Stefano Panebianco, Carsten Schürmann

The Egnatia Motorway
– a chance for Northern Greece to catch up?

Paper presented at the 42nd Congress of the
European Regionanl Science Asociation (ERSA),
Dortmund, 27-31 August 2002

Stefano Panebianco, Carsten Schürmann
Institute of Spatial Planning (IRPUD)
University of Dortmund
D-44221 Dortmund
Fon: +49 (0) 231 755 2293/2457
Fax: +49 (0) 231 755 4788
sp@irpud.rp.uni-dortmund.de
cs@irpud.rp.uni-dortmund.de

Abstract

This paper seeks to analyse the spatial and economic impacts of Via Egnatia, a motorway of 680 km length currently under construction in Northern Greece. It proposes three hierarchical analysis dimensions. First, the travel time reduction is assessed by calculating changes in travel times and by generating isochrones prior and after the opening of a new transport link. Second, the effect on the potential type accessibility is taken into consideration. Third, the possible impacts of changes in the transport network on the regional economic development are examined through the use of an appropriate simulation model. The three analysis steps lead to a differentiated assessment of the Egnatia motorway's effects. According to the travel time and the isochrone approach, a number of Greek regions can benefit from considerable travel time reductions. The expected increase in potential-type accessibility is yet relatively small and can hardly diminish interregional accessibility disparities in Greece. Finally, the impacts of the new transport link on the regional economy measured by changes in gross domestic product (GDP) remain rather modest. The application of the proposed analytical assessment framework to the Egnatia case study underlines the importance of multi-dimensional impact analyses and the need for new simulation models.

1 Introduction

The construction of the Egnatia motorway in Northern Greece represents one of the largest current road infrastructure projects in Europe. It is part of the European Union's Trans-European Transport Networks (TETN) programme of the European Union (European Communities, 1996; European Commission, 2001). The TETN masterplans for rail, roads, water-ways, ports and airports require public and private investments of 400 to 500 billion Euro until the year 2016. 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 impact assessment of new transport links such as the Egnatia motorway usually focuses on measuring the direct impacts of network improvements on categories such as transport flows and modal splits. However, recent progresses in the fields of simulation models and the use of geographic information systems allow to extend the assessment to spatial and socio-economic changes induced by transport network improvements. This paper gives an insight into two recent research projects of the Institute of Spatial Planning (IRPUD) which aim at capturing the effects of the TETN projects on the European accessibility patterns and regional economic development: first, the European Peripherality Index developed for DG REGIO (Schürmann and Talaat, 2001), and second, the SASI project (Socio-Economic and Spatial Impacts of Transport Infrastructure Investments and Transport System Improvements), part of the EUNET project conducted for DG TREN (Fürst et al., 1999; 2000).

The Egnatia motorway project is used for evidencing three sequent analysis steps of impact analysis: first, the change of car travel times between selected destinations in Greece, and their illustration as isochrones (section 4); second, the increases in potential type accessibility, taking into consideration the size of potential destinations (section 5); and third, the impact on socio-economic variables, namely the regional gross domestic product, achieved through the use of the SASI simulation model (section 6). The different findings and their implications for further research tasks are summarised in a final statement (section 7).

2 The case study: the Egnatia Motorway in Northern Greece

The Egnatia motorway follows the alignment of the old roman Via Egnatia, extending from Igoumenitsa on the Adriatic coast to Kipi on the north-eastern edge of the Aegean Sea. The length of the new transport axis adds up to a total of 680 km. Before 1994, only 94 km of the motorway had been completed. Today, 339 km of the motorway are opened to traffic, another 55 km are to be delivered in Summer 2002. 190 km are currently under construction, the remaining 96 km are ready to be tendered or in the design phase already. Egnatia is built as a closed dual carriageway motorway with two traffic lanes plus an emergency lane per direction, for a total paved width of 24.5 m over its greatest part, except for the road's mountainous sections.

Not astonishingly, the implementation of this historical road project through the mountainous regions of Epirus, Macedonia and Thrace represents a major technical challenge. The realisation of the new motorway axis requires about 1650 bridges (combined length: 40 km), 76 tunnels (combined length: 49,5 km), 43 river crossings, 11 railway crossings and a total of 50 junctions interchanges with the existing road network (Egnatia Odos A.E., 2002). As the Egnatia motorway is to function as collector road for transport in the whole Balkans and South-Eastern Europe, the East-West motorway track will be complemented by nine vertical road axes in North-South direction (European Communities, 1996). Altogether, a total of 3.2 billion Euro of funding have been approved in order to make this ambitious infrastructure project possible.

Figure 1. Via Egnatia and the P.A.T.H.E. corridor

The new Egnatia motorway is expected to become "the backbone of Northern Greece's transport system" (Egnatia Odos A.E., 2002). It shall bring "areas like Epirus, Western Macedonia and Thrace out of their isolation [and] multipl[y] investment in industry and tourism" (Egnatia Odos A.E., 2002). Finally, it is supposed to "enhance [..] the geopolitical position of Greece in Europe, the Balkans, the Mediterranean Sea and the countries of the Black Sea" (Egnatia Odos A.E., 2001b). It is difficult to predict to which extent these expectations will be fulfilled. The three analysis steps presented in the following attempt to anticipate changes in accessibility and GDP induced by the Egnatia motorway.

