additional broadly port related businesses located in the port area</td>
</tr>
<tr>
<td>18</td>
<td>Corridor 22</td>
<td>At corridor level: change on GDP; change on welfare; social impacts, i.e. by change in poverty intensity in function of passenger time savings share At country level: change on GDP; change on welfare; relative change in equivalent variation (compared to consumer budget by income quintile); relative change in poverty and inequality indicators by quintile</td>
</tr>
<tr>
<td>21</td>
<td>Twente Mittelland canal</td>
<td>Agglomeration impacts; employment effects; other</td>
</tr>
<tr>
<td>22</td>
<td>Crossrail</td>
<td>Move to more productive jobs; agglomeration benefits; increased labour force; imperfect competition.</td>
</tr>
<tr>
<td>23</td>
<td>HS2</td>
<td>Regional effects; labour markets; agglomeration benefits; imperfect competition.</td>
</tr>
<tr>
<td>24</td>
<td>Außenweser shipping fairway</td>
<td>Benefit of employment effects linked to the extension of the Außenweser shipping fairway; benefit of employment effects linked to improved infrastructure; benefit of promoting international accessibility</td>
</tr>
<tr>
<td>25</td>
<td>Stichkanal Hannover-Linden</td>
<td>Benefit of employment effects linked to the construction of the canal; benefit of employment effects linked to improved infrastructure; benefit of promoting international accessibility</td>
</tr>
</tbody>
</table>

Source: [2]
recommendations from the German Federal Transport Infrastructure Plan. This methodology puts emphasis on the impact of infrastructure on employment, and specifically, on the benefits directly linked to the construction of the infrastructure, and on those linked to the existence of additional infrastructure. Other case studies assessments are based on quantitative or qualitative analyses such as Amsterdam Orbital and Öresund Bridge. The former considered two methodologies: a quantitative analysis of business changes and office rental prices, and a qualitative analysis based on a questionnaire distributed to businesses and interviews with experts. Another two case studies (HSL Zuid and Corridor 22) appraise wider economic effects based on a general equilibrium model. Both focus on the impacts of the infrastructure on aggregate magnitudes such as GDP, welfare and social impacts, consumption or aggregate employment effects. The approach adapted in particular investment project is therefore highly influenced by general appraisal framework which is in turn specific for country and mode. Some examples of the WEE appraisal practice showing the range of possible methodologies are given in the next section.

**Case studies in assessing wider economic effects in infrastructure projects**

The analysis of specific non-direct impacts of any infrastructure investment is limited to the cases where:

- project is completed - majority of wider economic effects are associated with operational phase and are hardly visible during early stages of the project development,
- there is data available on the actual developments since the completion of the project. In many European infrastructure projects it is hard to decouple wider economic effects resulting from infrastructure investment from other effects resulting from economic activity in the area, migrations etc.

Most importantly expected effects could be very different depending on both project and environment in which project is being realized. The five cases which could provide some insight into types of possible wider economic effects are: **Amsterdam Orbital, Container Terminal Altenwerden in Port of Hamburg, Corridor 06 Lyon-Budapest, HSR Barcelona-Madrid and Malaga Airport enlargement**. The selection of those particular case studies is dictated by their scope – allowing to specify effects in different modal setups and because those are projects whose expected (in ex ante analysis of investment) impacts upon competitiveness and economic growth are supposed to be important.

The Amsterdam Orbital is an internal city motorway project. For the decoupling of wider economic effects it is useful since it comprises both ex-ante and ex-post evaluation. This enables a comparison between the modelling results and the observed situation after opening of the project. The effects of the Orbital Motorway have been approached through 18 distinct projects evaluating changes in travel behaviour, traffic flows, changes in goods transports, development in public transport, changes in environment quality, spatial dynamics and economic assessment. The later three represent wider economic effects. Amsterdam Orbital, led to extra road capacity and road links for traffic crossing the North Sea Canal. As a result, travel time, costs
and distances diminished. Due to these impacts, different changes in user choices were predicted. There were changes in route choice, mode choice, destination choice and time-of-day choice all of them contributed to WEE. Probably the easiest WEE to capture is that of increases accessibility. Significant reduction of vehicle hours on the entire road network, which means an increase of the average speed and a clear improvement of the traffic situation after opening of the Orbital has been noted. This development was accompanied by sharp decline in the travel time losses, an indicator of congestion. [7]. Spatial effects were more differentiated. The good measure of spatial development is change in value of land and houses or offices. In this case the renting prices for offices next to the Orbital had upward effect. Yet at the same time prices in the adjacent zones which were supposedly affected most by the Orbital in terms of traffic improvement have hardly grown. For the measurement of direct GDP effects a survey conducted among companies in Amsterdam has shown their belief that they have benefited from the Orbital due to less traffic congestion and one in ten companies indicated that they would have invested less if the Orbital was not opened. Those initial results were subjected to the back cast modelling conducted with use of the LMS model (Dutch National Model System) run for 2004, 1990 and 1989, were 2004 served as a base year which confirmed expected results [8].

