European Investment Bank

The EU bank

EIB Working Papers 2016 / 01

Infrastructure Investment in Europe and International Competitiveness

Debora Revoltella, EIB
Philipp-Bastian Brutscher, EIB
Alexandra Tsiotras, EIB Consultant
C. Weiss, EIB

Infrastructure Investment in Europe and International Competitiveness[1]

DEBORA REVOLTELLA, PHILIPP-BASTIAN BRUTSCHER,
ALEXANDRA TSIOTRAS, CHRISTOPH WEISS [2]

Summary

Infrastructure investment in Europe has been adversely affected by the economic crisis, undermining both the immediate recovery and longer-term growth potential. This paper discusses recent trends in infrastructure investment and finance in Europe, before exploring one way in which transport infrastructure – the sector that has been arguably hardest hit by the crisis – contributes to regional growth. Using a novel approach, we show that firms in regions with a more developed transport network are better placed to benefit from positive growth opportunities than firms in regions with a lower transport stock. This advantage is most pronounced in times of economic stress – making a good transport infrastructure a key ingredient for economic recovery. This indicates one channel through which the activities of the European Investment Bank, now extended through the Investment Plan for Europe, can be expected to foster growth and enhance competitiveness in Europe.

1. Introduction

An adequate supply of infrastructure is an essential ingredient for competitiveness and long run potential growth in an economy. The public and private stock of infrastructure plays a critical role in enhancing the productivity of people and firms throughout the economy by lowering the costs of combining different productive inputs, accessing markets and by increasing mobility and competition. Achieving and maintaining efficient infrastructure in the education, energy, health, ICT, transport, water and waste sectors depends on sustained long-term investment.

Investment in infrastructure has received heightened attention in Europe in recent years. In particular, the marked retrenchment of both the public and private sector from their infrastructure investment activities with the onset of the Euro crisis has spurred wide-spread concern of the negative consequences this might have. Indeed, this crisis-related retrenchment

[1] Disclaimer: The views expressed are those of the authors and do not necessarily reflect the position of the EIB.
[2] We thank Tim Bending and Pedro de Lima for useful discussion. The views expressed in this paper are those of the authors and do not reflect those of the EIB. All errors are our own.

can be seen as merely compounding longstanding under-investment in critical infrastructure in Europe.

To put recent crisis-related trends in context, it is possible to compare current levels of infrastructure investment in the EU with approximate estimates of annual investment needs with regard to both the replacement of assets reaching the end of their economic life and to the achievement of key European policy goals.

For example, recent estimates find that investment will need to increase by 50% over 2014 levels in order to meet policy goals in the modernisation of urban transport and ensuring sufficient capacity in inter-urban transport, which will facilitate growing trade and further integration of the EU's internal market. Taking also into account the need to address the crisis-related backlog, this corresponds to extra investment flows of approximately EUR 50bn per year.[3]

In the energy sector, it is estimated that achieving policy goals in terms of upgrading energy networks to integrate renewables and ensure security of supply, increasing power generation from renewables and energy efficiency in buildings and industry will require additional annual invest in the order of EUR 100bn.[4] Meanwhile achieving the EU's Digital Agenda targets and matching US data centre capacity is expected to require additional annual investment of approximately EUR 55bn.[5] Further large annual investment shortfalls can be identified for sectors such as water and flood management as well as waste management and materials recovery.

It is in the context of these structural investment gaps that the Investment Plan for Europe has been launched. As a pillar of the plan, the European Fund for Strategic Investment (EFSI) has been designed to provide an impulse for up to EUR 315bn of new investment over three years, mostly from the private sector, with three quarters of the fund focused on innovation and infrastructure.

This paper begins by providing an overview of recent trends in infrastructure investment in Europe, with regard to sectors, geographical regions and sources of finance, including project financing. We also discuss some of the current key constraints on infrastructure investment.

---

[3] EIB estimates for 2015-2020 based on OECD/ITF statistics (accessed February 2014).
[4] European Commission estimates of average annual investment in EU-28 over the period 2016 to 2030, supplemented on by EIB estimates. The scenario assumes compliance with all existing EU legislation, plus adoption of a 40% GHG target by 2030. See also Berndt et al. (2015).
[5] EIB estimates for 2014 to 2020. See also Hätönen, J. (2011) and WEF (2011).

We then turn to focus in greater depth on the importance of infrastructure investment for competitiveness and growth, using the transport sector as an example. We find that a well-developed transport infrastructure stock is instrumental when it comes to linking local businesses with their global growth opportunities. We show that firms in regions with a more developed transport network are better placed to benefit from positive growth opportunities than firms in regions with a less well developed transport stock. This advantage is most pronounced in times of economic stress – making a good transport infrastructure a key ingredient for economic recovery.

The last section is a conclusion of this analysis in connection with the role of the EIB and the Investment Plan for Europe.

2. Evolution of Infrastructure Investment in the EU

This section provides an update of the state of infrastructure investment in Europe, by year, sector and source of finance. Data on infrastructure investment, let alone its financing sources, are not available in any ready-to-use form. We follow Wagenvoort et al. (2010) to compute workable estimates of infrastructure investment.[6]

Figure 1 shows that infrastructure investment in the EU followed the business cycle closely over the past decade, falling in the wake of the global financial crisis and again after the sovereign debt crisis. The first phase of contraction was driven by private infrastructure finance with public infrastructure investment remaining stable at first. However, with the onset of the sovereign debt crisis in 2011 and 2012, this picture changed, with fiscal consolidation acting pro-cyclically to deepen the decline in infrastructure investment. With regard to sectors, the steady decline of investment in the transport sector is striking; while transport accounted for 31% of total infrastructure investment in 2007 (corresponding to 1.6% of GDP), it stood at only 26% in 2015 (1.3% of GDP).

[6] As a starting point, we use national accounts statistics from Eurostat to construct estimates of total and government investment in infrastructure sectors. Private investment is then derived as a residual. We also provide a sectorial breakdown of these estimates using Eurostat data on gross fixed capital formation in individual infrastructure sectors, including education, health, transport, communication, and utilities. In a second step, we break down our (derived) infrastructure aggregates with the help of data from Projectware. This database allows us to identify investments made through Special Purpose Vehicles (SPVs, i.e. projects) and thus to identify corporate (non-project) infrastructure investment as the difference between total private and total project investments. Finally, we divide our project investment into Public-Private Partnership projects and non-PPP projects, using data described in Kappeler and Nemoz (2010). Since most PPP finance is entirely private, we approximate non-PPP private project finance simply as the difference between total private project investment and PPP investment.