3 The methodological approach: comparison of scenarios

The main interest of this research is to specify some expected spatial and socio-economic impacts of the Egnatia motorway project. However, Egnatia is not the sole large motorway project in Greece. In parallel, the north-south connections of the country are presently being improved by upgrading and completing the so-called P.A.T.H.E. motorway which links the cities of Patras, Athens, Thessalonica and Evzonoi. Besides, the European Commission's TETN programme envisage further road infrastructure investments in different parts of Greece, namely the counties of Ilias and Messinias, Trikalon, Larditsis and Larisis. Consequently, the accessibility calculations presented in this paper are applied to five different scenarios:

Table 1: Scenarios applied

Scenario	*Description*
Base year (2001)	Base scenario
Via Egnatia	Base scenario plus full Via Egnatia implementation
Via Egnatia and P.A.T.H.E.	Base scenario plus full Via Egnatia and P.A.T.H.E. Corridor implementation
Greek motorways	Full implementation of all Greek TEN road projects
TEN/TINA	Full implementation of all TEN/TINA road projects

The *base year scenario* for the year 2001, where some 255 kilometres of Egnatia are already completed and opened to traffic; the *Via Egnatia scenario* comprising the full implementation of the 680 kilometres long Via Egnatia; the *Via Egnatia-P.A.T.H.E scenario*, covering the implementation of Via Egnatia and the P.A.T.H.E. motorway; the *Greek motorways scenario*, which also includes the mentioned additional road network improvements foreseen by the TETN programme; and finally the full *TEN/TINA scenario*, where also improvements in all other EU member states and candidate countries are taken into consideration. Most of the results presented in the following sections refer either to the Via Egnatia or to the TEN/TINA scenario. The different analysis steps are performed by using GIS-techniques combined with simulation models developed at IRPUD.

4 First Analysis step: Travel times and isochrones

An easy way of measuring the benefits of new transport links consists in looking at the travel times. As expected, the implementation of Via Egnatia leads to a clear reduction of average car travel times. According to the presumptions of the IRPUD calculations, the travel time between the two end points of Egnatia – the city of Igoumenitsa in the West, the city of Alexandroupolis in the East – will diminish from about 620 minutes in 2001 to 400 minutes after the completion of the motorway. In total, it will take about 3,5 hours or 35% less to cross Northern Greece. Moreover, the implementation of the Egnatia-P.A.T.H.E.-Scenario and the full Greek motorway scenario will contribute to a further improvement of travel times, in particular for locations at the far ends of the Via Egnatia, as the examples of the sections Igoumenitsa-Athens and Alexandroupolis-Athens show (see Table 2).

Table 2: Travel times according to the different scenarios – two examples

	Base	*Via Egnatia*	*Via Egnatia-P.A.T.H.E.*	*Greek Motorways*	*TEN/ TINA*
Igoumenitsa-Athens					
Travel times (minutes)	437	414	410	345	345
Travel time reduction (vs. Base scenario, minutes)	0	-23	-28	-93	-93
Travel time reduction (vs. Base scenario, percent)	0	-5,3	-6,4	-21,3	-21,3
Alexandroupolis-Athens					
Travel times (minutes)	648	533	490	488	488
Travel time reduction (vs. Base scenario, minutes)	0	-115	-159	-160	-160
Travel time reduction (vs. Base scenario, percent)	0	-17,7	-24,5	-24,7	-24,7

The numerical presentation of travel times has an evident disadvantage: Each pair of origins and destinations needs to be displayed separately which complicates a comprehensive view of the achieved travel time gains. The use of isochrones represents an alternative form of illustrating changes in travel time. Exemplarily, Figure 2 shows isochrones prior and after the full implementation of the Egnatia motorway, taking Thessalonica, the main city in northern Greece, as origin. In 2001, the 60 and 90 minutes isochrones form approximate concentric rings around the regional capital. All regions adjacent to the Thermaikos Bay (from south of Kalamaria to Katerini) lie within the ring delineated by the 60 minutes threshold; within 90 minutes car travel time, the borders to Bulgaria and former Yugoslavia can be reached.

A comparison of base scenario (2001) and Via Egnatia scenario reveals that the greatest travel time reductions will be obtained north-east of Thessalonica towards the city of Kavalla. This corresponds to the area where a major section of Via Egnatia still is to be completed. Not surprisingly, its implementation will lead to conspicuous travel time reductions mirrored by an extension of the 60 and 90 minutes isochrones in North-Eastern direction. On the other hand, in the South-Western hinterland of Thessalonica very small further improvements are likely to occur after 2001. Indeed, here the motorway link had already been accomplished in the 1990s.

