# Spatial Impacts of the Trans-European Networks for the New EU Member States

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## Abstract

In the EU project *Integrated Assessment of Spatial Economic and Network Effects of Transport Investments and Policies* (IASON) a model of regional socio-economic development was applied to different scenarios of further development of the European transport networks in the enlarged European Union plus Norway and Switzerland to answer the question whether infrastructure improvements contribute to the reduction of economic disparities among regions and so the cohesion objective of the European Union.

The results of the model simulations show that the infrastructure investment programmes of the past have contributed to widening the spatial disparities between central and peripheral regions in Europe. The new list of TEN priority projects is a clear advance in this respect. The simulations demonstrate that rapid upgrading and extending of the rail and road infrastructure in eastern Europe would contribute to the economic and social integration of the new member states after the enlargement of the European Union.

## 1. Introduction

The relationship between transport infrastructure and economic development has become more complex than ever. There are successful regions in the European core confirming the theoretical expectation that location matters. However, there are also centrally located regions suffering from industrial decline and high unemployment. On the other side the poorest regions, as theory would predict, are at the periphery, but there are also prosperous peripheral regions in the Nordic countries. The enlargement of the European Union has made things even more difficult as in the new member states there are fast growing regions both in the centre and at the periphery.

The European Union expects to contribute to reducing the socio-economic disparities between its regions by the development of the trans-European transport networks (TEN) in the old member states and the so-called Transport Infrastructure Needs Assessment (TINA) networks in the new member states. However, although the TEN and TINA networks are one of the most ambitious initiatives of the European Community, the programme is not undisputed.

Critics argue that many of the new connections do not link peripheral countries to the core but strengthen the ties between central counties and so reinforce their accessibility advantage. Some analysts argue that regional development policies based on the creation of infrastructure in lagging regions have not succeeded in reducing regional disparities in Europe, whereas others point out that it has yet to be ascertained that the reduction of barriers between regions has disadvantaged peripheral regions. From a theoretical point of view, both effects can occur. A new motorway or high-speed rail connection between a peripheral and a central region, for instance, makes it easier for producers in the peripheral region to market their products in large cities; however, it may also expose the region to the competition of more advanced products from the centre and so endanger formerly secure regional monopolies. These issues have received new attention through the enlargement of the European Union by ten countries in eastern and southern Europe in 2004.

The consistent prediction and the rational and transparent evaluation of likely socio-economic impacts of major transport infrastructure investments has therefore become of great political importance. In several EU-funded research projects models for forecasting the economic and spatial impacts of large transport investments in Europe were developed. One of them was the project *Socio-Economic and Spatial Impacts of Transport Infrastructure Investments and Transport System Improvements* (SASI) conducted in the 4th Framework Programme for Research and Technological Development under the leadership of the Institute of Urban and Regional Research of the Technical University of Vienna (Wegener and Bökemann, 1988; Fürst et al., 2000; Schürmann et al., 2001). The SASI model was further developed at the Institute of Spatial Planning of the University of Dortmund in the project *Integrated Assessment of Spatial Economic and Network Effects of Transport Investments and Policies* (IASON) in the 5th Framework Programme (Bröcker et al., 2002a; 2002b; 2004).

The main goal of the application of SASI in IASON was to forecast the impacts of transport infrastructure investments and other transport policies on socio-economic activities and developments in Europe with special attention to the spatial and temporal distribution of impacts. The extended SASI model was applied to a number of different scenarios of implementation of the TEN and TINA networks and of additional transport policies.

In this paper these results are presented with special emphasis on the impacts of European transport policy on the new member states. For this the list of scenarios studied in IASON was extended by two scenarios with specific assumptions about the implementation of the TINA networks in eastern Europe provided by the Stanisław Leszczycki Institute of Geography and Spatial Organization of the Polish Academy of Sciences. This paper is the result of that co-operation.

## 2. Model Overview

The SASI model is a recursive simulation model of socio-economic development of regions in Europe subject to exogenous assumptions about the economic and demographic development of the European Union as a whole and transport infrastructure investments, in particular of the trans-European transport networks, and other transport policies.

The main concept of the SASI model is to explain locational structures and locational change in Europe in combined time-series/cross-section regressions, with accessibility indicators being a subset of a range of explanatory variables. The focus of the regression approach is on the long-term spatial distributional effects of transport policies. Factors of production including labour, capital and knowledge are considered as mobile in the long run, and the model incorporates determinants of the redistribution of factor stocks and population. The model is therefore suitable to check whether long-run tendencies in spatial development coincide with the spatial development objectives of the European Union. The application of the SASI model is restricted, however, in other respects: The model generates mainly distributive and only to a limited extent generative effects of transport cost reductions, and it does not produce regional welfare assessments fitting into the framework of cost-benefit analysis.

The SASI model differs from other approaches to model the impacts of transport on regional development by modelling not only production (the demand side of regional labour markets) but also population (the supply side of regional labour markets). A second distinct feature is its dynamic network database based on a 'strategic' subset of highly detailed pan-European road, rail and air networks including major historical network changes as far back as 1981 and forecasting expected network changes according to the most recent EU documents on the future evolution of the trans-European transport networks.