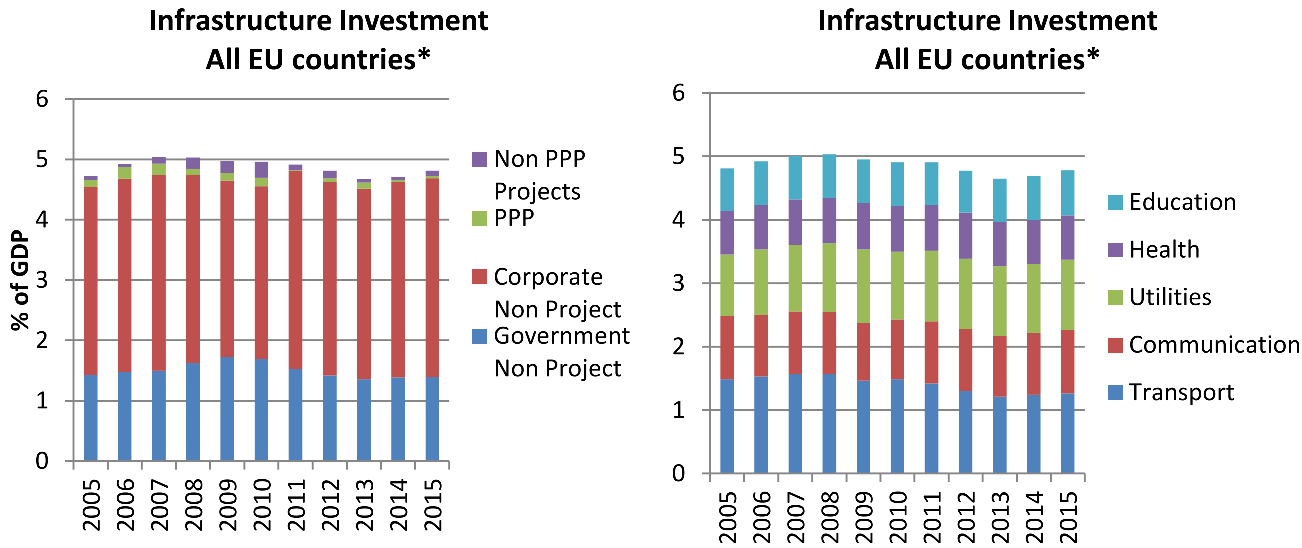

Figure 1: Infrastructure investment as a percent of GDP. * Croatia, Cyprus, , France, Lithuania and Poland are excluded from the analysis due to missing data.

Investment in infrastructure differs markedly across regions. Figure 2 decomposes the source of infrastructure finance for various groups of EU countries: Old Member States (OMS), New Member States (NMS), countries in the geographical "periphery" of the Euro area (GIIPS) and "Euro area core" countries. In line with long run trends of economic convergence, infrastructure investment over the past decade has generally been higher in the NMS than the OMS and (to a somewhat lesser extent) in the Euro periphery than the countries of the Euro core. However, it is also the NMS and the periphery that have been affected the most by the crisis; infrastructure investment is down 1.29 pp of GDP in the NMS and 0.32 pp in the Euro periphery, compared to only 0.19 pp in the OMS and 0.20 pp in the Euro core. The decline in infrastructure investment in the NMS can be explained in equal parts by declines in government and non-government spending, the decline in the Euro periphery countries almost entirely by changes in government spending.

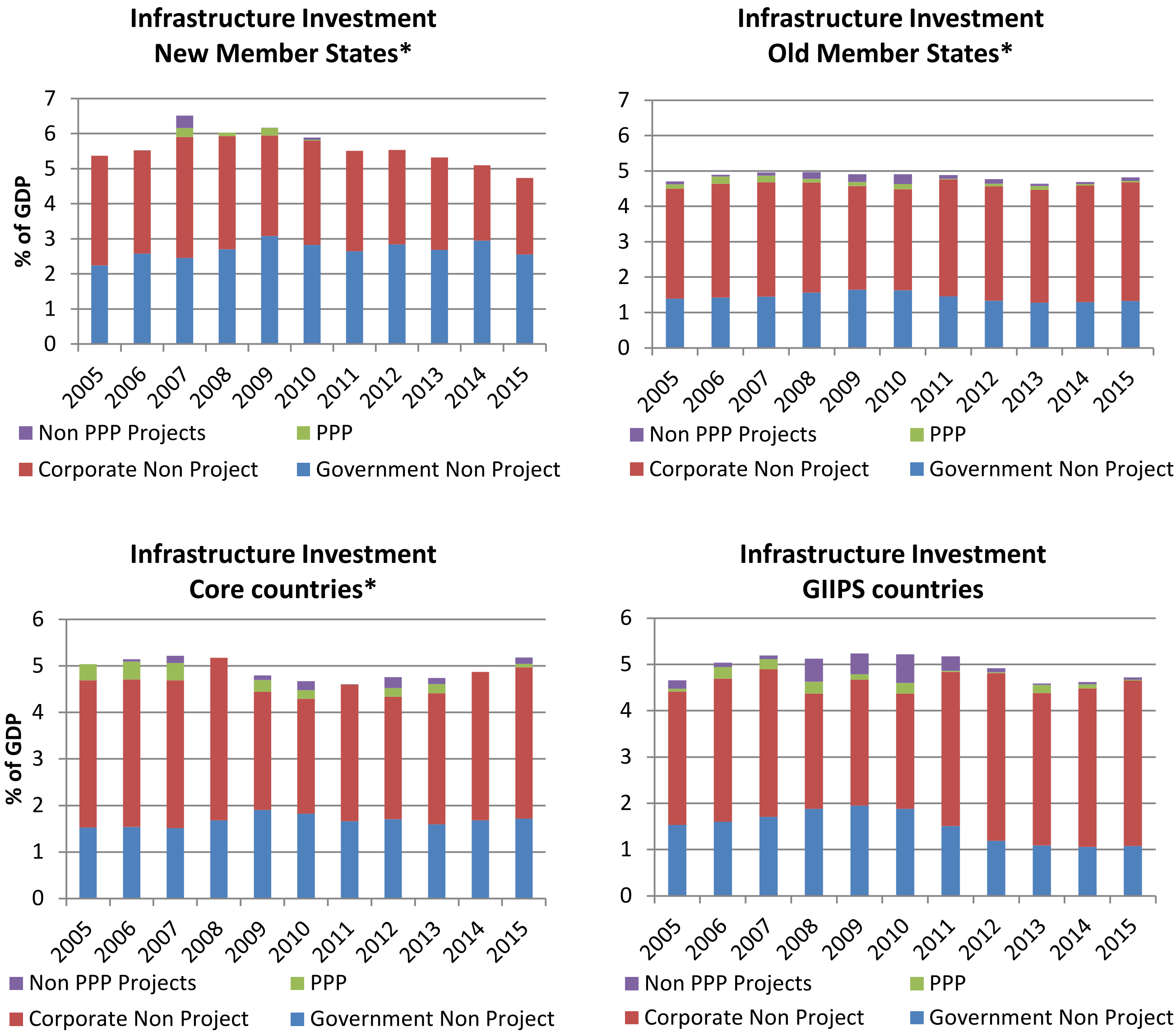

Figure 2: Infrastructure investment as a percent of GDP, by source and region. *New Member States exclude Croatia, Cyprus, , Lithuania and Poland due to missing data. Old Member States and Core countries exclude France due to missing data.

Further light can be shed on these trends by examining them in real terms to exclude the effect of changes in GDP. Figure 3 shows the evolution of real infrastructure investment for the government and private sector and for key sectors: education, health, transport, communication and utilities (including energy, water and waste). For ease of comparison, we index real infrastructure investment to equal 100 in 2008. The figure indicates that real government investment increased in 2008 to 2010 – acting counter-cyclically – while corporate investment fell quite dramatically over this period. With the onset of the sovereign debt crisis, this picture changed: the government sector cut back on its infrastructure investment activity – while the corporate sector recovered somewhat (but only to cut back on its investment in 2012 and 2013 again). Since 2013, both – real government investment and corporate investment – have increased. However, real government infrastructure investment in 2015 came still in below its 2008 level (-2.6%), whereas private investment is now higher than in 2008 (+6.6%).