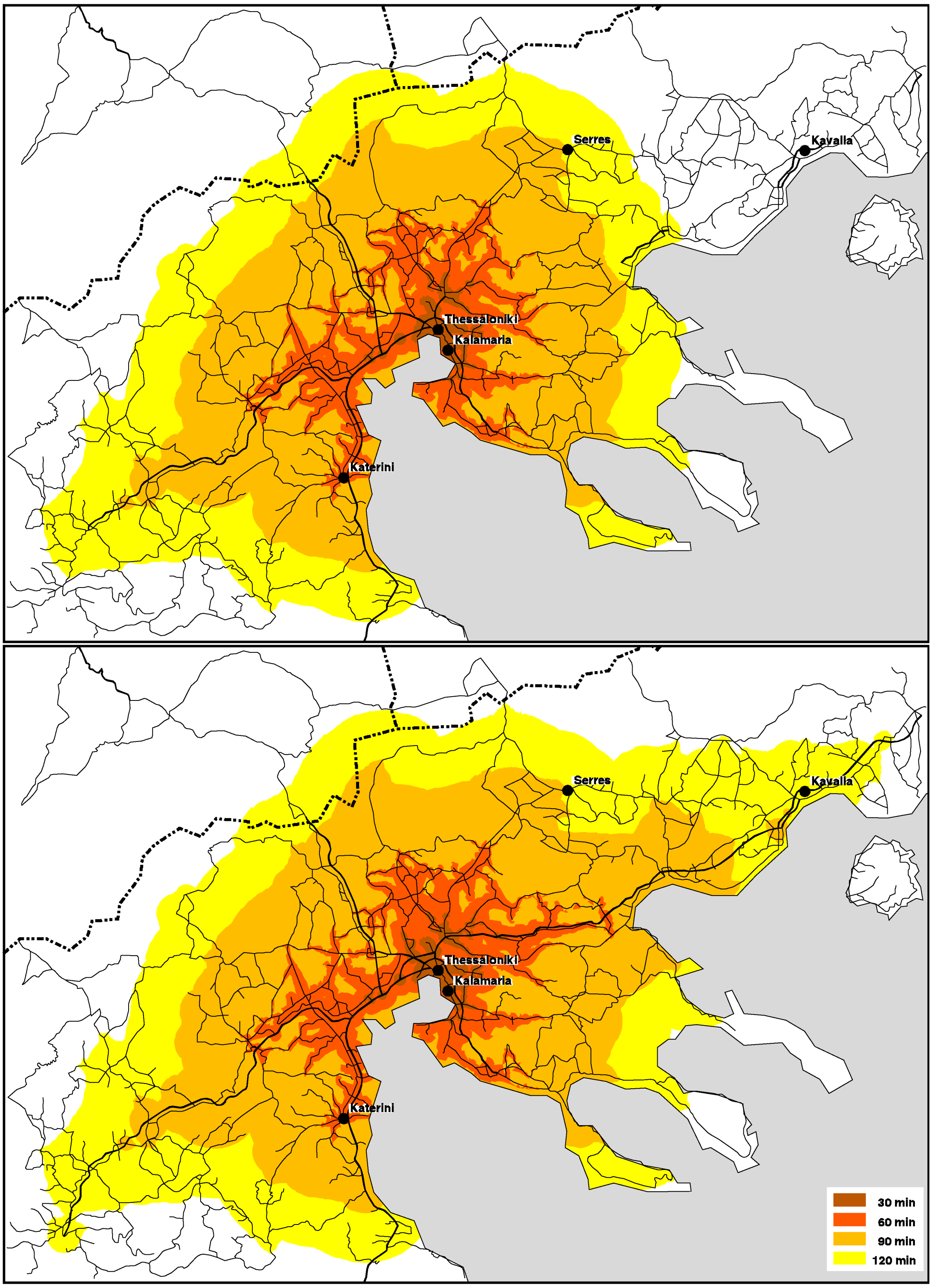

Figure 2: Isochrones prior (top) and after (bottom) the full implementation of the Egnatia motorway

In order to identify those regions benefiting the most from travel time reductions, the average travel times from each Greek NUTS3-region to all other Greek regions are calculated. As expected, there are large differences between core and periphery: While the average travel time from the centrally situated regions - namely Fthiotidas and

Larisis – to all Greek NUTS3 regions (comprising the islands) is of about 6 hours, the same variable exceeds 10 hours for the very North-Eastern regions Evrou, Rhodopis and Xantis. If the average travel times of the different scenarios are compared, it is possible to find out the relative "winners" in terms of travel time savings. Figure 3 shows the travel time differences between Base Scenario and Via Egnatia Scenario. It proves that, as already shown above, the regions at the end points of Via Egnatia take the greatest advantage. Their travel time savings amount to more than two hours. and compared between the different scenarios.

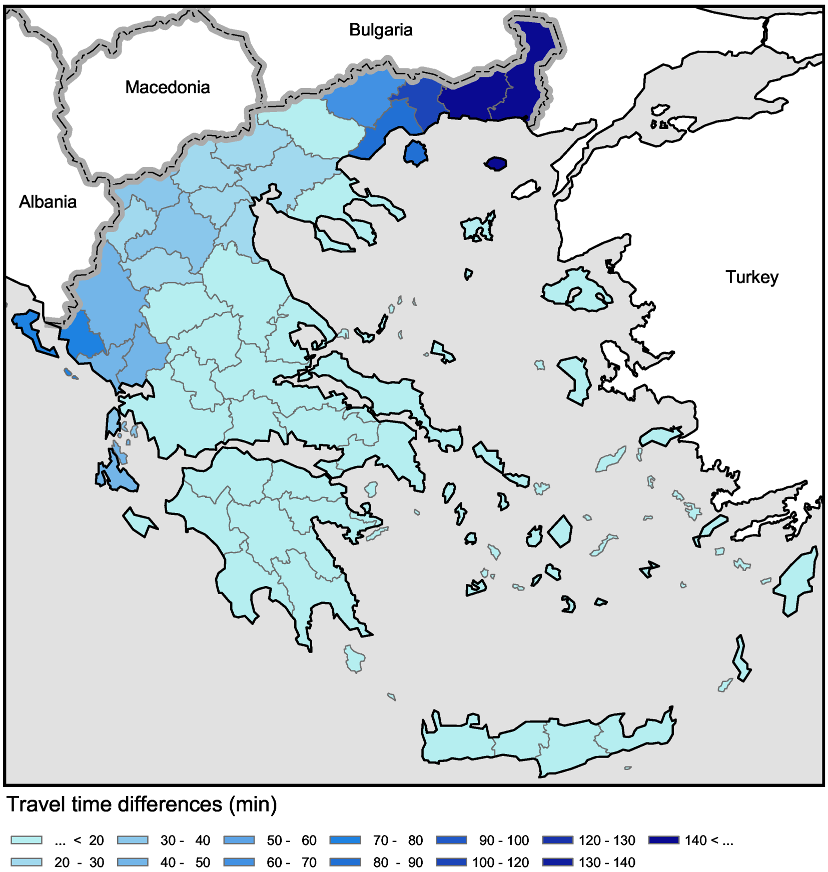

Figure 3: Via Egnatia vs. Base Scenario. Travel time differences.

Despite of their intelligibility, travel time figures and isochrones are hardly suited to evidence the outcomes of improvements in transport networks. They fail to capture the size of destinations at the respective nodes of a transport route. Likewise, the mere calculation of travel time changes between two nodes of a transport link does not reveal much about the amount of expected movements and the economic importance of the link, and hence the need for investing in the reduction of travel time.

5 Second analysis step: potential type accessibility

In contrast, potential type accessibility models also take into consideration the "mass" of destinations. The accessibility values referred to in this paper rely on the European Peripherality Index developed by Schürmann and Talaat (2001). Belonging to the group of more complex accessibility indicators, the potential-type accessibility combines activity function (destinations to be reached) and impedance function (costs to reach a destination). In this study, the impedance function is represented by car travel time subject to national speed limit, road gradients and congestion. For the activity function the population mass term is employed. By applying this potential-type accessibility model to the Greek NUTS 3 regions, it is possible to foresee the increase of accessibility due to single infrastructure projects. As expected, the implementation of the Egnatia motorway leads to an advanced accessibility of all NUTS3 regions in Northern Greece. However, the accessibility increments are not limited to the regions adjacent to the new motorway route, but also extend to the more distant regions in central Greece. Totalling, the accessibility improvements are yet rather modest (see Figure 4).

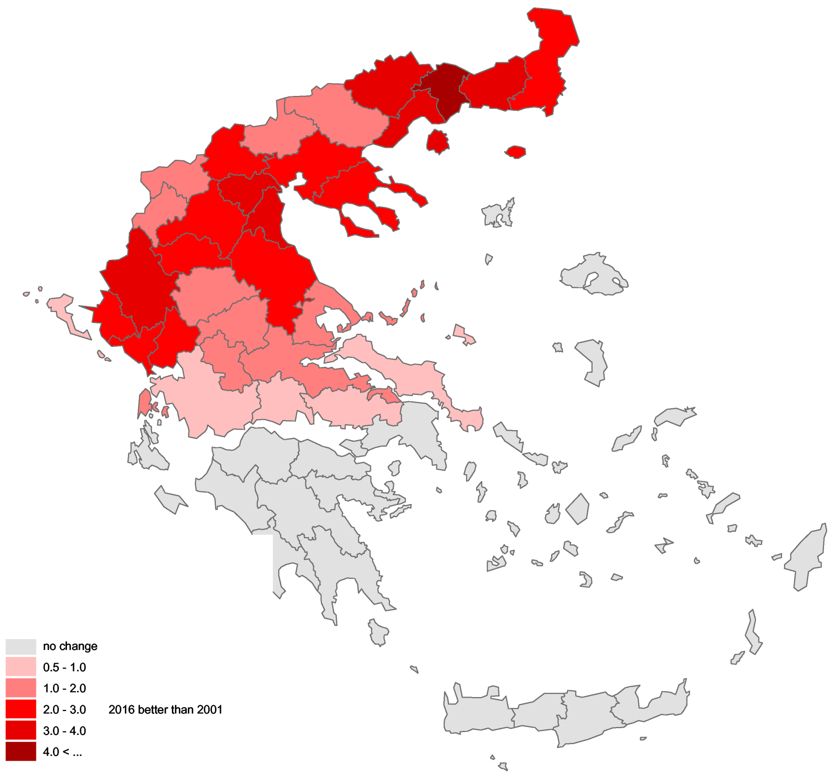

Figure 4: Via Egnatia v. Base scenario. Access to population by car for NUTS 3 regions. Relative differences in percentage points (GR current situation = 100).

The NUTS 3 region benefiting the most in accessibility terms is Xanthis in the North-Eastern part of the country. Its accessibility will rise by more than 4%. Similar gains in accessibility can be stated all along the Egnatia route, from Thesprotias and Prevezas on the Adriatic Coast to Rodopis and Evrou in the very East (+2 to +3%). The more distant regions such as Evias, Viotias and Fokidos will anyhow advance in accessibility by some 0.5 to 1 percent.

At a first glance, these results may surprise as the changes in accessibility turn up rather small. However, the low increments can easily be interpreted by recalling the accessibility equation. Truly, the Egnatia motorway contributes to a clear reduction of travel times between the nodes of the motorway route as shown in the isochrone illustrations of the preceding analysis step. Thereby, the "impedance-factor" is diminished. The other half of the accessibility equation, the activity function, yet remains stable. In other words: the population directly reachable through the new motorway does not increase significantly, which results in only slight accessibility gains. Contrary, the realisation of the whole TEN/TINA motorway projects, including the P.A.T.H.E. North-South corridor, will lead to clearly higher accessibility gains (see Figure 5). The positive impacts of the P.A.T.H.E. link are not limited to its direct "neighbours", but comprise the whole of the Northern Greek regions. The improved access to the densely settled South of the country through the Egnatia *and* the P.A.T.H.E. motorways leads to relative accessibility increments of 10 to 15 percent in several of the Northern Greek regions along the Egnatia motorway.

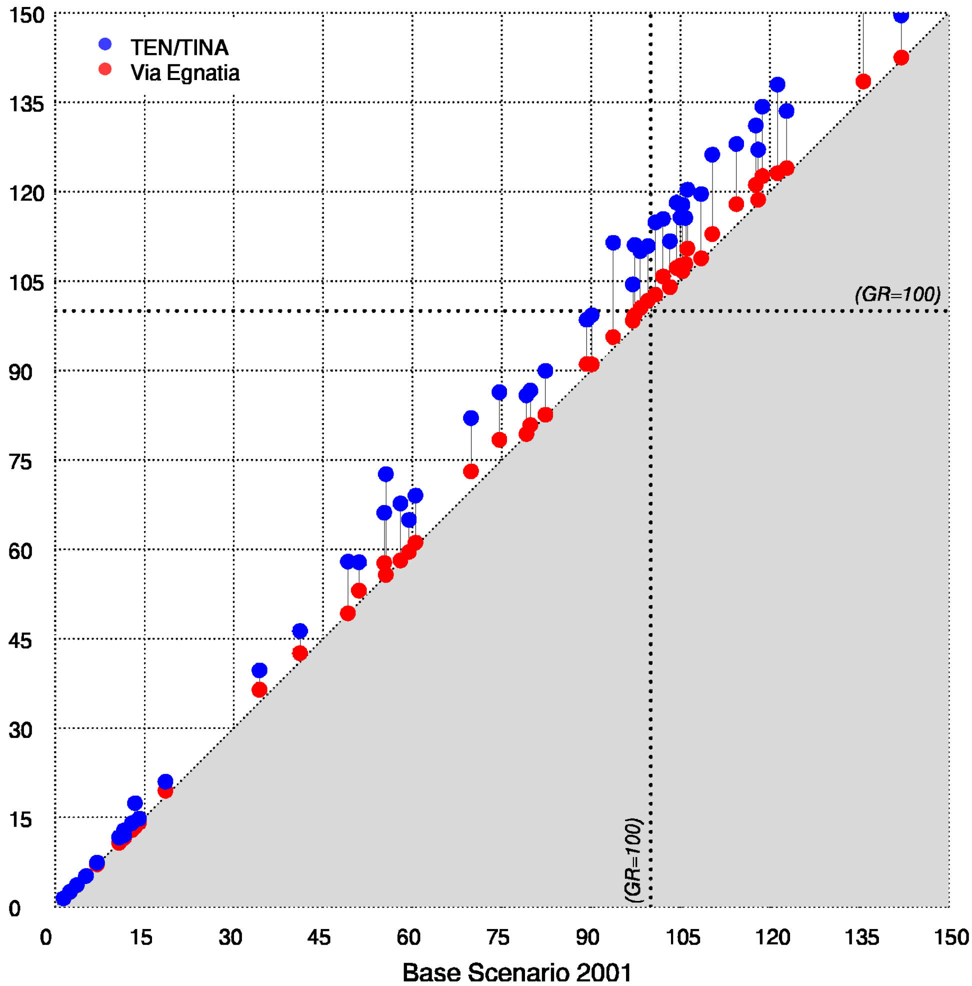

Figure 5. Access to population by car for Greece regions (NUTS 3) (GR current situation =100). Base Scenario against Via Egnatia Scenario and full TEN/TINA Scenario.

Figure 5 confirms that the overall impact of the new Egnatia motorway on the potential type accessibility of the Greek NUTS3-regions will be rather small, while the combined implementation of all road infrastructure investments foreseen in the TEN/TINA scenario leads to clearly higher increases in accessibility (blue dots in the diagram). These results highlighten the importance of improved transport connections between peripheral and central, densely populated regions for increasing the potential of markets accessible from peripheral locations, though the causal connection between accessibility and economic development of peripheral regions is generally discussed controversally.

Finally, the analysis of the potential type accessibility allows an important conclusion with regard to cohesion. Despite of the large road infrastructure investments in the Greek "periphery", the overall accessibility patterns of the country hardly change. The relative accessibility differences between Greek core and periphery persist. Even after the implementation of the Egnatia motorway, the regions on the Adriatic coast still belong to the group of least accessible regions in Greece, while the Eastern part of the country remains ahead (see Figure 6). Also the realisation of the Egnatia-P.A.T.H.E. scenario, the TEN scenario and the TINA/TEN scenario do not lead to more evenly distributed accessibilities among the Greek regions. Hence, the European Commission's aim of reducing regional disparities in terms of accessibility is hardly attained, which is also confirmed by the Gini coefficients. Even the implementation of the full TEN/TINA road network does not significantly decrease the Gini coefficient with regard to the accessibility of the Greek NUTS3 regions (see Table 3, Figure 7). In this, the Gini coefficients confirm previous accessibility studies where also only small cohesion effects could be evaluated (e.g. Wegener et al., 2001)

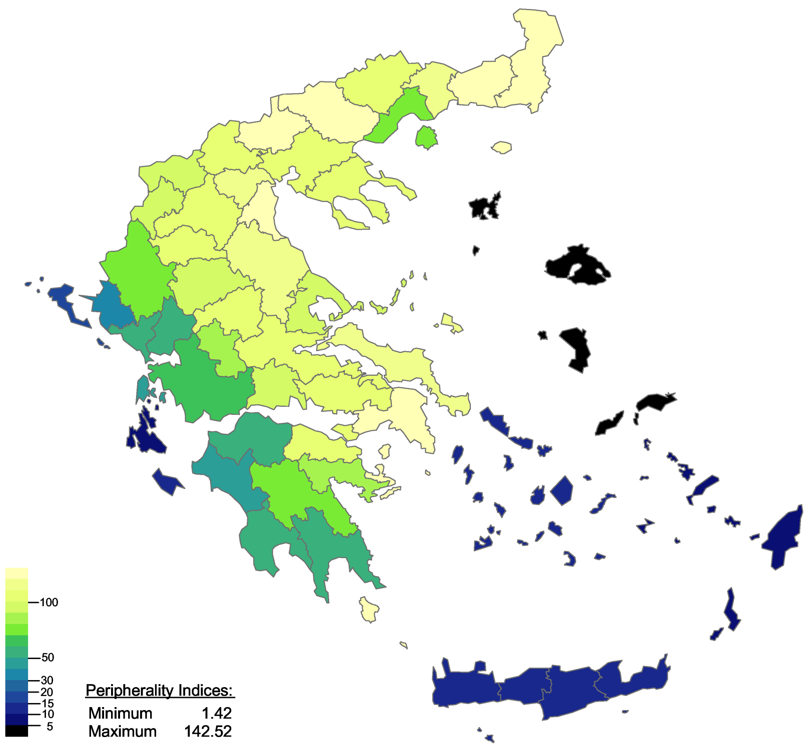

Figure 6: Access to population in the Via Egnatia scenario (GR Base Scenario = 100) for NUTS3 regions

