The Egnatia motorway is part of the Trans-European Transport Networks (TETN) programme of the European Union. The TETN masterplan for rail, roads, water-ways, ports and airports require public and private investments of 400 to 500 billion Euro until the year 2010. One of the main objectives of these enormous infrastructure investments is to contribute to reducing the disparities between European regions and to achieving a more balanced economic growth. However, the impacts of these new transport infrastructures on the peripheral regions of Europe are uncertain.

The Institute of Spatial Planning (IRPUD) in Dortmund carried out a series of research projects on transport infrastructure and accessibility. They aim at modelling the relationships between improvements of transport infrastructure and regional development. This paper gives an insight into two recent research projects of IRPUD:
- the European Peripherality Index developed for DG REGIO,
- the project SASI (Socio-Economic and Spatial Impacts of Transport Infrastructure Investments and Transport System Improvements), part of the EUNET project conducted for DG TREN.

This paper addresses three central questions: First: What is peripherality? Second: What impact does transport infrastructure have on regional development? And third: How can the regional economic impacts of the trans-European networks be modelled?

1) What is peripherality?

Various development theories provide different definitions and explanations of peripherality.

In general, the term peripherality implies different aspects. According to the classic polarisation theories of Hirschman (1958) and Myrdal (1959), peripherality stands for an economic delay caused by the “backwash effects” of large agglomerations. Friedman (1972) defines peripherality as oppression based on “modernisation effects”: The core regions are more flexible, they learn faster and are therefore economically more successful. For Krugman (1991), peripherality is the result of missing economies of scale and high transport costs. All these definitions cover certain aspects of peripherality. In the context of impact simulation models, the most suitable approach is the geographical definition of peripherality as an in-
verse function of accessibility, i.e. the higher the accessibility, the less peripheral is the location of a region. This definition yet implies the next question: How can accessibility be measured or quantified?

There are two groups of indicators for measuring accessibility. Simple accessibility indicators are e.g. the total length of motorways in a region or the number of railway stations. These indicators describe the provision of infrastructure within a region but fail to capture the network character of transport infrastructure. More complex accessibility indicators therefore look at the origins and destinations of traffic. They combine activity functions (destinations to be reached) and impedance functions (costs to reach a destination). Within this group of indicators there are different sub-types: travel cost, daily accessibility or potential. Some indicators also consider different modes of transport – car, train, airplane – or calculate multi- or intermodal accessibility. The European Peripherality Index developed by Schürmann and Tallaat (2001) at IRPUD follows the model of the potential accessibility.

\[
A_i = \sum_j W_j^a \exp(-\beta c_{ij})
\]

**Figure 1: The European Peripherality Index**

The economic potential of a region is the total of destinations in all regions weighted by a function of distance from the origin region. It is assumed that the potential for economic activity at any location is a function of both its proximity here expressed by 'travel time' to other economic centres and its economic size or 'mass'. The latter can be measured using different mass terms, such as population, employment or GDP. For the impedance function, the European Peripherality Index offers the choice between two transport modes: car travel time and lorry travel time. On the basis of these assumptions, the European Peripherality Index calculates a total of 192 peripherality indicators differing in mass term, spatial scope and resolution and type of indicator. A particular feature of this index is that it was calculated for all European countries, including the 12 countries applying for membership in the European Union.

One of the main findings of the European Peripherality Index study was that the spatial patterns generated by the different peripherality indices are very similar, i.e. that the correlation between different type of indicator is rather high. This reflects the fact that, irrespective of the kind of peripherality index used, the distant geographical position of peripheral regions cannot be fully removed by transport infrastructure improvements. Moreover, the peripherality index identifies regions with low accessibility and allows a differentiated assessment of the peripherality situation at the NUTS-3 level.
Figure 2: Peripherality with respect to population by car
Figure 2 shows the peripherality of European NUTS 3-regions calculated with respect to population by car. Not surprisingly, peripherality is lowest in central Europe, comprising Western Germany, Belgium, Netherlands, and parts of France, characterised by green colour in the map. At the other extreme there are Scandinavia, parts of Italy, and also parts of Greece with the highest peripherality indicated by red colour. However the map also shows significant differences within the individual countries.