The container terminal Altenwerder is development project of the Port of Hamburg and was planned in order to avoid the demand for container handling surpassing the available capacity at some point. Addition of new terminal and additional space for warehouses, logistics services and railway infrastructure for hinterland transport in Altenwerder was supposed to prevent bottlenecks. In the original appraisal of the project [8] outside of those direct transport effects some wider economic benefits were considered mainly on the part of GDP increase as result of more cargo flowing through port and prevention of moving cargos to competitors. In addition considerable employment effects were expected. Those were attributed to as much as 97% of all external benefits. The container terminal Altenwerder was built between 1997 and 2002. The back cast procedure allows for calculation of those effects using with (by now) historical observed data. The back cast covers the period form 2002, when the terminal commenced operations, to 2012.

The handling capacity is for short time periods fixed. In the case of Altenwerder terminal the effect of avoidance of cargo shifts to competing ports is dependent on the overall free cargo processing capacity in the whole North Range. Due to high utilization rates throughout the ports in this area and thus a very limited possibility for cargo to be shifted to ports with idle capacity, no capacity threshold was assumed in back cast for 2002 to 2008. Observed decline in cargo throughput in 2008-09 made this factor important again. Further increases in number of cargo handling operations are noted afterwards. The second effect – employment is even more problematic mainly because there is no sound methodology for this type of assessment. The estimate should allow to identify those economic activities which are dependent on port throughput and their labour intensity (number of jobs) but also to assess the magnitude of multiplier effects associated with the activities, i.e. the induced impact in other sectors of the economy [1].

The assessment accompanying feasibility study used bottom-up survey and estimated the relationship
between employment and container handling of the magnitude that 208 jobs exist in Hamburg per every 10000 TEU handled in the port and that for every two jobs directly related to container handling one indirectly associated job existed [8]. The back cast procedure shows that in reality total employment in Hamburg Port was almost constant from 1990 to 2010. During those years the number of containers increased from about 2 million TEU to 9 million TEU. This means that the number of employees per containers handled declined from about 200 to about 50 employees per 10000 TEU in 2010. The effects were therefore negative and contrary to expectations. The only positive figure is that of employment multiplicator in the intermediate and capital goods industry over the same time period where increase from 0.5 jobs in 1990 to 0.8 jobs in 2012 for every job directly related to container handling was observed.

The Altenwerder project is certainly responsible for additional indirect economic benefits in the port hinterland and oversees destinations which route cargo through the port. However, this cannot be directly calculated and is determined only in the qualitative way by comparing situation before and after terminal has been constructed. Since regions involved are huge at the same time there are many other investments which impact their economic life making separation of the terminal effects in hinterland very difficult.

An example from air sector could be found in the case of Malaga airport which is main airport in Andalusia region capturing more than 70% of all passengers. The case of Malaga airport is similar to previous one due to its function of a node. Similar reasoning behind decisions to invest in airport infrastructure could be used. Here as well capacity constraint was regarded as important investment decision factor. The new terminal has a capacity for about 4000 passengers per hour. On the side of wider economic effects mainly further development of tourism was considered. The investment original assessment was based on conventional CBA (cost – benefit) approach thus no wider economic benefits were discussed [3]. Still it was accompanied by econometric modelling of capacity restrictions which allowed to forecast demand values thus providing at least proxy measure for possible tourism increases. Currently back cast allows to check the project assumptions against actual developments. The re-estimated NPV shows that only half of original figure materialized [8]. Within the back cast analysis the level of demand that produces a zero NPV has been calculated at the level of traffic corresponding to 10.5 million passengers in 2010 – the first year of operation of the airport. Hence if demand starts with this figure and increases as expected this would be a positive net effect due to the tourism generated benefits.

Because original assessment of the Malaga airport extension did not look into other indirect effects even having the knowledge of back cast results it is very difficult to determine the extent of other than tourism components of wider economic benefits. As the airport is extended in size and thus capacity and resulting network of connections it can be said that the accessibility has improved but the GDP effects in cooperating companies and employment effects in this case study have never been measured.

The Lyon-Budapest corridor case study shows the possible wider economic effects of the development of linear infrastructure. The corridor is mainly used for freight transport. The original assessment of the project
was based on the methodology built up by a combination of transport models and macro-economic models [11]. The method adopted overlaid the transport use model on spatial CGE model allowing to assess the indirect network effects, but also the wider economic impacts. The results are produced for EU as a whole due to the fact that corridor is part of TENT network. The corridor concerns only inland routes thus short sea shipping is not affected. The results show that Europe wide, the extra amount of tons transported by rail goes up by 0.32%. The decrease for road and inland waterways is 0.01% for both modes [9]. But even more important are indirect network effects. These are the effects that are fed back from the economy into the transport system. The impact factors calculated for each mode show the relative change of the indirect effects compared to the direct effects. A value of -1.41 for road means that the direct network effects should be multiplied by -1.41 to get the indirect network effects on the volume (resulting in increase of the magnitude of 0.020 bln tons per year). For inland water transport it is 0.82 and for rail 0.14. The project leads to a change in GDP due to the changes in travel time. But even more significant observations could be made when zooming in on specific regions. For example, the results for rail show that the impacts in Hungary and Slovenia can amount to as much as 10% of total rail transport.