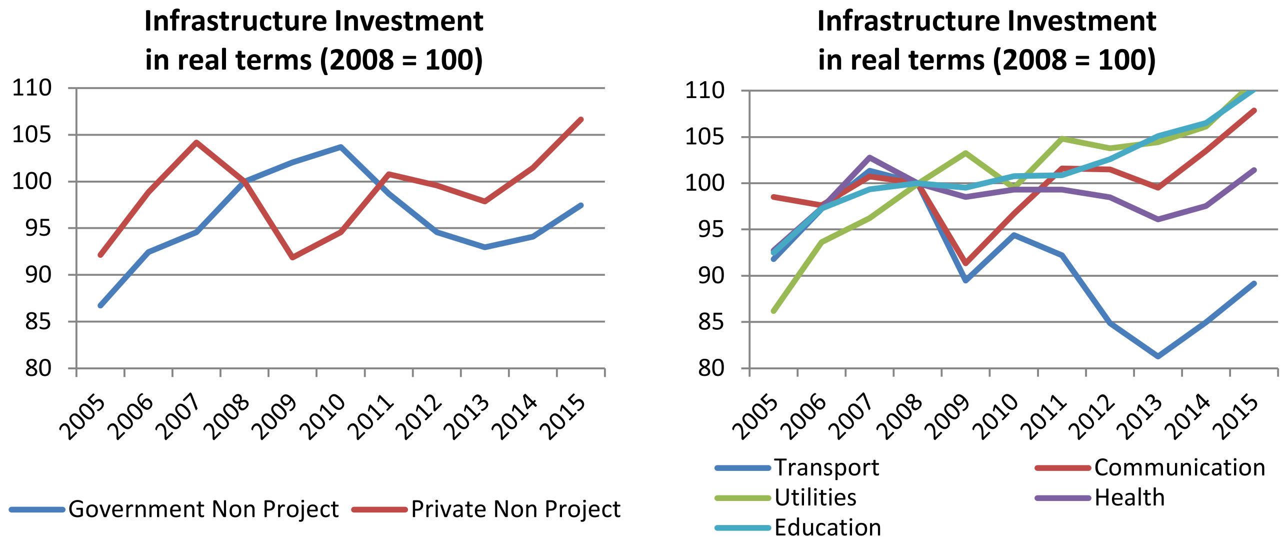

Figure 3: Real infrastructure investment, by source and sector

Figure 3 confirms that the sector hardest hit by the economic crises in real terms is transport (down 10.8% from 2008). The other sectors showed more resilience. Indeed, investment in education, health, communication and utility infrastructure even increased in real terms (+10.1%, 1.4%, 7.9% and 11% respectively) compared to their 2008 level.

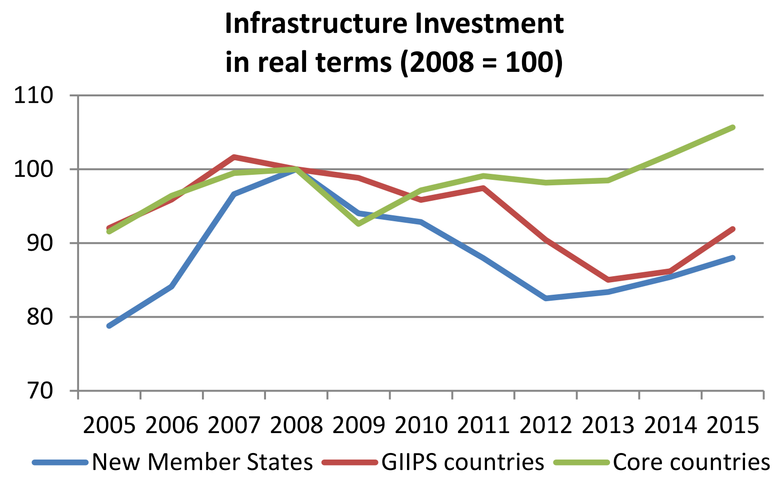

Figure 4: Real infrastructure investment, by region. * New Member States exclude Croatia, Cyprus, , Lithuania, Poland and Romania. Old Member States and Core countries exclude France due to missing data.

Figure 4 shows the evolution of real infrastructure investment by region. It shows that the countries of the Euro Core were hit hard by the financial crisis of 2007-2008 but more moderately by the sovereign debt crisis. For the GIIPS region, the opposite is true; they exhibited some resilience after the financial crisis but the sovereign debt crisis lead to a sharp contraction in real infrastructure investment. Infrastructure investment was initially hardest hit in the New Member States (-17.5% in 2012 relative to where they were in 2008). However, their recovery started already in 2013, when the GIIPS region still experienced contractions.

Public-private partnerships (PPPs) represent a small component of the overall infrastructure market but are seen as strategically important for infrastructure finance, particularly in the light of the fiscal space constraints faced by public authorities. The total PPP market in Europe has grown steadily over the past twenty years, reaching its historical peak in 2007 – at around EUR 30bn.[7] Since then, both the total number of deals and the aggregate value of deals have declined considerably. In 2014, the aggregate market value achieved a total of EUR 16bn, returning to positive growth in nominal terms for the second time after 2013 (and a small bump in 2010).

Geographically, the PPP market remains highly concentrated. The UK is still the largest European PPP market in 2013/2014 (EUR 6bn), although its share of the EU market has declined to 35%, from 56% in 2007. The UK is followed by Italy (EUR 2.6bn), France (EUR 1.1bn) and the Netherlands (EUR 0.7bn). With EUR 9bn, the transport sector represents more than half the total market value in 2013/2014.

PPP financing is dominated by debt. Figure 5 shows that the debt-to-equity ratio has come in at around 5:1 over the past decade.[8] Most of this debt is made up of loans (typically provided through syndicates of lenders). While bond financing played an important role in providing funding before the crisis – accounting for up to 19% of total financing and 22% of total debt in 2007 – it disappeared almost completely in the period 2009-2012. In 2013 and 2014, bond financing made a comeback contributing to almost 6%/13% of total PPP financing in the two years. However, the use of project bonds is largely restricted to only four member States: Germany, Netherlands, Spain and the United Kingdom.

[7] For completeness, we also include PPPs in non-infrastructure related sectors.
[8] Figure 5 uses the EIB ECON/EPEC database. Note that a breakdown by source of finance is only available for roughly 80% of all PPP projects in the database.

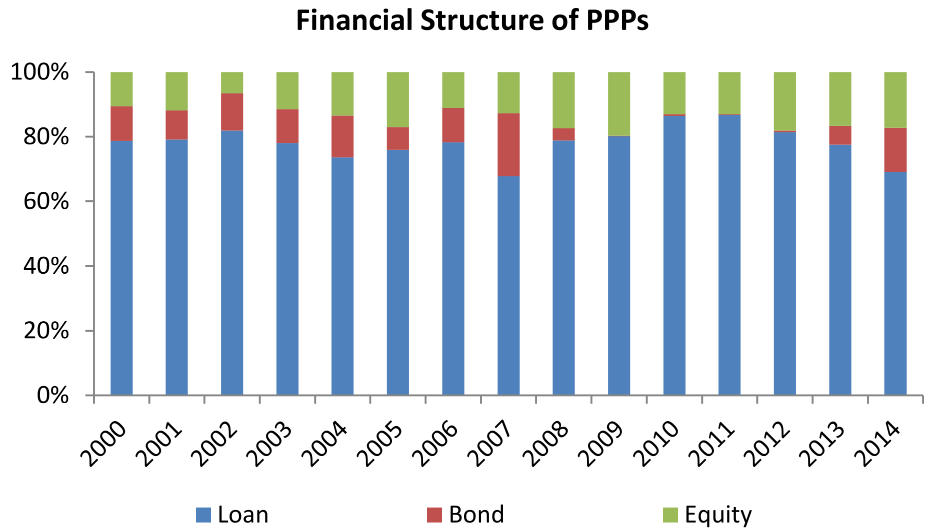

Figure 5: Financing structure of European PPP investments

The global financial crisis and the sovereign debt crisis have had a dramatic impact on the cost of debt finance for PPPs. Figure 6 shows that spreads over Libor/Euribor declined in the run-up to the financial crisis, from 110 basis points in 2000 to 80 basis points in 2007. The financial crisis dramatically reversed this tendency as spreads tripled to more than 250 bps between 2007 and 2010. After reaching a plateau in 2010/2011, there was another significant increase – by almost 100 basis points – as the sovereign debt crisis hit in 2011/2012. 2013 and 2014 marked the first years since 2007 that prices weakened somewhat.

For comparison, Figure 6 also shows the weighted average of sovereign credit default swaps as a broad measure of market condition.[9] Pricing for PPP loans broadly moved in line with CDS in the run up to the crisis – and during the initial crisis years – but there is a notable divergence of the two measures in more recent years. While sovereign default swaps have fallen markedly since 2011, PPP pricing have continued to rise initially and remained relatively elevated since.

[9] Figure 6 uses the EIB ECON/EPEC database. Data on pricing refer to the principle loan of each project as made available by Projectware and/or the Infrastructure Journal. As this information is available for a sub-sample only, the results should be taken as indicative rather than definitive. For CDS, we use 5 year sovereign CDS from Bloomberg.

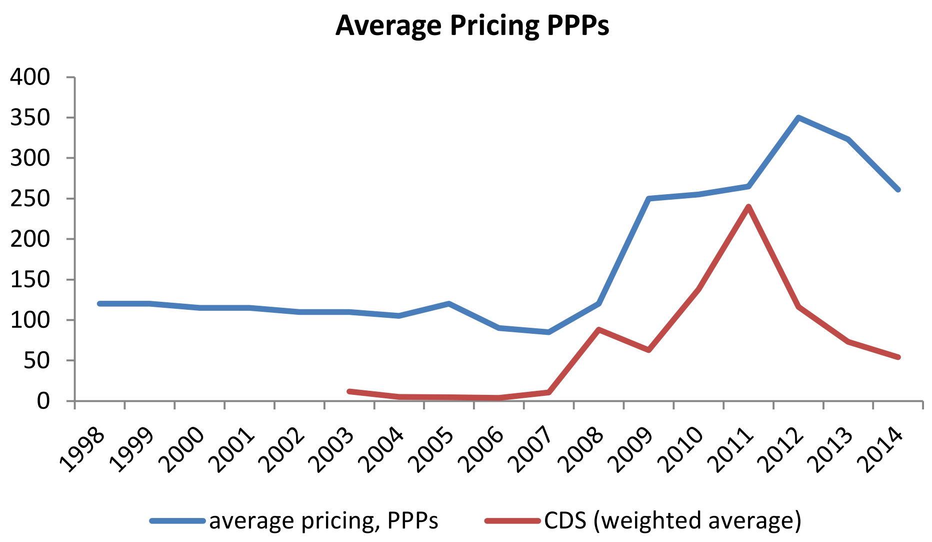

Figure 6: Pricing of PPPs

The trends clearly show the impact of financing constraints on the infrastructure sector. In the wake of the crisis, many Member States and sub-sovereigns find themselves with less fiscal space for direct funding through budgets or the provision of risk-taking equity in PPP schemes. At the same time, several major banks have retreated from the infrastructure investment field or have become more selective, possibly reflecting enhanced capital constraints faced by the European banking sector. While European banks are now generally well capitalised in terms of CET1 capital ratios, the space they have to expand their balance sheets or to shift from low risk sovereign holdings to higher risk investments including project lending is limited.

The situation for infrastructure investors has been compounded by the decline of monoline insurers. This has reduced the availability of credit insurance which played a crucial role in enhancing credit quality of infrastructure investment and thereby pulled in investors that sought limited exposure to risks. Whilst there has been some market recovery and liquidity has returned to some sectors of some markets, many projects, perceived as carrying higher risk (e.g. risk associated with greenfield projects, the predictability of demand, the very long-term development period, or the cross-border element of the project), are still unable to secure adequate funding. Institutional investors, including insurance corporations and pension funds, are a potentially important source of finance for infrastructure projects that offer long-term assets to match their long-term liability structure. However, the involvement of institutional investors remains weak.

The lack in many countries of a strong pipeline of projects structured in a suitable way to attract private investors, as well as the uncertainty related to the macroeconomic environment and regulatory stability have also been identified as an important constraints on infrastructure finance. To address these issues effectively, the Investment Plan for Europe intends to combine regulatory reforms in EU countries, better support and advisory for project preparation, and the European Fund for Strategic Investment (EFSI) implemented by the EIB.

3. Investigating the importance of transport infrastructure: linking local business with global growth opportunities

Transport is the largest infrastructure sectors (in terms of investment) and it has been affected particularly severely by the economic crisis. In the following sections, we take transport as an example and examine one important way in which investment in infrastructure can contribute to economic recovery.

Using data on 245 European regions, we show that transport infrastructure plays a role in explaining why firms in some regions are better placed in capitalising on global growth opportunities than firms in other regions. We also find that the positive effects of a well-developed transport stock are particularly pronounced in regions where there is 'economic slack'. This suggests that a higher transport network can act as a catalyser for economic recovery in times of stress. In other words, a poor infrastructure stock may hamper economic recovery by cutting the link between local businesses and their global growth opportunities.

Our study builds on a long history of literature going back to the founders of trade theory and microeconomics. Heckscher (1916), for example, qualified many of his early arguments about the resource basis for trade with caveats about initial physical conditions that might facilitate or hinder trade relations. A variety of authors, including Obstfeld and Taylor (1997), have implemented Heckscher's notion in an empirical application. Samuelson (1952) made an early contribution to economic and trade analysis from a spatial perspective – which was also followed by many contributions from regional analysis and location theory (e.g. Bergstrand 1990) and directly inspires the current study.

While our study builds on this literature, it also expands on it in several ways. Most importantly: (i) the paper is the first (to the best of our knowledge) to examine the importance of regional transport infrastructure when it comes to linking local business to global growth opportunities in the context of European regions; and (ii) we use a direct measure of global growth opportunities (instead of an indirect measure, such as trade flows).

4. Conceptual Framework

To measure global growth opportunities, we build on Bekaert et al. (2007) – who recently proposed a measure of global growth opportunities based on global industry price to earnings (PE) ratios weighted by the local industry mix within a particular country. They argue that their measure is a good predictor of economic growth. More specifically, they find that countries with a high concentration of high PE industries (using global industry PE ratios) grow faster on average. Using data on 245 European regions over the period 2002 to 2013, we show in Table 1 that such global growth opportunities also predict economic activity at the regional level.

Table 1. Global growth opportunities are associated with regional economic activity. Dependent variable: regional GDP growth and change in the regional unemployment rate

	GDP growth	Unemployment
Global Growth Opportunity	0.011***	-0.146*
	(0.003)	(0.079)
Sample size	2,444	2,468
R-squared	0.033	0.003
Number of regions	245	245

Note: All regressions control for region fixed effects. Unbalanced panel. Time period: 2002-2013. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

However, not all regions benefit from global growth opportunities in the same way. Figure 7 illustrates the difference between the growth rates predicted by our measure of global growth opportunities and the actual growth rates of different European regions over the time period 2002-2013. It suggests that some regions did a lot better in terms of actual growth rates than what one might have expected given their global growth prospects; while others did a lot poorer – which raises the question: what determines the extent to which a region manages to benefit from positive global growth opportunities?

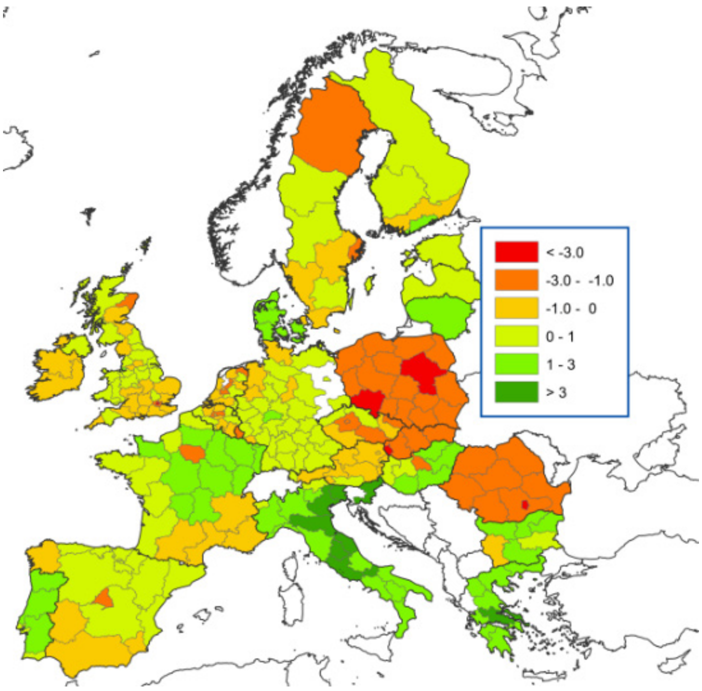

Figure 7: Average difference in predicted and actual growth rates. Dependent variable: GDP growth. Explanatory variable: Global growth opportunities and region fixed effects

This paper also takes inspiration from classical trade theory which states that price differences create incentives for international and inter-regional exchange of goods.[10] According to this view, high distribution margins (due, for instance, to poor infrastructure) serve to undermine these price differences and, thus, the basis for trade.

To see this, consider two prices P_H and P_F for comparable goods from two different sources: home and foreign (although they could simply be from different regions or even cities in the same country). Given that a trade margin (M) is generally symmetric, the ratio of these two prices is given by the following expression, evaluated as M rises without limit:

$$\frac{P_H + M}{P_F + M} \rightarrow 1 \qquad (1)$$

Evidently, if there is a poor transport network in a region, then the margin will be higher (for instance, because of higher accessibility costs) and it will be more costly for a local firm to serve markets beyond its immediate surrounding. Similarly, and because the trade margin is symmetric, it will be more costly for a non-local firm, in such a situation, to serve the local market.

This effect is accentuated by the fact that, at the same time, higher margins worsen terms of trade. Consider the local producer price of exports $P_E = P_{WE} - M$, where P_{WE} denotes the

[10] See, e.g., Roland-Holst (2009) for a review.

international price of an export good and M the margin on an exporter's net revenue (producer price). Symmetrically, the local purchaser price of imports takes the form $P_M=P_{WM}+M$ where P_{WM} is the corresponding international price of imported goods and the margin M must be added to purchaser prices.

$$M\uparrow \rightarrow \frac{P_{WE}-M}{P_D}\downarrow \text{ and } \frac{P_{WM}+M}{P_D}\uparrow \qquad (2)$$

This suggests that higher margins (due to poorer regional infrastructure and higher accessibility costs) induce an increase in terms of trade P_E/P_M – and so reduce the incentive to trade.

There are several hypotheses that can be derived from this basic idea:

1. *Hypothesis 1: Everything else equal, an exogenous shock to a region's global growth opportunities will have a different impact on economic activity depending on a region's transport infrastructure. A positive shock will have a stronger positive effect on output and unemployment in regions with good transport infrastructure. A negative shock will not be amplified by a higher transport infrastructure (and may even be mediated by a higher transport stock).*

If a positive demand shock occurs, our conceptual framework suggests that firms in regions with a higher stock of regional infrastructure will be better placed to benefit from this shock in terms of output and unemployment than the same firms in regions with low regional infrastructure. They will have better access to local and global markets (both in terms of attracting resources and distributing output) to exploit such shocks.

A negative shock in terms of global growth opportunities, on the other hand, will not translate into a stronger negative effect in regions with good transport infrastructure. While it is true that being more closely integrated into global markets means that regions with a higher transport stock are likely to be affected more immediately, it is also the case that, insofar as a negative shock means that supply will be priced out of global markets, the first ones to suffer from this will be the regions where marginal costs are highest. As a result, the negative effect on export (and import) prices should make regions with low transport infrastructure at least as vulnerable to a negative shock as(and possibly even more vulnerable than) regions with a high transport stock.[11]

[11] Given the focus on European regions, which tend to be globally relatively well integrated, we expect that the 'price effect' (of being priced out first) outweighs the 'quantity effect' (of being less integrated to start with).

2. *Hypothesis 2: Everything else equal, we expect that 'economic slack' accentuates the role played by regional transport infrastructure in case of a positive exogenous shock – making infrastructure an important ingredient for a fast economic recovery.*

Assuming that prices respond less to positive growth opportunities in regions in which there is 'economic slack' (as defined in detail later), we expect that better regional infrastructure translates into higher economic benefits for local firms (given a positive shock to their global growth opportunities) if there is economic slack than when there is not. The intuition would be as follows: any expansion of production at or above full capacity is likely to involve significant upward pressure on prices which undermines (at least in part) the advantage of lower margins (due to a better transport network) and, hence, international competitiveness.

A further issue is whether a shock to global growth opportunities can be expected to have spill-over effects in neighbouring regions. While beyond the scope of this paper, we also examine in Revoltella et al. (Forthcoming) the hypothesis that the level of transport stock in neighbouring regions will enhance the likelihood of spill-overs from a positive shock and have no effect on any spill-overs from a negative shock.

5. Empirical framework

This section provides an empirical strategy on how to test hypotheses 1 and 2. The general idea is to explore whether and to what extent regions' with a higher stock of transport infrastructure are better placed to benefit from positive shocks to global growth opportunities while not being more affected by (or possibly even being shielded from) adverse shocks. The basic empirical model takes the following form:

$$\Delta GDP_{i,t} = \alpha_i + \beta_1 GGO_{i,t-1} + \beta_2 TS_i + \beta_3 \left(GGO_{i,t-1} x TS_i\right) + \varepsilon_{i,t} \quad (3)$$

$$\Delta unemploy_{i,t} = \alpha_i + \beta_1 GGO_{i,t-1} + \beta_2 TS_i + \beta_3 \left(GGO_{i,t-1} x TS_i\right) + \varepsilon_{i,t} \quad (4)$$

where $i = 1, ..., R$ denotes the regions, $t = 1, ..., T$ the time periods, α_i captures regional fixed effects, $GGO_{i,t-1}$ is the proxy for global growth opportunities (in logarithm), TS_i is an indicator variable denoting a high stock of transport infrastructure and $\left(GGO_{i,t-1} x TS_i\right)$ is the interaction term between these two last variables.[12]

[12] Global growth opportunities (GGO) enter our specification with a one period lag (just as in Bekaert et al., 2007) because changes in production tend to take time to be put in place (in particular if they are associated with capacity extension).

To distinguish between positive shocks and negative shocks (hypothesis 1), we compare the pre-crisis (2003-2007) and the (post-)crisis periods (2008-2012).[13] To determine whether the role of transport infrastructure varies with the level of 'economic slack' in a region's economy (hypothesis 2), we divide the sample based on an indicator variable capturing the degree of employment slack in a region.

Given our two first hypotheses and the model specification, Table 2 summarises the expected signs on the interaction term in the basic model. All signs are stated for GDP growth as the dependent variable but the opposite signs apply for regional unemployment as the dependent variable. Our theoretical framework suggests that the interaction term between the measure of global growth opportunities and transport infrastructure $(GGO_{i,t-1}xTS_i)$ should be positive in case of a positive shock to a region's global growth opportunities and negative (or insignificant) in case of a negative shock. In the first case, a better transport network should accentuate the positive shock; in the second case, it should mediate the negative shock (or at least not amplify it).

Table 2. Expected sign on the interaction term between global growth opportunities (GGO) and transport infrastructure. Dependent variable: regional GDP growth

Type of shock:	Positive		Negative	
Transport stock:	High	Low	High	Low
$(GGO_{i,t-1}xTS_i)$	++		-/0	
$(GGO_{i,t-1})$		+		++

Note: ++: large increase; +: limited increase; –: limited decrease; —: large decrease.

The expected sign on the coefficient of global growth opportunities (GGO) is the same whether it captures a positive shock or a negative one – as we assume that a positive (negative) shock will lead to higher (lower) growth even in regions with low regional infrastructure.

Table 3 summarises the expected signs on the coefficients in the version of the model that accounts for slack. In case of a positive economic shock, the coefficient on the interaction term between global growth opportunities (GGO) and the transport stock should be positive, both in the case of economic slack and in the absence of economic slack. This is because we expect a positive shock to translate into higher growth in both cases. However, the magnitude

[13] Instead of focusing on the pre-crisis and (post-)periods, we also estimated the model using a panel of regions experiencing positive shocks to their global growth opportunities and a panel of regions experiencing negative shocks to their global growth opportunities (GGO), respectively. That is, as a robustness check, we focus on regions with strokes of positive (or negative) global growth opportunities (GGO) over several consecutive years and find that the results are in line with those reported here.

of the coefficients is expected to differ. We expect a larger coefficient when there is slack (than when there is not) – as, at or above full capacity, higher prices are likely to diminish the positive effect of a better transport stock.

Table 3. Expected sign on the interaction term between global growth opportunities (GGO) and the transport stock when there is economic slack. Dependent variable: regional GDP growth

	Positive Shock			
Economic slack:	Yes		No	
Transport stock:	High	Low	High	Low
$(GGO_{i,t-1}xTS_i)$	++		+	
$(GGO_{i,t-1})$		+		+/0
	Negative Shock			
Economic slack:	Yes		No	
Transport stock:	High	Low	High	Low
$(GGO_{i,t-1}xTS_i)$	-/0		-/0	
$(GGO_{i,t-1})$		++		++

Note: ++: large increase; +: limited increase; –: limited decrease; —: large decrease.

In the case of a negative shock, we expect an insignificant (or negative) coefficient because we expect a higher transport stock to not amplify (and possibly mediate) the negative consequences of a deterioration of global growth prospects. Due to price stickiness, we do not expect any difference between situations with high or low economic slack.[14]

The coefficient on global growth opportunities (GGO) is likely to be positive if there is economic slack and insignificant otherwise. In case of a negative shock, we expect a positive coefficient irrespective of whether there is economic slack: a negative development of global growth prospects should affect regions (with a low transport stock) in the same way whether or not they suffer from economic slack.

6. Data and results

This section describes the variables used in the empirical analysis and reports regression results based on the empirical framework discussed in the previous section. We use annual data at regional level. We rely on an unbalanced panel dataset covering 245 regions in 19 EU

[14] Given a certain stickiness of prices when it comes to negative shocks, we expect to find no difference in the effect of a negative change in global growth opportunities for firms in regions in which there is 'economic slack' and firms in regions where there is not. See Blinder (1998) for an overview of the related literature.

countries over the time period 2002 to 2013.[15] Table A.1 in Appendix 1 gives more details on the source of the data and Table A.2 reports descriptive statistics.

Dependent variables: To determine whether and to what extent the level of transport stock in a region can affect how an exogenous shock to a region's global growth opportunities translates into regional economic activity, we use regional real GDP growth and the change in the regional unemployment rate as dependent variables.

Global growth opportunities: To proxy for global growth opportunities in each region in the sample, we follow Bekaert et al. (2007) and use global price-to-earnings (PE) ratio weighted by the regional industry mix. We use global PE ratios of 25 industries in the manufacturing sector.[16] We weight the importance of each industry using the salary share of each industry out of total salaries in a region. Intuitively, our measure, thus, takes each region as a composition of sectors with different growth opportunities (captured by investors' expectations about their future growth potential). Because the PE ratios are global, the proxy measures exogenous growth opportunities rather than region-specific growth opportunities.

High stock of regional transport infrastructure: To capture the level of regional transport infrastructure, we aggregate the average number of kilometres of roads, motorways and rail lines between 2002 and 2013. We divide this measure of distance by the average of the regional population between 2002 and 2013. We then create an indicator variable equal to 1 if a region's transport stock density is in the upper tercile of the overall transport stock density distribution and 0 otherwise.[17] This creates a measure of transport stock density in a region weighted by its population. The measure is by construction time-invariant over the period that we consider. The transport stock tends to vary rather slowly and our transport stock variable is discrete.

Positive vs negative shocks: To capture the different effects of a positive and negative exogenous shocks to regions' global growth opportunities, we use the pre-crisis period (2003-

[15] We follow the EU classification of regions and use NUTS at level 2. There are 273 regions at NUTS level 2 in the EU28. We had to exclude 9 EU member states because of missing data at the regional level on some of the variables used in the analysis.
[16] We focus on the manufacturing sector as Bekaert et al. (2007) argue that their measure is a better predictor of economic activity for open economies and industries.
[17] All the results reported in this paper are robust to an alternative definition of the indicator variable for the transport stock where we use the upper quartile of the transport stock density distribution (instead of the upper tercile).

2007) and the (post-)crisis period (2008-2013) to distinguish between an environment with (largely) positive and (largely) negative global growth opportunities.[18]

Economic slack: To proxy for economic slack, we use the distance to 'full employment' for each region. Specifically, we calculate the difference between the regional unemployment rate in each year and its average unemployment rate between 2002 and 2013.[19] Similarly to the transport stock density variable, we create an indicator variable equal to 1 if a region's unemployment gap is positive and in the upper tercile of the sample-wide unemployment gap distribution and 0 otherwise.[20]

The first column in Table 4 finds that the interaction term between the proxy for global growth opportunities and the transport stock is positive and statistically significant for GDP growth; and negative and statistically significant for unemployment. This is broadly in line with our hypothesis.[21]

Table 4. The interaction term between the proxy for global growth opportunities and the transport stock is associated with regional economic growth and unemployment. Dependent variable: regional GDP growth and change in the regional unemployment rate

	GDP growth	Unemployment
Global Growth Opportunities	0.007**	-0.090
	(0.003)	(0.078)
GGO x Transport stock	0.041***	-0.563***
	(0.006)	(0.158)
Sample size	2,444	2,468
R-squared	0.075	0.007
Number of regions	245	245

Note: All regressions control for region fixed effects. Unbalanced panel. Time period: 2002-2013. Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

When focus on instances with mostly positive shocks to global growth opportunities, we find that that the interaction term is also positive and statistically significant when the dependent

[18] As discussed above, as robustness check, we also identify all those instances where a region had a PE ratio in the top (and bottom) tercile of PE ratios in at least 4 out of 6 years and assembles these instances to create a panel consisting only of regions affected by positive (negative) shocks to their global growth opportunities.

[19] A comparison of the average unemployment rate with European Commission estimates of the natural rate of unemployment at the national level confirms that the average unemployment rate is a good proxy for the natural rate of unemployment (and hence full employment).

[20] In view of better reflecting national differences in the labour market structure, we also use an indicator variable equal to 1 if a region's unemployment gap is positive and in the upper tercile of the *country's* unemployment gap over the period 2002 and 2013. The results are not affected by this alternative definition of employment slack. The results are also robust to an alternative definition of employment slack where we use the employment rate instead of the unemployment rate. In this case, the indicator variable for slack is equal to 1 if a region's employment gap is negative and in the lower tercile of the European or country-specific employment gap distribution.

[21] When we use country fixed effects (instead of region fixed effects) or add year fixed effects to the model, we also find that the estimated coefficient on the interaction term is always positive and statistically significant.

variable is output growth (see Table 5).[22] For the sake of brevity, we focus on GDP growth but the results are similar when use the change in unemployment as the dependent variable (i.e. the estimated coefficients have the opposite sign). This suggests that regions with a high stock of transport infrastructure are better placed to benefit from positive global growth opportunities.

Given that the coefficients on the global growth opportunities are insignificant in our 'positive growth' scenario, the estimates also show that, on average, *only* regions with a high stock of transport infrastructure are able to significantly benefit from positive global growth opportunities. For regions with a low transport infrastructure, a positive shock to global growth opportunities does not seem to translate into any material improvement with respect to growth.

If we focus on a negative shock environment, we find that negative changes to global growth opportunities translate into negative outcomes in GDP growth. This is the case both for regions with a high level of transport shock and regions with a low level of transport stock – which means that while a high transport stock does not amplify the negative consequences of a deterioration global growth outlook it does not mediate them either.

Table 5. The interaction term between the proxy for global growth opportunities and the transport stock is associated with regional economic growth only before the crisis. Dependent variable: regional GDP growth

	Pre-crisis (2003-2007)	(Post-)crisis (2008-2012)
Global Growth Opportunities	0.001	0.046***
	(0.002)	(0.003)
GGO x Transport stock	0.017**	0.002
	(0.009)	(0.007)
Sample size	1,050	1,050
R-squared	0.006	0.325
Number of regions	210	210

Note: All regressions control for region fixed effects. Balanced panel. Time period: 2003-2012. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

In Table 6, we test whether employment slack affects the role played by the region's transport stock in case of an exogenous shock. We find that the simple interaction term ($GGO_{i,t-1}xTS_i$) has the same positive sign, both in case of slack and in the absence of slack. However, and in line with our second hypothesis, we find that the transport network has a larger impact on

[22] The estimates in Table 5 use a balanced panel over the period 2003-2012 so that the same regions are included in the pre-crisis period and (post)crisis period. The results using an unbalanced panel over the period 2002-2013 are qualitatively similar.

economic activity in regions with employment slack (making it a possible source for faster economic recovery) – as the difference between the two coefficients is statistically significant.

Table 6. The size of the interaction term between the proxy for global growth opportunities and the transport stock is larger in regions with economic slack. Dependent variable: regional GDP growth

	Slack	No slack
Global Growth Opportunities	0.010**	0.009**
	(0.004)	(0.004)
GGO x Transport stock	0.062***	0.030***
	(0.011)	(0.007)
Sample size	880	1,562
R-squared	0.195	0.063
Number of regions	241	235

Note: All regressions control for region fixed effects. Balanced panel. Time period: 2002-2012. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Figure 8 illustrates this result by means of simple plot of the regression outcome. It shows that the effect of an exogenous shock to global growth opportunities is larger in regions with a high transport stock, regardless of the degree of economic slack inherent in the regions. However, the effect is even more pronounced in regions suffering from economic slack – suggesting that having a high regional transport stock may be an important ingredient for economic recovery.

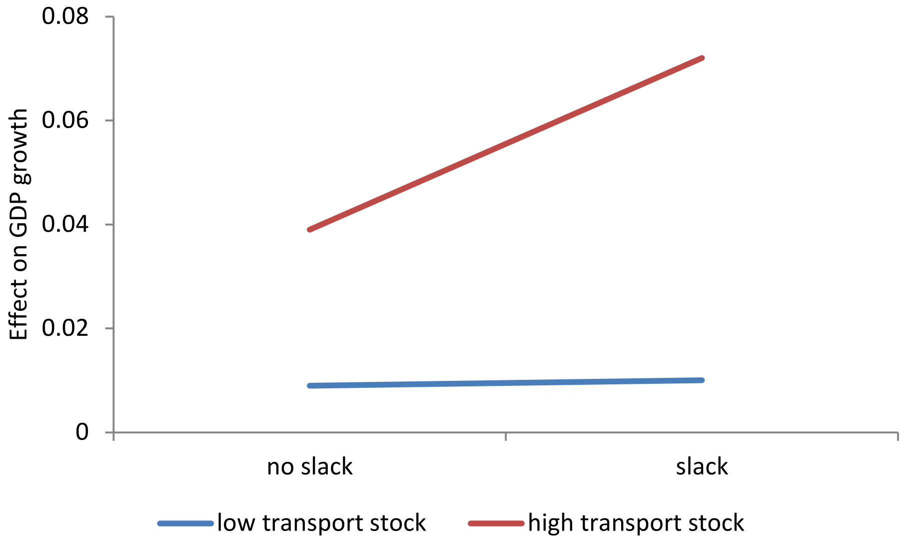

Figure 8: Average marginal effects of the PE ratio on regional GDP growth and unemployment in regions where there is employment slack and in the absence of employment slack

A detailed analysis (distinguishing between positive and negative shock scenarios and taking slack into account) also shows that the amplifying effect of a higher transport stock holds when there are positive shocks to global growth opportunities (only). The case of negative shocks is more problematic to examine as periods with primarily negative shocks tend to come with high slack – and a comparison with no slack is, therefore, difficult.

7. Conclusion

This paper finds evidence for the hypothesis that the regional transport stock matters to link local businesses with global growth opportunities. More specifically, we show that an increase in exogenous global growth opportunities translates into stronger economic growth in regions with a better transport network. This effect is particularly pronounced in periods of economic slack – when, arguably, there are sufficient resources available to expand capacity.