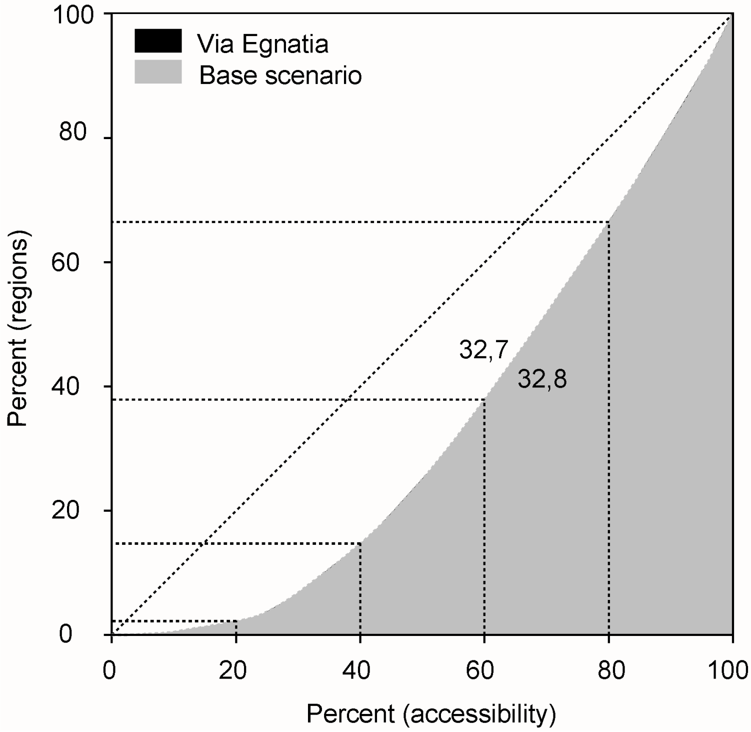

Figure 7: Gini coefficients indicating the distribution of accessibility in Greece; 51 NUTS3 regions included; Base scenario and Via Egnatia scenario

Table 3. Accessibility. Gini coefficients; 1,083 NUTS 3 regions for EU member states, 51 Greek NUTS 3 regions included.

Scenario	*EU regions*	*Greek regions*
Base scenario	0.324	0.328
Via Egnatia	0.323	0.327
Via Egnatia / P.A.T.H.E.	0.323	0.327
Greek motorways	0.323	0.321
TEN/TINA	0.321	0.321

The explanation for the persistence of unequal accessibilities is evident. On the one hand, the accessibility calculations depart from stable “masses” – i.e. population distributions – for all scenarios. Therefore, the self-weight of each NUTS3 region as one crucial variable for its potential type accessibility remains also stable – a factor systematically neglected by simple travel times models. On the other hand, the positive effects of the new TEN road links, namely the Egnatia motorway, is not restricted to the regions situated nearby. As shown before, the accessibility benefits achieved through Via Egnatia are largely distributed over the Greek mainland (see Figure 4). Consequently, not only the accessibility of the rather peripheral regions along the Egnatia track, but, to a minor degree, also the one of centrally situated regions such as Attica is increased. Therefore, the gap between core and periphery is hardly diminished.

6 Third Analysis step III: Socio-economic impacts

So far, only direct effects of Via Egnatia on travel times and accessibilities were analysed. However, from a political, economic and social point of view not only the changes in accessibility, but rather in dimensions such as "wealth" or "economic development" need to be looked at. Therefore, the third analysis step introduces the SASI model, a simulation model of regional economic development which allows to anticipate changes of the regional Gross Domestic Product (GDP) related to changes in the transport network.

The simulation model "Socio-economic and Spatial Impacts of Transport Infrastructure Investments and Transport System Improvements" (SASI) was developed by IRPUD and its research partners in the context of the 4th Framework Programme for DG TREN as part of the EUNET project. The SASI model consists of six interdependent forecasting sub-models: 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 (see Figure 8).

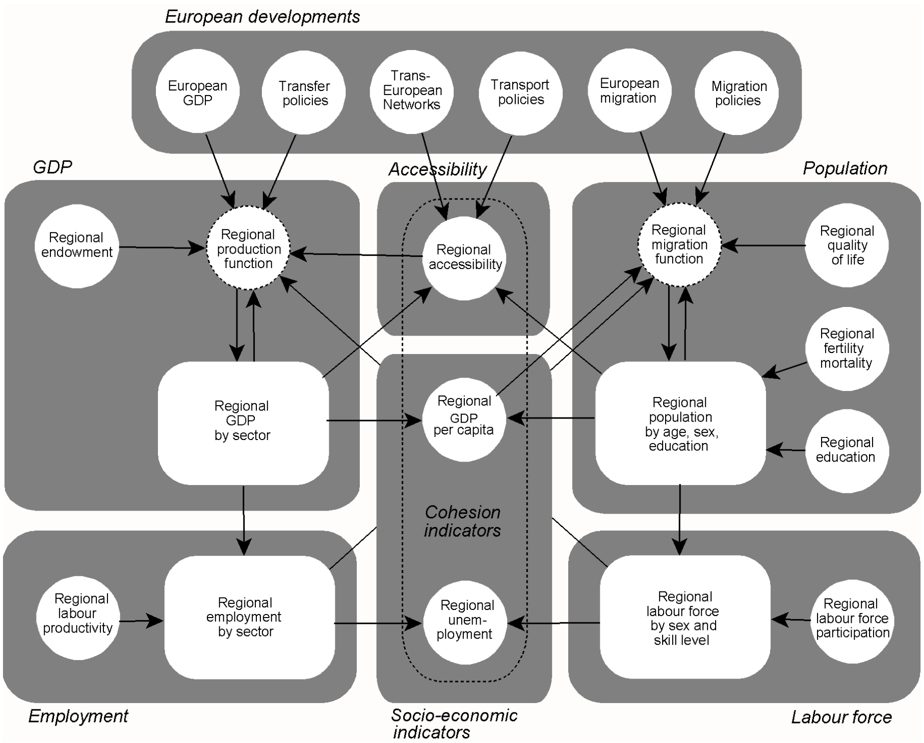

Figure 8: The SASI-model (Fürst et al., 1999).