This case shows both direct and indirect impacts and their interrelation. For direct impacts main observed benefits result from time savings for rail freight transport. In this case indirect impacts are limited to GDP improvement. The effects are strongest in countries like Slovenia and Hungary probably because their relatively poorer initial infrastructure. Employment was not taken into account. A drawback of the study is that the results are available at European and national level, but not for the regions.

Another example of rail infrastructure impact on wider economic benefits could be observed for HSR line Barcelona-Madrid. This project is a passenger high-speed railway network that connects Madrid and Barcelona, the two largest cities in Spain and expected wider economic benefits apply to the passenger transport. The approach adapted in this case study was based partially on classic CBA model but extended into some items influencing the possibility for wider economic benefits like: changes in resources and willingness to pay. In this approach clear distinction is made between direct effects (experienced by direct users, producers, individuals affected during the construction and operation phase) and indirect effects applicable to those affected in secondary markets (i.e. indirect effects in markets with distortions or intermodal effects). The main benefits are supposed to come from travel-time savings. The observed travel time savings alone would create an improvement of the accessibility of both Madrid and Barcelona. However, the new HSR competes with air transport. Keeping this in mind, one could argue that the competitiveness due to this infrastructure project is limited especially that NPV values are negative. The back cast recalculation using actual data supports this observation [4]. The perceived wider economic benefits in terms of GDP growth will materialize only if initial passenger numbers per year are at the level of 10 million. Real figures for the first year was 5.5 million. Other wider economic benefits were excluded in the analysis.
Conclusions

Assessment of wider economic benefits is strongly influenced by specificity of the setup. Assessment models used for infrastructure concerning nodes such as ports, terminals, airports and stations might look for different wider economic effects as key components influencing overall level of the benefits. In majority of cases benefits are considered through analysis of GDP growth potential, employment effects, accessibility improvement. Often transport related indicators are used as proxies (e.g. time savings). It is also common practice to derive indirect effects from direct effects.

Estimates of wider economic benefits are often made in order to justify project. It is possible because wider economic effects are speculative and can only be checked against assumptions after some time has passed using back casting procedure. While analysis of direct effects often leaves the project on the negative side of any economic efficiency appraisal, wider economic benefits added to the analysis tend to improve cost-benefit ratio making project viable. Based on the analysis of 5 case studies and having conducted back cast for them it should be concluded that certainly wider economic benefits result from transport infrastructure development. Yet it is clear that ex ante analysis is often overoptimistic and real wider economic benefits are not as substantial as expected. Another conclusion is that it is often very difficult to separate direct from indirect effects which needs to be done in order to avoid double counting. For the different infrastructure, usually different scenarios were used. It is recommended to make a distinction between background scenarios covering socio-economic future, and policy scenarios, which cover the different variants of an infrastructure project.

As a final remark recommendation should be formulated to develop better methodological approach in order to treat wider economic effects in consistent manner regardless of the type of the project. This would make the outcomes of any project more valuable as in the future project might be evaluated, taking into account the original assumptions, data, models and scenarios. This way wishful thinking about a project can be diminished.

Summary

The aim of this paper is to overview the current infrastructure project assessment practice in Europe regarding indirect and wider economic effects (WEE) and to compare approaches to the treatment of those effects based on the case studies conducted within I-C-EU research project. The paper deals with the methods used to assess wider economic effects based on actual investment projects which tried to take those effects into consideration. The initial assessment for each project is set against real developments using back cast procedure. In the first part of the paper the concept of indirect effects and WEE and their measurement is presented, in the next one some empirical results based on conducted studies are discussed with conclusions drawn at the end.
Pośrednie efekty ekonomiczne w analizie transportowych projektów inwestycyjnych – studia przypadków

Streszczenie
Celem niniejszego artykułu jest przegląd aktualnej praktyki oceny transportowych projektów infrastrukturalnych w Europie w zakresie ujmowania pośrednich efektów ekonomicznych (PEE) i porównanie podejść stosowanego w krajach członkowskich UE w tym zakresie. Analiza została przeprowadzona na podstawie wybranych studiów przypadku przeanalizowanych w ramach projektu badawczego I-C-UE. W pierwszej części opracowania nakreślono koncepcję kategorii ekonomicznych efektów pośrednich oraz podejście do ich klasyfikacji i pomiaru przyjęte w literaturze przedmiotu, w następnej części przedstawiono empiryczne wyniki uzyskane na podstawie przeprowadzonych badań poszczególnych studiów przypadku oraz sformułowano wnioski.

References:


