Transport infrastructure and regional growth:

Evidence from roads and railways across the EBRD regions

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Evaluating the impact of transport infrastructure is challenging but important. New or improved transport routes can foster economic integration and have substantial economic benefits. These benefits may nevertheless vary considerably across regions and sectors, depending on how the new infrastructure changes access to buyers, suppliers and workers. This Impact Brief reports on recent EBRD research that estimates the impact of major investments to upgrade roads across Turkey as well as roads and railways in the Western Balkans. These analyses incorporate unique data at finely disaggregated geographic levels and use models to assess the impact of transport upgrades on local production, redistribution of the workforce and the wellbeing of households.

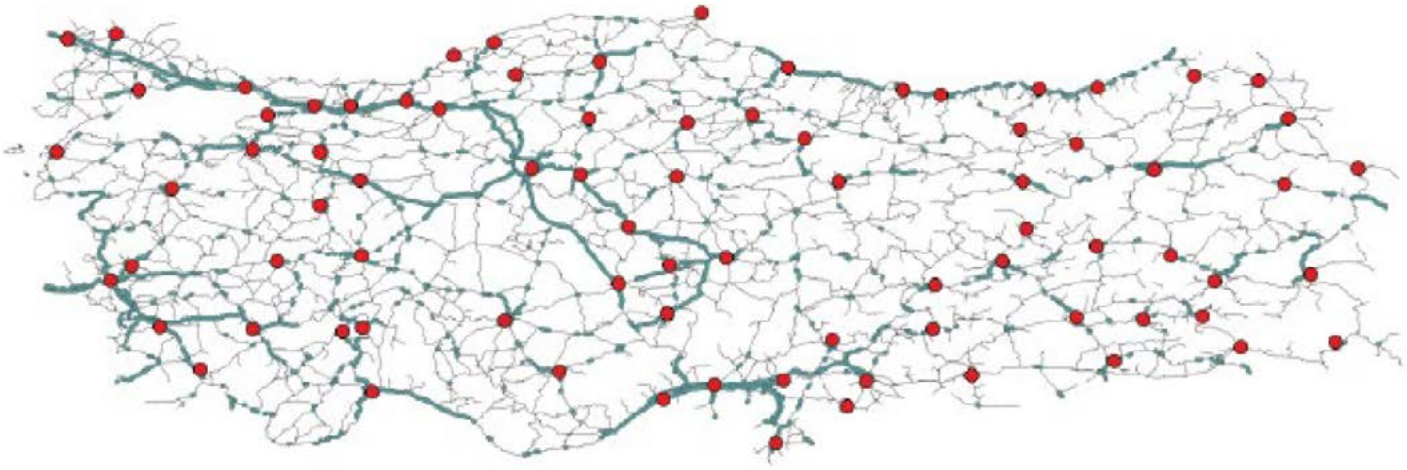
Road upgrades in Turkey

Road transport accounts for approximately 90 per cent of domestic freight and passenger traffic in Turkey. While an extensive network of paved roads already existed in 2000, their capacity and safety were deemed inadequate. A major public investment aimed to expand the road network capacity. Segments of single-carriageway, two-lane roads were upgraded to dual-carriageway, four-lane roads. As a result of this investment programme, the share of national roads consisting of dual-carriageways increased from 10 per cent to 35 per cent between 2002 and 2015. The upgrades focused on existing roads, leaving the total number of kilometres of national roads essentially unchanged. Road safety improved, accident rates decreased and travel times became more predictable (Coşar and Demir, 2016).

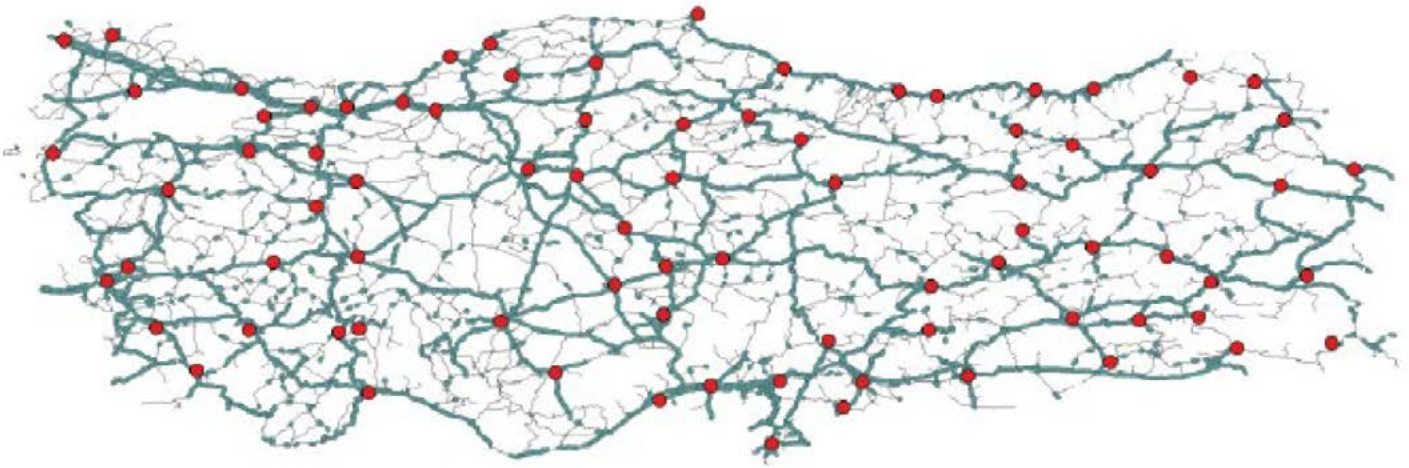
To evaluate the impact of this upgraded road network on travel times between Turkey's 81 provincial centres, the research team applied geographic information systems (GIS) analysis (see Coşar et al., 2020). Researchers first digitised road network maps published by the General Directorate of Highways to generate detailed snapshots of all single and dual carriageways across Turkey at different points in time. Figure 1 shows maps for 2005 and 2015, with thicker lines indicating dual carriageways. Upgrades were widely dispersed and benefited travel routes between provincial centres across Turkey. To quantify the resulting time savings, the average speeds for trucks over different road categories were taken from administrative records. The set of fastest possible travel times between provincial centres were then calculated for the road networks as they existed in 2005, 2010 and 2015.

Figure 1. Turkey's national road networks

Panel A. 2005



Panel B. 2015



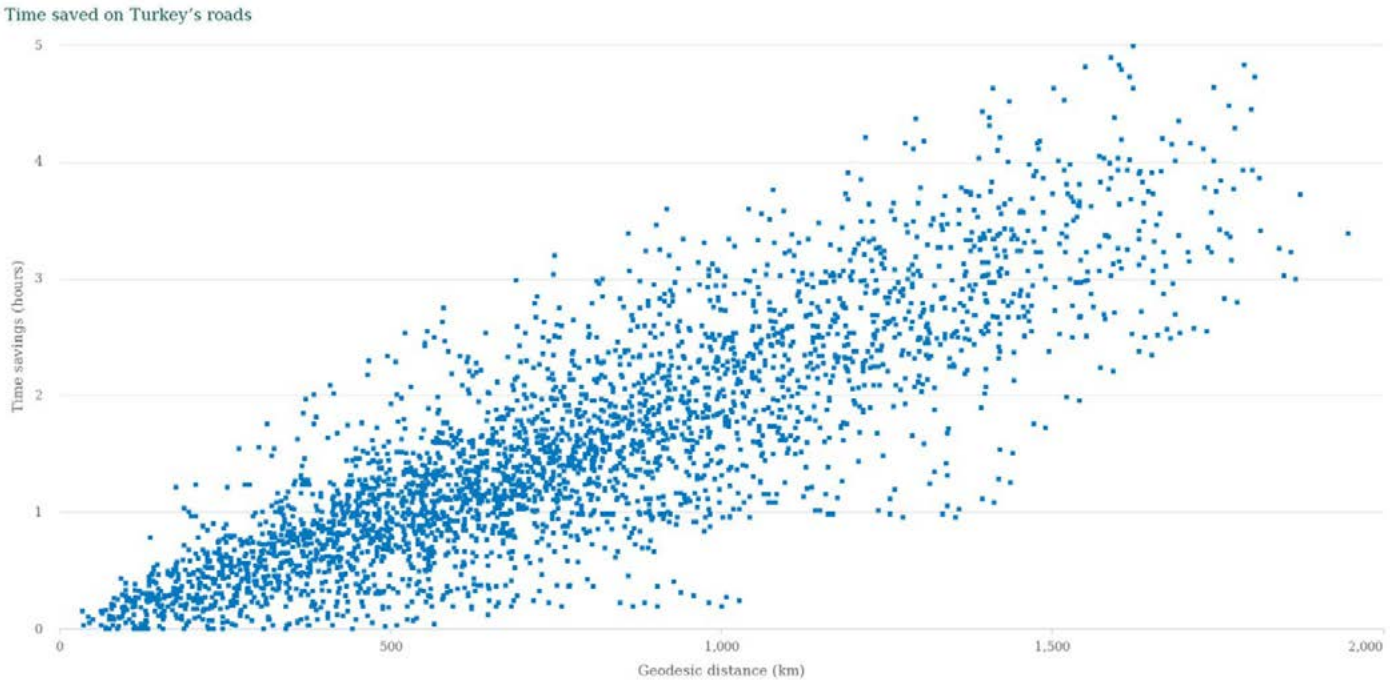
Note: Red nodes denote provincial centres, thin blue lines represent single-carriageway roads and thick blue lines represent dual-carriageway roads.