The SASI model has six forecasting submodels: *European Developments*, *Regional Accessibility*, *Regional GDP*, *Regional Employment*, *Regional Population* and *Regional Labour Force*. A seventh submodel calculates *Socio-Economic Indicators* with respect to efficiency and equity. Figure 1 visualises the interactions between these submodels.

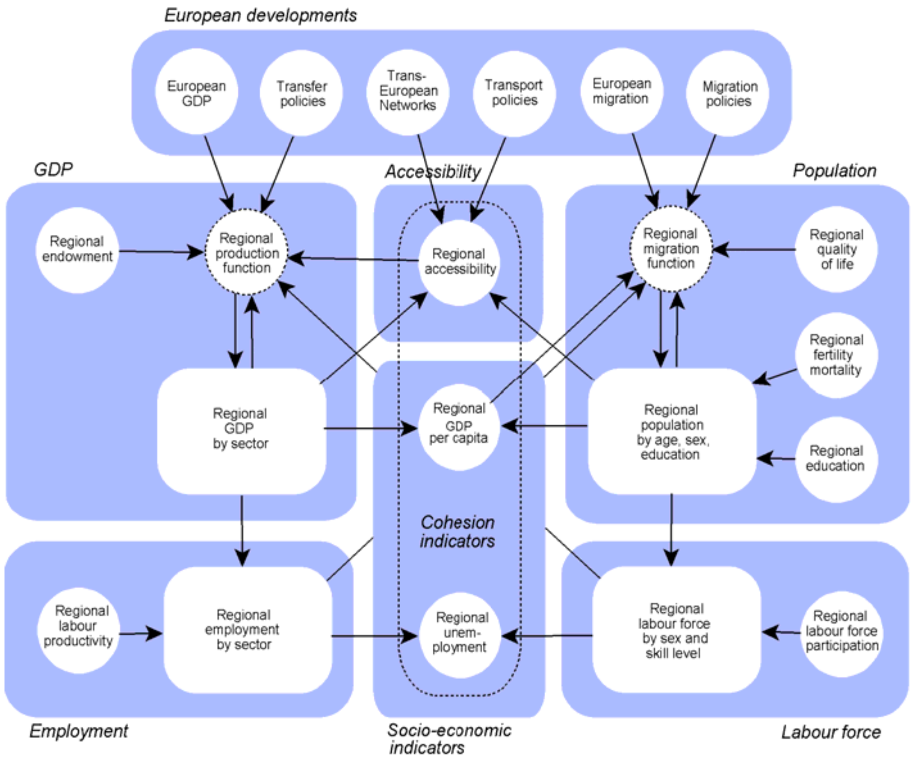


*Figure 1. The SASI model*

The *spatial* dimension of the model is established by the subdivision of the European Union plus Norway, Switzerland, Bulgaria and Romania in 1,321 regions and by connecting these by road, rail and air networks. For each region the model forecasts the development of accessibility and GDP per capita. In addition cohesion indicators expressing the impact of transport infrastructure investments and transport system improvements on the convergence (or divergence) of socio-economic development in the regions of the European Union are calculated.

The *temporal* dimension of the model is established by dividing time into periods of one year duration. By modelling relatively short time periods both short- and long-term lagged impacts can be taken into account. In each simulation year the seven submodels of the SASI model are processed in a recursive way, i.e. sequentially one after another. This implies that within one simulation period no equilibrium between model variables is established; in other words, all endogenous effects in the model are lagged by one or more years.

A detailed description of the original SASI model and the model extensions implemented in IASON can be found in Schürmann et al. (2001) and Bröcker et al. (2002a). The common spatial database used in IASON is documented in Bröcker et al. (2002b). All simulation results achieved with the SASI model are described in Bröcker et al. (2004).

## 3. Scenarios

A scenario in IASON is a time-sequenced programme of implementation of transport policy options. A base or reference scenarios, in which no network improvements after 2001 are assumed serves as the benchmark for comparing scenarios. The transport policy scenarios studied in IASON included network scenarios in which different schedules of implementation of transport infrastructure projects were assumed and pricing scenarios, in which different schemes of transport pricing were examined and various combinations of the above. In this paper only the reference scenario and four network scenarios relevant for the new member states are considered (see Table 1).

*Table 1. Transport scenarios simulated in IASON*

| Scenario | Code |
|---|---|
| Reference scenario | 000 |
| Implementation of all TEN priority projects (Essen list) | A1 |
| Implementation of all TEN and TINA projects | A3 |
| Implementation of new priority projects | A51 |
| Scenario A3 plus implementation of additional TINA projects | A61 |
| Scenario A3 plus implementation of maximum TINA projects | A62 |

All scenarios rely on the trans-European transport network GIS database developed by the Institute of Spatial Planning of the University of Dortmund. The *strategic* road and rail networks used in IASON are subsets of this database, comprising the trans-European networks specified in Decision 1692/96/EC of the European Parliament and of the Council, further specified in the *TEN Implementation Report* and latest revisions of the TEN guidelines provided by the European Commission (2002) and the latest documents on the priority projects (European Commission, 2003), the TINA networks as identified and further promoted by the TINA Secretariat (2002), the Helsinki Corridors as well as selected additional links in eastern Europe and other links to guarantee connectivity of NUTS-3 level regions.

The reference scenario, the benchmark for comparing the results of the policy scenarios, represents the actual development of the road, rail and air networks in Europe between 1981 and 2001. For all future years the reference scenario preserves the state of the networks in the year 2001, i.e. no further network development after 2001 is foreseen.

Scenarios A1, A3 and A51 assume different time schedules for the implementation of the TEN and TINA networks:

- *Scenario A1* assumes the implementation of the priority projects adopted in 1996 and in 2002 in the so-called Essen list (European Communities, 1996; European Commission, 2002). The Essen priority list put most emphasis on projects in central Europe and the so-called cohesion countries Portugal, Spain, Italy and Greece.
- *Scenario A3* considers all projects included in Decision 1692/96/EC of the European Parliament and of the Council (European Communities, 1996) and reported in the *TEN Implementation Report* (European Commission, 1998) as well as all projects reported in the *TINA Final Report* and *TINA Status Report* (TINA Secretariat, 1999; 2002). Compared to the priority project scenarios, the scenario includes many more projects because the priority projects are only a subset of all TEN projects.
- *Scenario A51* assumes the implementation of the most recent proposal for the further development of the priority projects. The proposals date back to the high-level group on trans-European transport networks, the so-called Van Miert group (High Level Group, 2003) and were subsequently revised by the European Commission (European Commission, 2003). The new priority list for the first time includes projects in the new member states and the candidate countries Bulgaria and Romania, such as the high-speed rail lines from Trieste to Budapest, from Athens via Sofia and Budapest to Vienna and via Prague to Nürnberg and from Gdansk via Warsaw and Katowice to Brno/Zilinia and the Rail Baltica from Tallinn to Warsaw.

In addition, two variants of the TINA outline plans for eastern Europe were suggested (Komornicki and Korcelli, 2003). Both scenarios assume the same network development as in Scenario A3 in the countries of the European Union before its enlragement, i.e. the full implementation of the all TEN projects. With respect to new member states and the candidate countries Bulgaria and Romania, both scenarios are modifications of the TINA networks (TINA Secretariat, 1999; 2002)

- Scenario A61 represents a more realistic scenario which compared to the full TINA outline plan reduces the number of transport projects implemented. However, the scenario is more optimistic with respect to the general upgrading of the transport networks in the new member states. Almost all major roads are upgraded to motorways or dual-carriageway roads and all main railway lines are upgraded to high-speed, including the rail connections between Berlin and Warsaw and Vienna and Budapest, that were not included in the TINA outline plans, and the railway line Riga-Tallinn.
- Scenario A62 represents a maximum development scenario featuring more transport projects than Scenario A61 but still less than in the TINA outline plan, in particular with respect to rail. Whereas the TINA outline plan mainly removes existing bottlenecks and Scenario A61 improves the access of capital cities, Scenario A62 connects all regional cities (defined as cities with a population of more than 300,000). Figures 2 and 3 shows all projects in the new member states and Bulgaria and Romania included in the two scenarios.

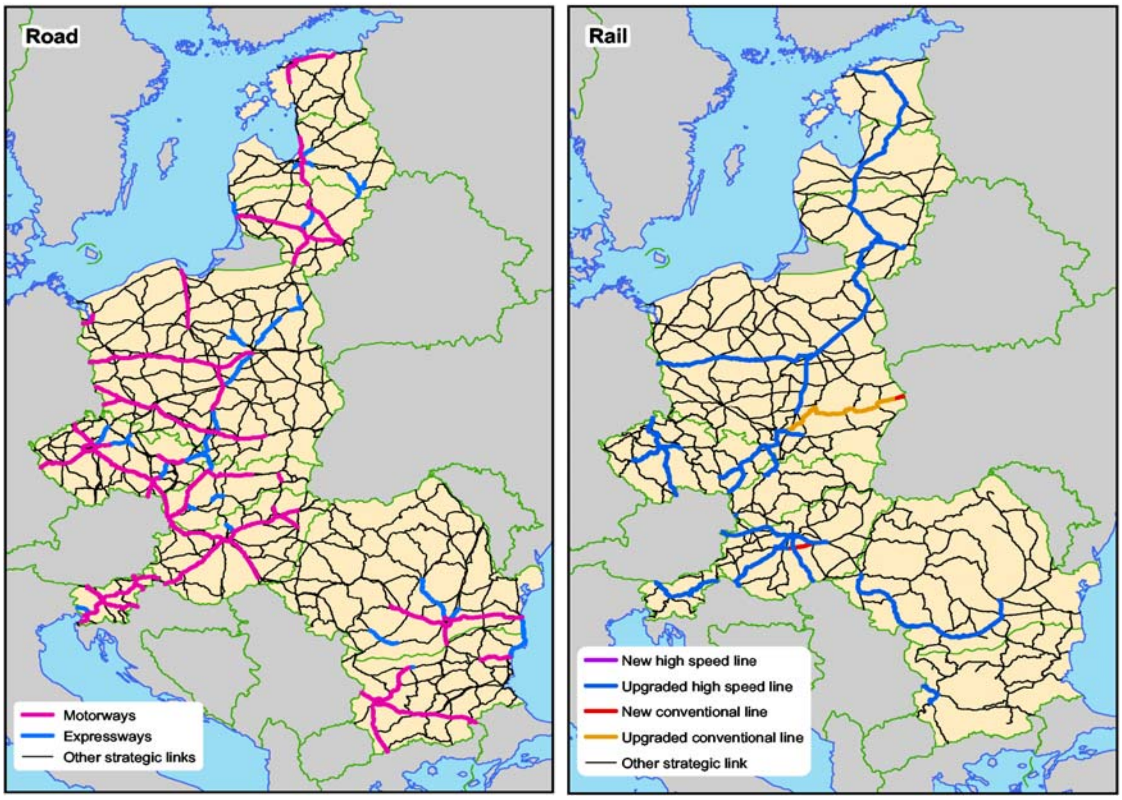


*Figure 2. Scenario A61: additional TINA projects*

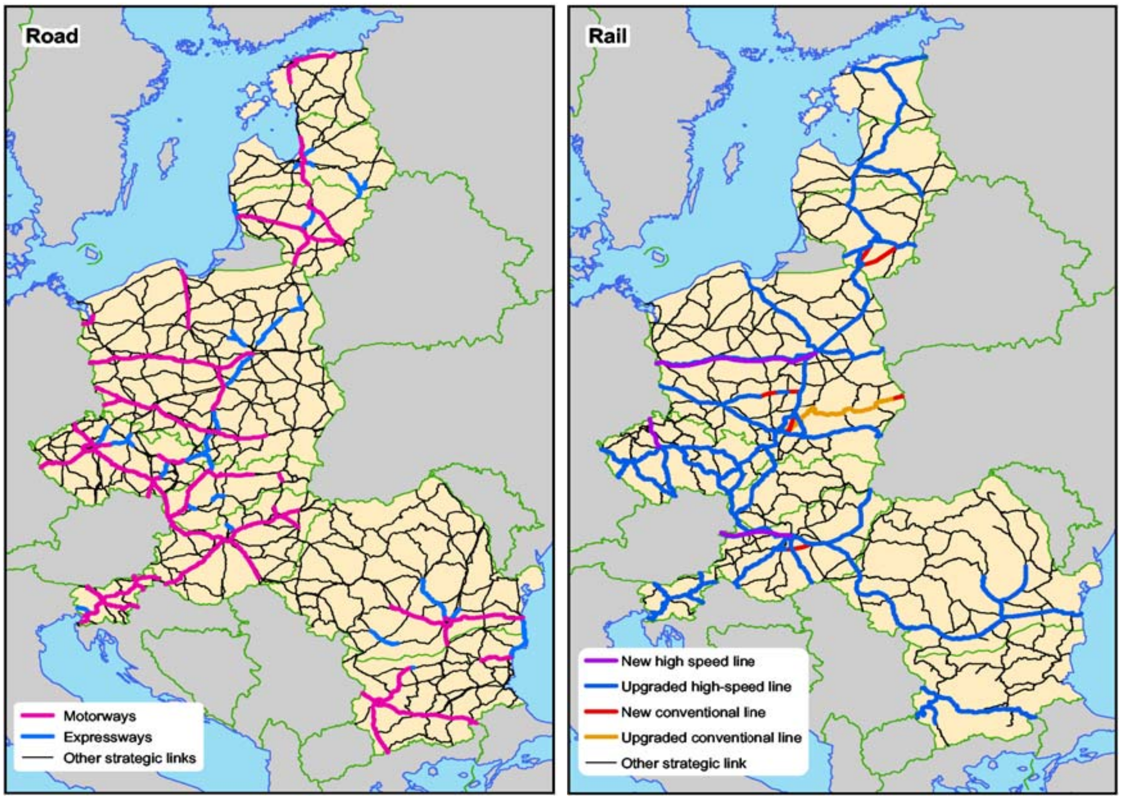


*Figure 3. Scenario A62: maximum TINA projects*

## 4. Results

The following paragraphs present the model results for scenarios A1 and A3 and A51 and A62 in terms of changes in accessibility and GDP per capita and their effects on cohesion.

### 4.1 Accessibility

Accessibility is a core concept of the SASI model. Figures 4 and 5 show the changes in accessibility caused by the policies in the selected scenarios (i.e., the difference between the accessibility in the policy scenario and in the reference scenario in 2020). The classes of the legend and the colour code are identical in all maps to allow easy comparison. Dark colour shades indicate stronger positive differences (i.e. the accessibility in the policy scenario is higher).

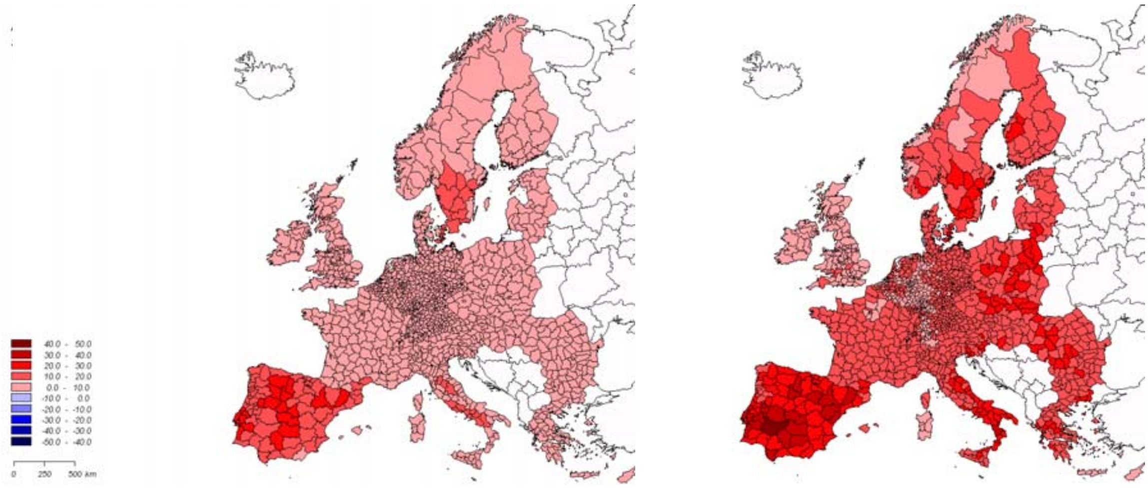


*Figure 4. Percent change in accessibility rail/road/air (travel). Scenario A1: TEN priority projects (left), Scenario A3: all TEN/TINA projects (right)*

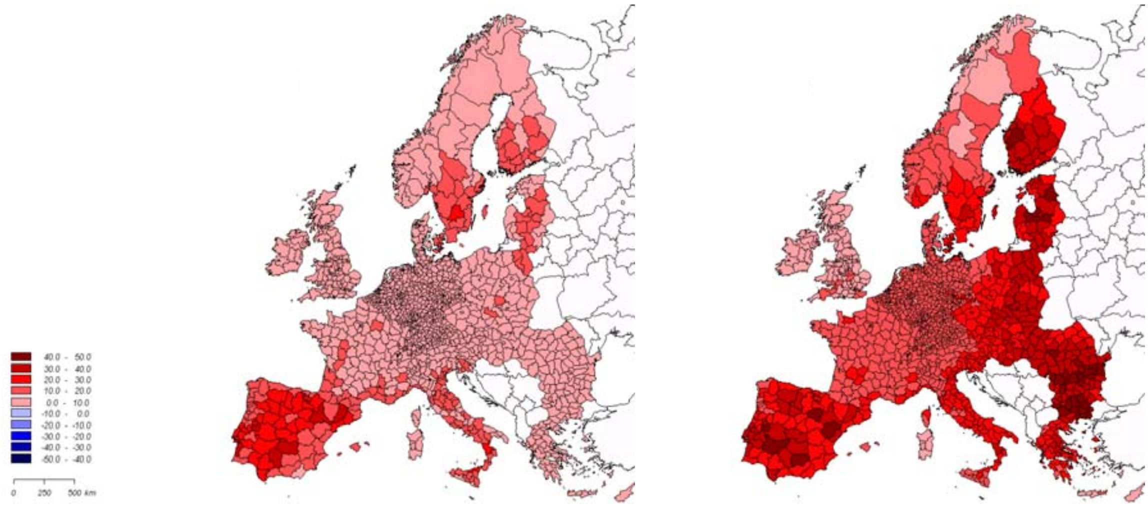


*Figure 5. Percent change in accessibility rail/road/air (travel). Scenario A51: new priority projects (left), Scenario A62: Scenario A3 plus maximum TINA projects (right)*

As to be expected, the network scenarios A1 and A3 improve accessibility everywhere but to a different degree and not equally in all parts of Europe. The TEN priority projects of the Essen list (Scenario A1) aimed primarily at improving the accessibility of the peripheral regions in the Mediterranean and the Nordic countries (see Figure 4 left). Today, with the enlargement of the European Union, the task of better linking the new member states and the candidate countries Bulgaria and Romania to the European core has become more important. If all network links designated as TEN and TINA are assumed to be implemented as in Scenario A3, the gains in accessibility are much larger and more evenly distributed across the European territory (see Figure 4 right).

Figure 5 presents the effects of the additional network scenarios on accessibility. If one compares the accessibility effects of the new list of priority projects of Scenario A51 (Figure 5 left) with those of the Essen list of Scenario A1 (Figure 4 left), the differences seem not very great. However, the new projects in Poland and the Baltic states, which also improve accessibility in Finland, can be clearly identified. Figure 5 (right) showing the effects of the most optimistic interpretation of the TINA outline plan in Scenario A62 should be compared with Figure 4 (right), in which only the minimum implementation scheme of TINA projects in Scenario A3 is assumed. The results are quite spectacular with accessibility increases in Poland, Slovakia, Romania and Bulgaria and the Baltic states between 40 and 50 percent. Again, Finland participates in these gains, but also central Europe gains because of the improved access to eastern markets.

## 4.2 GDP per Capita

The major policy-relevant output of the SASI model is regional GDP per capita, i.e. GDP totalled over all economic sectors divided by population.

Figures 6 and 7 show the changes in GDP per capita caused by the policies in the same set of policies as for accessibility (i.e., the difference between GDP per capita in the policy scenario and GDP per capita in the reference scenario in 2020). Again, the classes of the legend and the colour code are identical in all maps to allow easy comparison. Dark shades indicate positive differences (i.e. the GDP per capita in the policy scenario is higher), whereas light shades indicate negative differences. However, in contrast to the accessibility maps, now the regional GDP per capita are standardised as percent of the EU27+2 average, so that the generative effects of the GDP forecasts are neutralised and only the distributional effects are shown. This serves to demonstrate that even if the model predicts that all regions gain in GDP per capita, there are relative winners and losers.

Figure 6 demonstrates that regions that gain in accessibility also gain in GDP per capita. A comparison of Figure 6 with Figure 4 shows that if the TEN priority projects of the Essen list are implemented as in Scenario A1, the network improvements in the cohesion countries Portugal, Spain and Italy are successful in promoting economic development in these countries as intended. Figure 6 (right) shows that, as in Figure 4 (left), the implementation of all TEN and TINA projects would spread the impacts over a wider area including the new member states and candidate countries Bulgaria and Romania in eastern Europe.

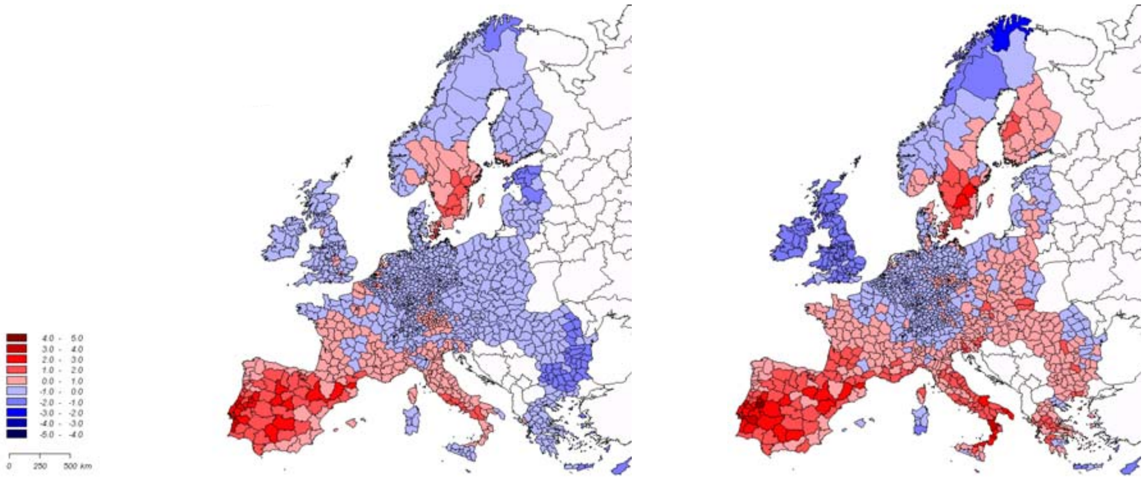


*Figure 6. Percent change in GDP per capita (EU27+2=100). Scenario A1: TEN priority projects (left),Scenario A3: all TEN/TINA projects (right)*

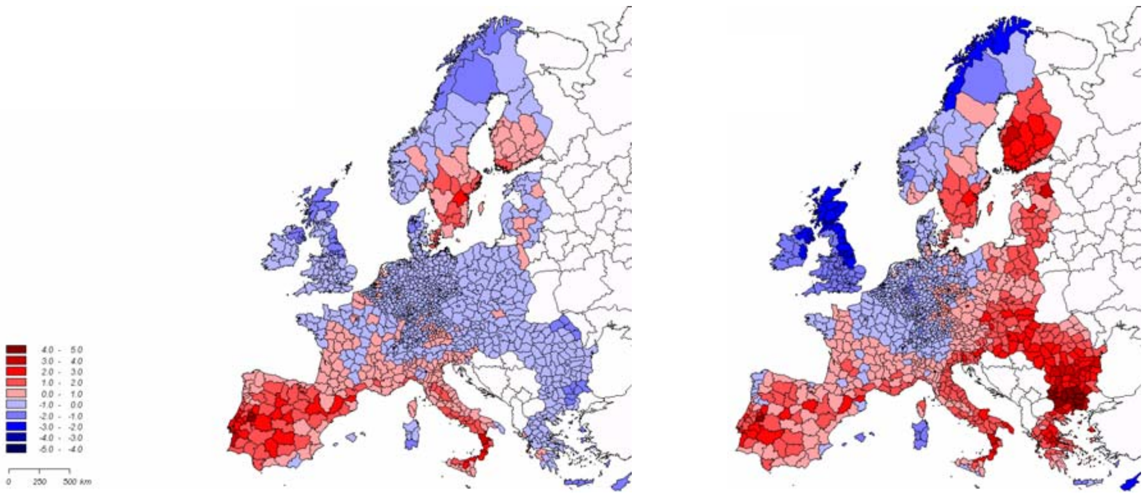


*Figure 7. Percent change in GDP per capita (EU27+2=100). Scenario 51: new priority projects (left), Scenario A62: Scenario A3 plus maximum TINA projects (right)*

The same relationship between accessibility and GDP per capita holds true for the two remaining scenario examples. The changes in GDP per capita resulting from the new priority projects in Scenario 51 (Figure 7 left) correspond with the changes in accessibility in that scenario in Figure 5 (left). A comparison with the GDP per capita in Scenario A1, in which the 'old' priority projects are implemented (see Figure 6 left), shows that the economic effects of the two priority lists are very similar, except that the new priority projects redress some of the disadvantages of the peripheral regions in eastern Europe. Not surprisingly, the massive network policies in eastern Europe in Scenario A62 lead to significant additional economic growth in the new member states and the candidate countries Bulgaria and Romania (Figure 7 right).