This observation also applies to the Greek NUTS 3-regions (see Figure 3). As expected, the capital region Attiki is the most accessible Greek region. Nevertheless, compared to the European average, which is set to 100, its accessibility is only 28%. Among the most accessible Greek regions are Evros, Serres, Pieia and Rodopi.

The diagram in Figure 3 indicates the accessibility of some of the Greek regions affected by the EGNATIA motorway. According to the IRPUD calculations, there are clear differences within this group: While some regions such as Thessaloniki already today have a relatively high level of accessibility, there are regions such as Thesprotia whose accessibility is only one third of Thessaloniki’s or 7 percent of the European average. At the bottom of the ranking are the islands such as Lesbos and Samos.

To sum up, overall Greece today still suffers from a very peripheral location within Europe, but there are also remarkable regional differences in accessibility. Some of the most peripheral regions of Greece are situated along the EGNATIA motorway.

2) What impact does transport infrastructure have on regional development?

In general, the impact of new transport connections can be ambiguous: On the one side, a new transport link creates new opportunities: it makes it easier for producers in peripheral regions to market their products in the large agglomerations. On the other side, a new motorway may
also expose regional monopolies to the competition of more advanced producers from core regions. Hence, from a theoretical point of view, it is not easy to predict whether the positive or the negative impact will prevail in the long run.

Also new development trends in the sector of transport make it difficult to give a clear answer to the above question. There are some trends that clearly diminish the importance of transport infrastructure:
- an increased proportion of high-value goods for which the transport costs are less relevant
- the rising role of telecommunications which start to partly substitute physical transport flows, and
- a growing importance of 'soft' location factors such as landscape, quality of life, and culture.

However, on the other side there are also trends that reinforce the role of transport infrastructure:
- Currently, new superior levels of transport such as the high speed railway systems are being introduced all over Europe. Many of them connect the large agglomerations and leave out the periphery. Hence the gap between core and periphery and therefore the role of transport infrastructure increases.
- Secondly, one can observe a general increase in the volume of goods movements. One could deduce: the more goods are transported, the more important it is to have an efficient transport system.

The above discussion shows that there are divergent trends concerning the future role of transport infrastructure and accessibility for regional development. Apparently, general theoretical observations are not very satisfying. It might therefore be helpful to have a look at the empirical situation.

Figure 4: Accessibility = Economic Success? The Example of Greece
Figure 4 shows accessibility and gross domestic product (GDP) per capita of the 54 Greek NUTS III regions. The horizontal axis displays the accessibility values, while the vertical axis indicates the GDP per capita as indicator of regional wealth or “economic success”. A 100% correlation of “accessibility” and “economic success” would mean that all regions lie on the diagonal. As expected, this is not the case, for it is clear that regional economic development is determined by more than just accessibility.

However, the diagram proves that there is a clear positive correlation between the two observed factors. In general, GDP per capita is much lower in regions with low accessibility and vice versa. For the Greek mainland regions, the statistical correlation (Pearson) of accessibility and regional wealth is 0.5 and highly significant. One can therefore assume that, at least in the past, accessibility has been a factor of regional economic success. A question arising from this observation is: What happens if accessibility is improved? If the EGNATIA Motorway improves the accessibility of regions such as Thesprotia and Ionànina from the present 7 or 11 percent of the European average to about 20 percent - will their GDP per capita rise to the level of Kosàni or Kavàlla?

3) How can the regional economic impact of trans-European networks be modelled?

The EGNATIA motorway is one of the largest priority road projects of the European Union’s TEN programme. Road investments of a similar size are only found in Portugal and Spain, Great Britain, Ireland, and southern Scandinavia.

![Figure 5: The SASI-model](image-url)
In order to forecast the spatial and socio-economic impact of these enormous infrastructure projects, IRPUD developed simulation models of regional economic development. The project “Socio-economic and Spatial Impacts of Transport Infrastructure Investments and Transport System Improvements” (SASI) was conducted as part of the 4th Framework Programme for DG TREN as part of the EUNET project. Project partners were the Institute of Urban and Regional Research of the Technical University of Vienna and the Department of Town and Regional Planning of the University of Sheffield.

As Figure 5 shows, the SASI model consists of six interdependent forecasting submodels, integrated with the help of a geographical information system: European Developments, Regional GDP, Regional Employment, Regional Accessibility, Regional Population and Regional Labour Force. A seventh submodel calculates socio-economic indicators with respect to efficiency and equity.