First, the analysis shows that road upgrades led to substantially reduced travel times. The average time savings between city-pairs was 1.5 hours, out of an average travel time in 2005 of 6.5 hours. Figure 2 plots the time savings against distances for all city-pairs. Cities separated by longer distances typically experienced the greatest time savings.

Second, the research showed that quicker travel contributed to improved economic integration between provincial centres, in terms of domestic trade. One hour of saved travel time increased bilateral trade in manufactured goods between provinces by about 5.3 per cent. Quicker travel also improved the chances that two provinces without any bilateral manufacturing trade in 2006 would have begun to trade by 2016. A pair of non-trading centres with a travel time saving of 1.9 hours, the average time saving for this pair, would be 7 per cent more likely to trade in 2016, compared to a scenario in which roads had not been improved.

Interestingly, with the upgrades, new trade links in the service

Figure 2. Time savings due to road improvements



Note: Each observation plots the time savings for travel against the straight-line distance between a given city-pair.

sector experienced even stronger impacts, being 18 per cent more likely to trade in 2016. A likely explanation is that, beyond moving goods around, better transport makes the process of finding new buyers and suppliers easier. This channel can expand the market reach of service providers in particular. Consider legal and accounting services: even if work is completed in a firm's office and transmitted electronically, lower travel times reduce the cost of recruiting new clients or holding initial face-to-face meetings. Architectural and engineering firms might specialise in particular fields, such that improved connectivity promotes better matches for firms in remote markets as specialists come into reach.

Regional analysis, comparing changes in outcomes for a given province to changes in its averaged travel times to all other provinces, shows employment gains in the regions that experience greater average time savings. These estimates indicate that reducing average travel times by one hour increases average employment within an industry by about 16 per cent. Around two-thirds of provinces experienced such time savings, translating to a meaningful boost in local job opportunities.

Back-of-the-envelope calculations for the rate of return from the Turkish road investments can be produced using the estimated impact of time savings. Consider a single hypothetical route of undivided roadway, equal in length to the average bilateral distance of city-pairs. This average route would be 755 km long and would require 234 km of upgraded road in order to reduce travel times by one hour. The improved route would still take 10.6 hours to travel for trucks driving freight. Such upgrades would cost US$ 25.7 million annually, and would generate approximately US$ 2.6 million in additional domestic trade, based on the estimated impact of reduced travel time. Every 10 US dollars generates one additional US dollar of domestic trade, ignoring other direct gains, such as those from increased road safety and higher exports.

Short-term and long-term effects on wellbeing

The researchers also apply a spatial equilibrium model, adapted from Allen and Arkolakis (2014), to estimate the impact of the road upgrades on wellbeing. The team considers two experiments:

- What is the short-term impact of upgrades (just after completion) before enough time has elapsed to allow the labour force to move to other provinces?
- What is the long-term impact when the labour force has been able to relocate between provinces?