In this unstandardised form, all network scenarios have a positive effect on GDP per capita. As with accessibility, the largest effects are associated with the more comprehensive investment programmes: all TEN projects (Scenario A1) and all TEN and TINA projects (Scenario A3). The strongest effects are associated with Scenario 62 which assumes the maximum additional projects in eastern Europe. This confirms the hypothesis that massive improvements of the transport infrastructure in the new member states and the candidate countries Bulgaria and Romania would significantly help these countries to economically catch up with the old EU members states.

## 4.3 Cohesion

Strengthening cohesion between the regions in the European Union and reducing the economic and social disparities between them is one of the main goals of the European Union. Transport policy is one of the major policy instruments of the European Union to serve this goal in conjunction with the goal to increase the economic competitiveness of regions. With the enlargement of the European Union, cohesion issues become of growing importance.

There are many possible ways to measure the cohesion effects of transport policy measures. Five indicators of territorial cohesion were applied to the results of the scenario simulations. The five indicators are:

- *Coefficient of variation (CoV)*. This indicator is the standard deviation of region indicator values expressed in percent of their European average. The coefficient of variation ranges between zero (no variation) and one (extreme polarisation).
- *Gini coefficient (Gini)*. The Gini coefficient measures the area between the accumulated distribution of sorted indicator values and the straight line representing an equal distribution. Like the coefficient of variation, the Gini coefficient ranges between zero (equal distribution) and one (extreme polarisation).
- *Geometric/arithmetic mean (G/A)*. This indicator compares two methods of averaging among observations: geometric (multiplicative) and arithmetic (additive) averaging. If all observations are equal, the geometric and arithmetic mean are identical, i.e. their ratio is one. If the observations are very heterogeneous, the geometric mean and hence the ratio between the geometric and the arithmetic mean go towards zero.
- *Correlation between relative change and level (RC)*. This indicator examines the relationship between the percentage change of an indicator and its magnitude by calculating the correlation between them. If the correlation between the changes in GDP per capita of the region and the levels of GDP per capita in the regions is positive, the more affluent regions gain more than the poorer regions and disparities in income are increased.
- *Correlation between absolute change and level (AC)*. This indicator is constructed as the previous one except that absolute changes are considered.

The coefficient of variation, the Gini coefficient, the ratio between geometric and arithmetic mean and the correlation between relative change and level measure *relative* differences between regions and classify a policy as pro-cohesion if economically lagging regions grow faster (in relative terms) than economically more advanced, i.e. more affluent regions. However, one percent growth in a poor region in absolute terms is much less than one percent growth in a rich region. Even if poorer regions grow faster than rich regions (in relative terms), in most cases the income gap between rich and poor regions (in absolute terms) is widening. Which concept of cohesion (or convergence or divergence) is applied, is a matter of definition – and political preference. It is therefore of great importance to clearly state which type of cohesion indicator is used in an analysis.

Tables 4 and 5 summarise the information gained from the five cohesion indicators for accessibility and GDP per capita.

*Table 4. SASI model: accessibility cohesion effects*

| | Scenario | Accessibility cohesion effects (+/–) | | | | |
|---|---|---|---|---|---|---|
| | | CoV | Gini | G/A | RC | AC |
| A1 | TEN priority projects | + | + | ++ | + | – |
| A3 | All TEN/TINA projects | ++ | ++ | ++ | ++ | – |
| A51 | New priority projects | + | + | ++ | ++ | – |
| A61 | A3 + additional TINA projects | ++ | ++ | ++ | ++ | – |
| A62 | A3 + maximum TINA projects | ++ | ++ | ++ | ++ | – |

+/++ Weak/strong cohesion effect: disparities reduced
–/— Weak/strong anti-cohesion effect: disparities increased
· Little or no cohesion effect

*Table 5. SASI model: GDP per capita cohesion effects*

| | Scenario | GDP per capita cohesion effects (+/–) | | | | |
|---|---|---|---|---|---|---|
| | | CoV | Gini | G/A | RC | AC |
| A1 | TEN priority projects | + | + | · | – | — |
| A3 | All TEN/TINA projects | + | + | · | + | — |
| A51 | New priority projects | + | + | · | – | — |
| A61 | A3 + additional TINA projects | + | + | + | + | — |
| A62 | A3 + maximum TINA projects | + | + | + | + | — |

+/++ Weak/strong cohesion effect: disparities reduced
–/— Weak/strong anti-cohesion effect: disparities increased
· Little or no cohesion effect

The two tables show that with respect to accessibility, all network policies contribute to cohesion if one applies one of the first four indicators measuring relative convergence or divergence. However, if one consults also the fifth indicator, the picture is more complex as often the sign of the indicator is reversed. In terms of GDP per capita, the choice of the indicator is even more critical as now even the relative correlation indicator signals polarisation where the coefficient of variation and the Gini coefficient signal cohesion. However here, too, the convergence effect, though only in relative terms, seems to be strongest in those scenarios in which transport investment is largest, i.e. in Scenarios A1 and A62.

## 5. Conclusions

The main general result from the scenario simulations is that the overall effects of transport infrastructure investments and other transport policies are small compared with those of socio-economic and technical macro trends, such as globalisation, increasing competition between cities and regions, ageing of the population, shifting labour force participation and increases in labour productivity. These trends have a much stronger impact on regional socio-economic development than transport policies. If one considers that under normal economic circumstances the long-term growth of regional economies is in the range between two and three percent per year, additional regional economic growth of less than one or two percent over twenty years is almost negligible.