The submodel European Developments comprises a number of exogenous assumptions about the economic, demographic and transport development. One of these exogenous variables are the trans-European networks which have a direct impact on the submodel of accessibility. Within this model, a change of the accessibility evokes changes in all other subsystems. Thereby, this model allows to quantify impacts of infrastructure improvements.

In order to demonstrate the impacts of different transport investments, the SASI model compares three basic scenarios, each of them referring to the forecasting horizon 2016: First, the “Do Nothing” scenario where the road and rail infrastructure does not change compared to the situation in the year 1996; second, the full TEN scenario where all planned road and rail projects funded by the EU are built - this scenario also includes the EGNATIA motorway. And third, the rail ten scenario where only the planned railway investments are implemented. A comparison of the different scenarios allows conclusions concerning the expected development of the accessibility of the Greek regions (see Figure 6). According to the SASI calculations, all European regions will experience an additional increase in accessibility through the implementation of the TETN. The greatest winners will be Spain, Portugal, and the Scandinavian countries. But also Greece will benefit from remarkable increases in accessibility of up to 40%. Moreover, the SASI model forecasts that Greece will belong to the group of winners in road accessibility (see second map in Figure 6).

However, better accessibility does not necessarily correspond to more regional wealth. The most important results produced by the SASI model are therefore its predictions of GDP development. If the GDP of “Do-Nothing scenario” and “TEN scenario” are compared, an evident result is that there will be a moderate redistribution of wealth from the North to the South of Europe. Compared with the “Do-Nothing scenario”, the GDP of the northern countries will relatively decrease, while the Mediterranean countries, including most parts of Greece, benefit from the new transport infrastructure.

The most impressive findings in regard to the role of the EGNATIA motorway result from a comparison of the rail-TEN and the TEN-scenario. This comparison allows to identify those European regions with the strongest expected impact of road infrastructure improvements on regional GDP (see last map in Figure 6). According to the SASI model, all Greek mainland regions will benefit from the new Greek motorways built in east-west and north-south direction. Compared with other European countries, the Greek regions will benefit the most, together with Portugal and some regions in Spain and France.
Figure 6: Results of the SASI model

Result I: Road&Rail Accessibility
TEN Scenario vs. ‘Do Nothing’ Scenario
relative difference, 2016

Greece
growth in accessibility:
up to +40%

Result II: Road Accessibility
TEN Scenario vs. Rail TEN Scenario
standardised difference, 2016
Result III: Impact on GDP (Road&Rail)
TEN Scenario vs. 'Do Nothing' Scenario
relative difference, 2016

Result IV: Impact on GDP (Road)
TEN Scenario vs. Rail TEN Scenario
relative difference, 2016
4) Conclusions

General conclusions based on the SASI model are that one should not over-estimate the importance of transport infrastructure. Socio-economic macro trends such as ageing of the population and increases in labour productivity have much stronger impact on regional development than transport policy. Furthermore, irrespective of the network scenario, most regions will improve their accessibility and economic performance in absolute terms. However, the SASI model also confirms that altogether the implementation of the TEN scenario will have slight cohesion effects, hence lead to a less polarised development in accessibility and GDP than the Rail-TEN and the Do-nothing scenario.

Concerning Greece, two main findings of the SASI model for 2016 are:

- First: The implementation of the TEN scenario will improve the accessibility of Greek regions by 10-40%. In comparison with other European regions, however, the relative accessibility of Greece will hardly increase.

- Second: Thanks to the TEN motorway projects, Greece will be one of the European countries with the highest relative gains in road accessibility and, due to that, induced increase in GDP.

The SASI model shows that new motorways in Europe will generally have a positive impact on the wealth of the affected regions. However, this economic gain must be related to other dimensions of regional development, i.e. the environmental and ecological situation. The construction of bridges, tunnels and interchanges for new motorways often lead to irreversible damages to the landscape and to ecological systems. In the long run, the neglect of ‘green’ interests may also affect regional economical development. A natural landscape is becoming an important location factor not only for tourism but also for modern service industries.

The SASI model focuses on issues such as accessibility, regional labour market, GDP, cohesion and demographical development. A future model developed by the EGNATIA observatory could try to integrate also possible impacts on environment and nature in order to allow decision makers a comprehensive comparison of different alternatives of the alignment of the motorway.
References