In the short term, when labour is immobile, households in all locations are found to be better off after the road upgrades. The gains, however, are uneven and the level of inequality between provinces is estimated to have increased. Differences between provinces in the level of trade cost reductions with all other provinces leads to uneven changes in the real wages of workers. Provinces with the highest gains improved wellbeing over 10 times more than the provinces with the lowest gains. The national gain, weighted by population, was 2.84 per cent.

The long-term impact of the upgrades depends on how substitutable the goods produced in each province are with those from other provinces. When a product from another location does not have close substitutes, the gains to consumers from reducing trade costs with that location are large. The positive impact on wellbeing is estimated to range from about 1.9 per cent to 6.3 per cent. Applying baseline levels of substitutability and congestion, a gain of 2.9 per cent emerges, similar to that of the short-term effect. With an annual cost of road upgrades at about 1.7 per cent of GDP per year, the estimated rate of return for this level is up to 70 per cent.

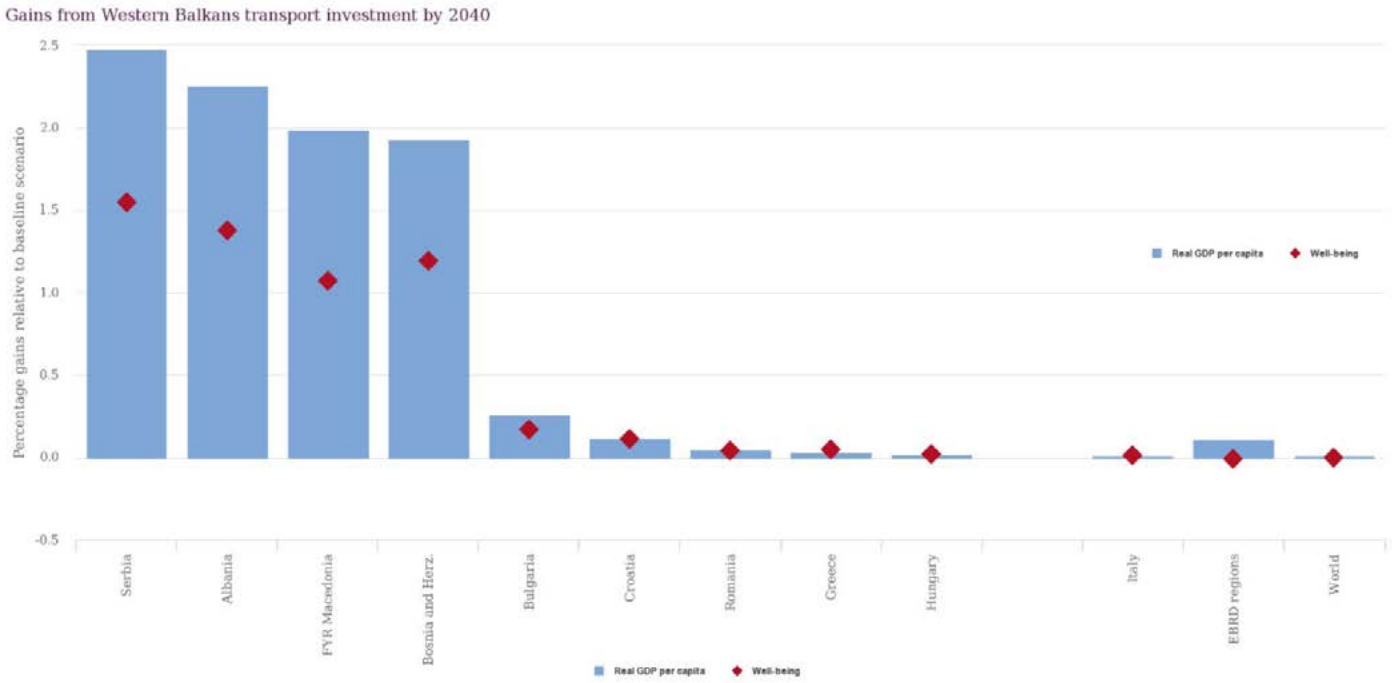
Impacts of infrastructure upgrades in the Western Balkans