The second main result is that even large increases in regional accessibility translate into only very small increases in regional economic activity. However, this statement needs to be qualified, as the magnitude of the effect seems to depend strongly on the already existing level of accessibility. For regions in the European core with all the benefits of a central geographical location *plus* an already highly developed transport and telecommunications infrastructure, additional gains in accessibility through even larger airports or even more motorways or high-speed rail lines may bring only little additional incentives for economic growth. For regions at the European periphery, however, which suffer from the remote geographical location *plus* an underdeveloped transport infrastructure, a gain in accessibility through a new motorway or rail line may bring significant progress in economic development. But, to make things even more complex, also the opposite may happen if the new connection opens a formerly isolated region to the competition of more efficient or cheaper suppliers in other regions.

As regards the cohesion goal, the situation is complex. There are several methods and indicators to measure the contribution of a policy or policy combination to the cohesion objective. However, these methods and indicators give partly contradictory results. In particular the most frequently applied indicators of cohesion, the coefficient of variation and the Gini coefficient, tend to signal convergence where in many cases in fact divergence occurs. Beyond these methodological difficulties, it has become clear that many infrastructure investment programmes of the past have been anti-cohesion, i.e. have contributed to widening the spatial disparities between central and peripheral regions in Europe. This is even true for the 'old' list of TEN priority projects. The 'new' list of priority projects is a clear advance in this respect. However, there is room for improvement, as some of the scenarios have shown. The simulations have demonstrated that rapid upgrading and extending of the rail and road infrastructure in eastern Europe would contribute to the economic and social integration of the new member states after the enlargement of the European Union.

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## References

Bröcker, J., Kancs, A., Schürmann, C., Wegener, M. (2002a): Methodology for the Assessment of Spatial Economic Impacts of Transport Projects and Policies. IASON Deliverable 2. Kiel/Dortmund: Christian-Albrechts-Universität Kiel/Institut für Raumplanung, Universität Dortmund.

Bröcker, J., Kretschmer, U., Schürmann, C., Spiekermann, K., Stelder, D., Wegener, M. (2002b): The IASON Common Spatial Database. IASON Deliverable 3. Kiel/Dortmund: Christian-Albrechts-Universität Kiel/Institut für Raumplanung, Universität Dortmund.

Bröcker, J., Meyer, R., Schneekloth, N., Schürmann, C., Spiekermann, K., Wegener, M. (2004): Modelling the Socio-Economic and Spatial Impacts of EU Transport Policy. IASON Deliverable 6. Kiel/Dortmund: Christian-Albrechts-Universität Kiel/Institut für Raumplanung, Universität Dortmund.

European Commission (1998): *Trans-European Transportation Network. Report on the Implementation of the Guidelines. Basic Data on the Networks.* Report to the European Parliament, the Council, the Economic and Social Committee and the Committee of the Regions on the implementation of the guidelines for the development of the trans-European transport network (Decision 1692/96/EC).

European Commission (2002): Trans-European Transport Network. TEN-T Priority Projects. Luxembourg: Office for Official Publications of the European Communities.

European Commission (2003): Vorschlag für eine Entscheidung des Europäischen Parlaments und des Rates zur Änderung des geänderten Vorschlages für eine Entscheidung des Europäischen Parlaments und des Rates zur Änderung der Entscheidung Nr. 1692/96/EG über gemeinschaftlich Leitlinien für den Aufbau eines transeuropäischen Verkehrsnetzes. Brüssel: Kommission der Europäischen Gemeinschaften.

European Communities (1996): Decision No. 1692/96/CE of the European Parliament and of the Council of 23 July 1996 on the Community guidelines for the development of the trans-European transport networks. *Official Journal of the European Communities* 39, L 228, 9 September 1996, 1-104.

Fürst, F., Schürmann, C., Spiekermann, K., Wegener, M. (2000): The SASI Model. Demonstration Examples. SASI Deliverable D15. Dortmund: Institut für Raumplanung.

High Level Group (2003): *High-level group on the trans-European transport network. Report.* Brussels.

Komornicki, T.; Korcelli, P. (2003): *Alternative Scenarios of Transportation Network Development for EU Accession Countries.* IASON Technical Note IGiPZ PAN 5. Warsaw: IGiPZ.

Schürmann, C., Spiekermann, K., Wegener, M. (2001): Regional Economic Impacts of trans-European Transport Networks. In: WCTR Society (Ed.): 2001 WCTR Proceedings. Seoul: WCTR Society.

TINA Secretariat (1999): *TINA Transport Infrastructure Needs Assessment. Identification of the Network Components for a Future Trans-European Transport Network in Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia.* Final Report. Vienna: TINA Secretariat.

TINA Secretariat (2002): Status of the Pan-European Transport Corridors and Transport Areas. Developments and Activities in 2000 and 2001. Vienna: TINA Secretariat.

Wegener, M., Bökemann, D. (1998): *The SASI Model: Model Structure***.** SASI Deliverable D8. Berichte aus dem Institut für Raumplanung 40. Dortmund: Institut für Raumplanung, Universität Dortmund. http://irpud.raumplanung.uni-dortmund.de/irpud/pro/sasi/ber40.pdf.