One of the exogenous variables in the European Developments submodel are the trans-European networks (TEN) which have a direct impact on the submodel of accessibility. A change in the accessibility submodel in turn evokes changes in all other subsystems. Thereby, the SASI model allows to quantify impacts of infrastructure improvements comprehensively (Fürst et al., 1999; 2000). In order to demonstrate the impacts of different transport investments, the SASI model compares three basic scenarios which partly coincide with the ones used in the first two analysis of this study: 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 leads to conclusions concerning the expected development of the accessibility and the resulting economic development of the Greek regions. Though SASI was not specifically applied to the Egnatia case study so far, its outcomes allow to make some general observations on the effects of the TETN road network improvements in Greece of whom Egnatia represents a major part.

According to the SASI model, the overall GDP-increase specifically due to the transport infrastructure investments is rather low. If the full "TEN-Scenario" and the "Do-Nothing-Scenario" are compared, the additional relative GDP-increase of Greek regions will be only of about 1 to 5 percent (see Figure 9).

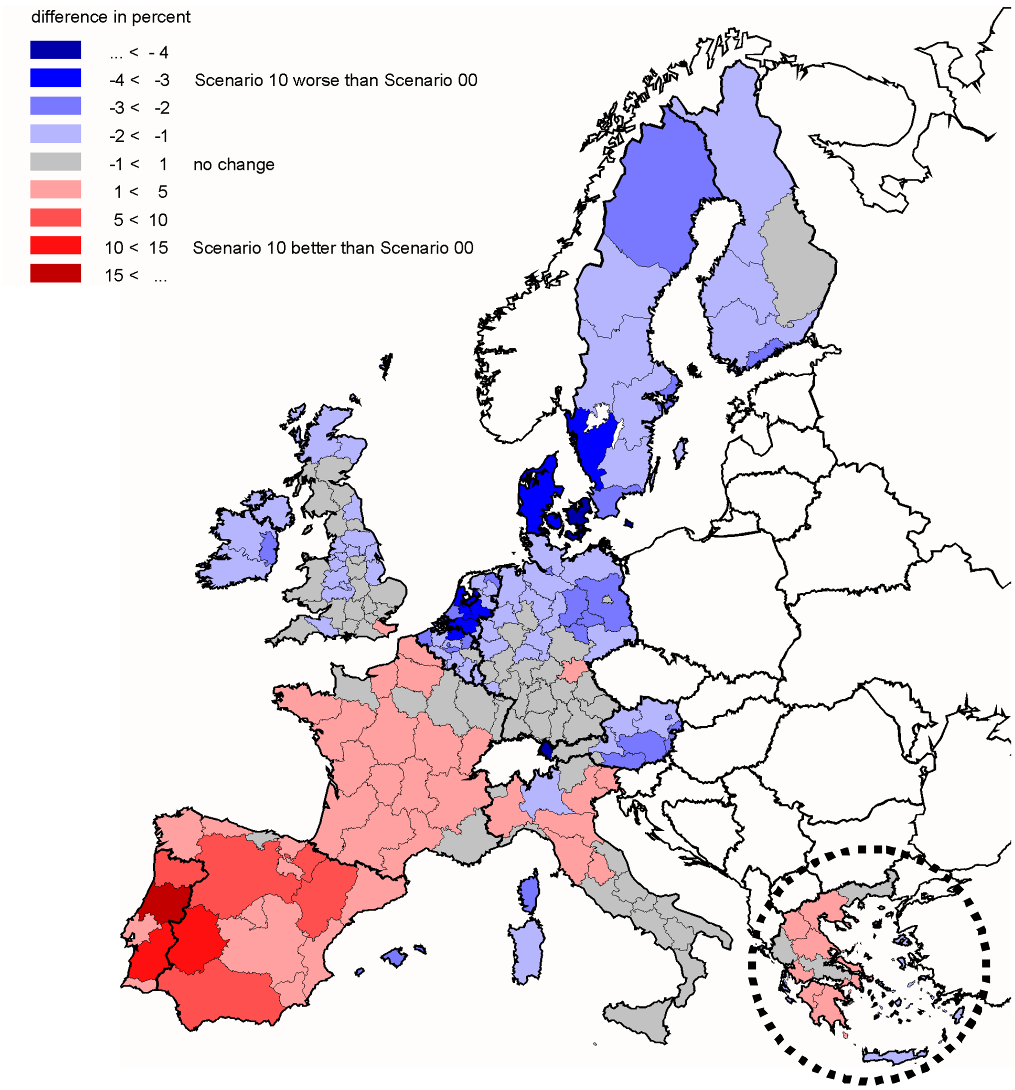

Figure 9: The impact of the TEN road and rail infrastructure investments on the relative development of the GDP in Europe (TEN-Scenario vs. Do-Nothing-Scenario, relative difference, 2016) (Fürst et al., 1999, 41).

In order to illustrate the impact of the planned *road* infrastructure investments on the GDP development, it is necessary to compare the “Rail TEN” and the “TEN-scenario”. This comparison allows to identify those European regions taking most advantage from the expected improvements of the road network. Figure 10 indicates that 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.