The research team also evaluated road and railway investments totalling €7.6 billion (of which the EBRD invested 40 per cent) in the Western Balkans since 2000 (Desmet et al., 2018). The researchers reviewed EBRD investment records to identify new and upgraded transport segments. These upgrades were matched to the roads, railways and waterways operating in 2000, using geographic information systems (GIS) software. The lowest cost routes for transporting goods before and after the upgrades were determined based on the available infrastructure between all locations. This set of lowest bilateral trade costs was paired to data on population and outputs for a grid measuring 1 degree by 1 degree. Together, they present a realistic geography of data that can be evaluated using modern trade models.

These data were analysed in a spatial equilibrium model based on the work in Desmet, Nagy and Rossi-Hansberg, 2018. The model incorporates competing forces as people seek out their best opportunities, balancing effects from the decisions made by all households as to where to live and work. Better transport connections lower the cost of trading with other markets. Places with good economic prospects and living conditions attract more people and benefit from greater innovation and higher productivity and consumption. At the same time, congestion hinders the enjoyment of local amenities and raises the cost of living. In the framework of the model, migration and economic outcomes evolve over time, driven by the balance of opportunities and costs.

The analysis finds that the Western Balkans infrastructure upgrades likely contributed to worker retention and

Figure 3. Gains from Western Balkans transport investment by 2040



an increase in local population density in the region. Importantly, the estimated positive gains related to this higher density (in the form of higher productivity and consumption levels) outweighed the negative impacts of congestion on wellbeing. Figure 3 shows a comparison between outcomes produced under baseline conditions and those with the upgrades, predicted for the year 2040. The figure shows that real output per person, as well as wellbeing, increase by around 2-2.5 per cent and 1-1.5 per cent, respectively, in economies receiving road and railway improvements. Neighboring countries in the region benefit as well, though to a lesser extent (about 0.25 per cent).[1]

Back-of-the-envelope estimates of the annualised rate of returns are 18 per cent for the region, ignoring maintenance costs. These returns vary by country. Albania and Serbia exhibit higher returns at 27 per cent and 23 per cent, respectively, while returns in Bosnia and Herzegovina and North Macedonia are 7 per cent and 8 per cent, respectively. These country-level estimates seem reasonable based on the respective investments by country and the pre-investment levels of infrastructure. However, it is important to note that improved segments of transport routes can benefit neighboring countries. The positive spillovers of upgrades, as regional trade costs decrease, mean that economic benefits likely extend beyond national boundaries. Estimating returns should therefore be conducted at the regional level when feasible.

Lessons learned

Investments in transport infrastructure can substantially improve the economic integration of a region as trade costs between markets decline. Better integration creates opportunities for local economies to become more productive, boost consumption and improve people's wellbeing. While one often thinks of roads as useful for transporting physical goods, evidence from Turkey shows that shorter travel times can also boost the services sector. Better connectivity between provinces strongly increased the probability of new trade links in service sectors. Firms that must regularly recruit new clients, or those offering or requiring specialised services, may particularly benefit from lowering the costs of reaching new pools of clients and suppliers in more remote markets.

The rate of return of Turkey's investments in roads, based on improvements to long-term wellbeing, is estimated to be up to 70 per cent. This estimate rests on standard assumptions for how easily consumers and firms can replace the goods and services produced in one province with those from another. When it is hard to replace goods or services produced in another location, the gains to consumers from reducing trade costs with that location are large. The analysis of road and railway upgrades in the Western Balkans produced estimates consistent with the findings from the Turkish roads study. The estimated long-term rate of return to investments in the region is lower, at 18 per cent. All locations are estimated to benefit from the upgrades, but just as in the case of Turkey, gains varied substantially across locations. Benefits accrued disproportionately to those locations closest to the physical investments.

1 Estimates for Kosovo are not available, but are reflected in those of its closest neighbours.

Suggestions for further reading

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CONTRIBUTORS

Nathaniel Young

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PHOTOGRAPHY

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