A deterioration in global growth opportunities, however, does not translate into a worse growth performance for regions with a higher transport stock. This suggests that the effect of a good transport network in absorbing global growth shocks is not symmetric. A higher transport stock benefits a region in times of positive shocks, but does not make it worse off in times of a negative shock.

Combined with our findings from the first part of the paper – that infrastructure investment in Europe has been on a downward trend for several years, this raises concern whether this may have already affected (or may sometimes soon constraint) the capacity of local firms in the EU to benefit from global growth opportunities. It also raises an additional question: what is holding back investment in transport infrastructure in Europe?

Limited fiscal space is an important constraining factor. While it is true that the importance of private finance in the transport sector has grown over the last two decades, mainly in the form of Public Private Partnerships (PPP), it would need to increase much further to compensate for the lack of public funds. The EIB, in collaboration with the European Commission, has developed over the years innovative financial instruments for more capital market as well as more bank participation in the funding of infrastructure projects.

In addition, the European Fund for Strategic Investment (EFSI), established as the main element of the Investment Plan for Europe, aims to mobilise some EUR 315 billion of investment over three years (a large part of which will come from private sources), helping to address key market gaps and structural weaknesses to build a more competitive EU economy.

The EFSI is funded by EUR 16 billion in guarantees from the EU budget and EUR 5 billion from the EIB's own funds.

But there are many other bottlenecks for additional investment apart from funding. An inappropriate regulatory environment is one of the most important constraints to the development of key transport infrastructure projects – in particular with regard to permitting and procurement procedures. Regulatory barriers induce very long lead times and delays, sometimes amounting to decades, with a very high opportunity cost for society. This is even more acute for cross-border projects where the differences in national systems and law accentuate the obstacles faced. A lack of harmonised standards at the European level can also hinder project implementation, while uncertainties related to tariff regimes can be a significant deterrent to private investors.

Last but not least, it is important to bear in mind that adequate funding and a proper regulatory framework can do only so much when it comes to promoting the development of additional transport infrastructure. An economically sound preparation of projects matters as well. There are already several initiatives that try to address this issue, and clearly more could be done. For instance, the JASPERS initiative has been instrumental in providing advice to EU member states with regard to project preparation. The European PPP Expertise Centre (EPEC) has also played a key role in developing the capacity of public sector entities to implement PPP projects and programmes. These and other technical advisory services will be brought together to form a European Investment Advisory Hub to create a one-stop-shop for project promoters to receive support in the context of the Investment Plan for Europe.

References

Bekaert, G., Harvey, C.R., Lundblad, C., and Siegel, S. (2007). Global growth opportunities and market integration. *Journal of Finance*, 62(3), 1081-1137.

Bergstrand, J.H. (1990). The Heckscher-Ohlin-Samuelson model, the Linder hypothesis and the determinants of bilateral intra-industry trade. *Economic Journal*, 100(403), 1216-1229.

Berndt et al. (2015). *Restoring EU competitiveness*. European Investment Bank, Luxembourg.

Blinder, A., Canetti, E.R.D., Lebow, D.E., and Rudd, J.B. (1998). *Asking about prices: A new approach to understanding price stickiness*. Russell Stage Foundation, New York.

Hätönen, J. (2011). The economic impact of fixed and mobile high-speed networks. *EIB Papers*, 16(2), 30-59.

Heckscher, E.F. (1916). Vaxelkursens grundval vid pappersmyntfont. *Ekonomisk Tidskrift*, 18, 309–312.

Kappeler, A. and Nemoz, M. (2010). Public-Private Partnerships in Europe – before and during the recent financial crisis. EFR 2010/4, European Investment Bank.

Obstfeld, M., and Taylor, A.M. (1997). Nonlinear aspects of goods-market arbitrage and adjustment: Heckscher's commodity points revisited. *Journal of the Japanese and International Economies*, 11(4), 441-479.

Revoltella, D., Brutscher, P.B., Tsiotras, A. and Weiss, C.T. (Forthcoming). Linking local business with global growth opportunities: The role of infrastructure. *Oxford Review of Economic Policy*

Roland-Holst, D. (2009). Infrastructure as a catalyst for regional integration, growth, and economic convergence: Empirical evidence from Asia. In Fan Z. (ed.), *From Growth to Convergence: Asia's Next Two Decades*, Palgrave Macmillan, New York.

Samuelson, P.A. (1952). The transfer problem and transport costs: The terms of trade when impediments are absent. *Economic Journal*, 62(246), 278-304.

Wagenvoort, R., de Nicola, C. and Kappeler, A. (2010). Infrastructure finance in Europe: Composition, evolution and crisis impact. *EIB Papers*, 15(1), 16-39.

WEF (2011). *Advancing cloud computing: What to do now? Priorities for industry and governments*. Report by the World Economic Forum in partnership with Accenture, Geneva.

Appendix 1

Table A.1. Description and source of the variables

Variables	Description	Source
$\Delta GDP_{i,t}$	Growth of real gross domestic product	Eurostat
$\Delta unemploy_{i,t}$	Change in the regional unemployment rate (15 years or over)	Eurostat
$GGO_{i,t}$	Global growth opportunities of the manufacturing sector considering the importance of the manufacturing sector in the region Composition: 1. Global PE ratios of 25 manufacturing industries 2. Weight the importance of each industry using the salary share of each industry out of total salaries in a region	Datastream, Eurostat
TS_i	Transport stock density: indicator variable equal to 1 if a region has a high transport stock (top tercile of the transport stock density distribution) and 0 otherwise. Composition: 1. Aggregate the regional averages of the number of kilometres of roads, motorways and rail lines 2. Weight the aggregated measure of the transport network by the region's average population size 3. Transform this continuous measure into an indicator variable	Eurostat
$GGO_{i,t}xTS_i$	Interaction term between the growth potential of the manufacturing sector and the transport stock indicator	
$slack_{i,t}$	Employment slack: indicator variable equal to 1 if a region's unemployment gap is positive and in the upper tercile of the sample-wide unemployment gap distribution, and 0 otherwise	Authors' computation
$shock_{i,t}$	Two approaches: 1. Compare the pre-crisis (2003-2007) and the (post-) crisis period (2008-2012) for all regions in the sample 2. Split the sample into positive (negative) shocks and keep regions who were for at least 4 years in the top (bottom) tercile of the distribution of global growth opportunities	Authors' computation
$pop_{i,t}$	Total population of the region	Eurostat

Table A.2. Descriptive statistics

	N	Mean	SD	Min	Median	Max
GDP growth	2,444	0.01	0.04	-0.15	0.01	0.19
Unemployment rate	2,468	8.59	4.69	1.90	7.50	36.20
Price to earnings (PE) ratio	2,400	18.47	3.60	9.87	19.06	33.37
PE ratio - manufacturing	2,374	19.36	5.17	7.94	19.37	45.23
Transport stock (in km)	2,468	16,972	17,413	31	11,703	94,336
Population (in thousand)	2,468	1,952	1,521	124	1,586	11,604

European Investment Bank
The EU bank

Economics Department
economics@eib.org
www.eib.org/economics

Information Desk
+352 4379-22000
+352 4379-62000
info@eib.org

European Investment Bank
98-100, boulevard Konrad Adenauer
L-2950 Luxembourg
+352 4379-1
+352 437704
www.eib.org