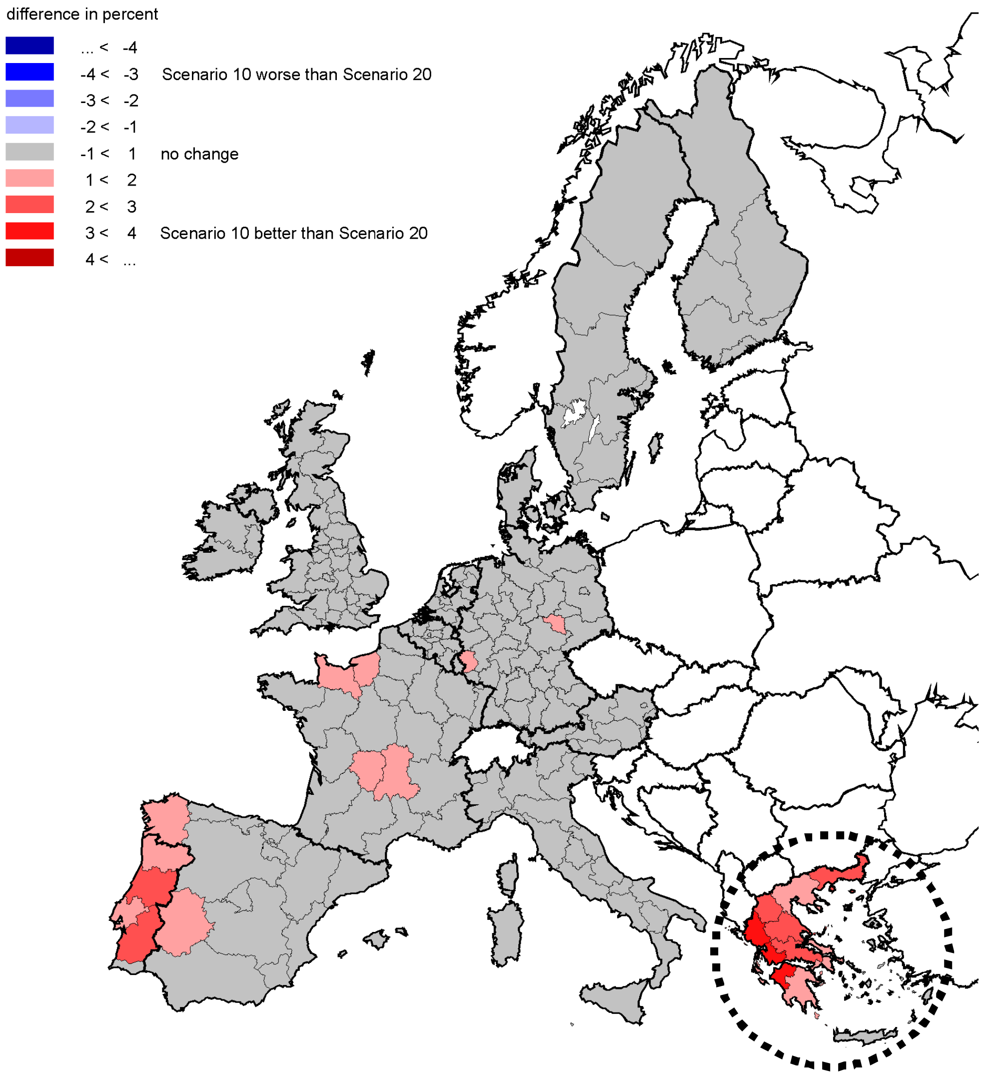

Figure 10: The impact of the TEN road infrastructure investments on the relative development of the GDP in Europe (TEN-Scenario vs. Rail TEN-Scenario, relative difference, 2016) (Fürst et al., 1999, 46).

7 Conclusions and outlook

The example of the Egnatia motorway served for presenting a proposal for a differentiated, multi-step analysis of spatial and socio-economic impacts induced by changes in the transport network. While the travel times and the isochrone approach is easy to communicate, but ignores the "mass" of potential destinations, the potential-type accessibility allows a sound assessment of the spatial impacts. The most relevant results can be attained by using a simulation model such as the SASI-model for reproducing the economic effects of new transport links.

Concerning the Egnatia motorway, the study found out that particularly the regions situated at the Eastern and Western end points of the Via Egnatia route will experience large travel time savings to other Greek and European destinations. Yet the relative increments in accessibility of the Northern Greek regions will remain rather small unless also further motorway projects, namely the P.A.T.H.E. motorway, are being implemented. An additional positive effect is to be expected by the vertical axes linking Egnatia to its hinterland. However, neither Via Egnatia nor the total of the TEN motorway projects will be able to clearly reduce the accessibility disparities within Greece, hence one has to question positive effects on cohesion.

Another result is that the expected effects of the Greek TEN projects on the GDP development are probably overestimated. Though the Greek regions will belong to those with the highest GDP gains in relative terms induced by road infrastructure improvements in Europe, the related increments in GDP will not exceed the 5 percent threshold (not to mention the absolute GDP level). To conclude, Egnatia will induce marked, but modest increases in GDP. Hence it may be doubted that Egnatia will effectively "multipl[y] investment in industry and tourism" (Egnatia Odos A.E., 2002) or "enhance[…] the geopolitical position of Greece in Europe" (Egnatia Odos A.E., 2001b).

The analysis steps presented in this paper deliberately focus on the spatial and economic impacts of new transport links. Moreover, the SASI model is also capable to predict impacts on socio-economic variables such as employment and cohesion (Fürst et al., 1999). An overall assessment of impacts should also extend to further analysis dimensions, namely the effects on the transport system itself, measured in the traditional transport simulation models, and the environmental impacts (energy consumption, impact on landscape and eco-systems, discharges). Innovative approaches towards such a comprehensive evaluation are presently developed by the "Egnatia Motorway Spatial Impacts Observatory", a co-operation of the Egnatia Odos A.E., the Aristotle University of Thessalonica and the Hellenic Institute of Transport (Egnatia Odos A.E., 2001a). The integration of environmental submodels into regional economic simulation models can be rated as an important task for future research.

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