INFRASTRUCTURE FOR GROWTH: HOW TO FINANCE, DEVELOP, AND PROTECT IT

edited by **Carlo Secchi, Stefano Riela**

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ITALIAN INSTITUTE
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POLITICAL STUDIES

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FOREWORD

This study is an initiative of the ISPI's Centre on Infrastructure, promoted with the knowledge partnership of McKinsey & Company. It analyses the importance of economic infrastructure and how to finance and develop it. Economic infrastructure is the backbone that, in many cases, crosses the borders of political geography and defines the space supporting the movement of goods, services, people and their ideas.

The eight articles of this study are structured into four main sections: 1) The economic impact of infrastructure, with a focus on the transportation network of the EU; 2) The geopolitical role of infrastructure; 3) The infrastructure gap at the global level and how to ease its financing; 4) The efficient development of infrastructure.

In particular, Section 1 underlines that infrastructure has the ability to determine a positive discontinuity in the economic growth of countries through direct and indirect effects. The realisation of an infrastructure boosts GDP and creates jobs, while its availability can increase productivity and promote both competition and cooperation. The completion of the core Trans-European Transport Network (TEN-T), for example, may increase the GDP of the EU by 1.6% and create new ca. 800,000 jobs by 2030. However, the realisation of the core TEN-T by 2030 and the comprehensive network by 2050 require that EU resources are used to attract private funds as proposed in the EU budget 2021-2027 (the draft of the Multiannual Financial Framework produced by the EU Commission), as well as in the updated versions of the Connecting Europe Facility (CEF) and of the so-called "Juncker Plan" (now InvestEU). The EU financial commitment for infrastructure investments extends also in countries that participate in the Neighbourhood Policy: the aim is to promote the economic and political stability of those countries and hamper the consolidation of geopolitical interests of other big players in the Eurasian continent (namely Russia and China).

In Section 2 the spotlight is placed on strategic infrastructure. When infrastructure is labelled as "strategic", states can introduce screening procedures and restrictions for FDIs depending on the nationality of the investor. This is to prevent foreign entities from threatening the security and the economy of the target country through the acquisition of key assets. The US, the EU and some EU states have recently introduced new and/or tougher criteria especially for potential FDIs from state owned enterprises (SOEs) rooted in non-market economies such as China, with explicit plans of global "shopping" for geopolitical purposes. Along with the FDIs, the asymmetry between market and non-market economies has raised concerns even in the field of tenders for infrastructure projects in the EU. Firms supported by state aids may distort competition in procurement procedures: those companies often offer prices and conditions that cannot be met by European firms. This is why the European Council has recently (22 March 2019) acknowledged that the EU must "*safeguard its interests in the light of unfair practices of third countries, making full use of trade defense instruments and our public procurement rules, as well as ensuring effective reciprocity for public procurement with third countries*", a few weeks before the EU-China Summit on 9 April 2019.

Section 3 focuses on the increasing needs for infrastructure funding. Despite the positive impact of infrastructure, there is a gap between the investment needed to maintain the current level of global GDP growth and the resources actually invested. One of the main obstacles to infrastructure financing relates to the lack of "investment grade". This is due to the shortage of expertise for projects with an increasing complexity as well as the lack of information and standardisation in data and procedures. A significant role in filling that gap is played by multilateral development banks. These institutions provide governments with tools to improve the attractiveness of investments and have a direct role in financing specific infrastructure projects. They provide loans, guarantees and technical assistance to prepare the investment and reduce the related risk. They also co-finance projects with governments, commercial banks, credit export agencies and other private investors. A web platform called "Source" has been created by multilateral development banks to develop infrastructure investment-ready projects, especially in low and middle-income countries.

Section 4 tackles the most pressing issues in infrastructure design and realisation. The recent wave of infrastructure investment is marked by higher complexity also due to an increasing demand for environmental, social and financial sustainability. To this aim, procurement strategies and procedures need to be updated and customised to ensure greater efficiency and to attract qualified contractors; indeed, the latter are becoming picky and shy away from those projects that present substantial social, political or sovereign-type risks that could harm profitability and reputation. To boost efficiency in the sector, firms are turning to data-driven solutions and Artificial Intelligence to improve capital project outcomes and to reduce risk. Firms can leverage the vast amounts of data they already collect and analytics can uncover critical insights that speed

up and improve the quality of management decisions. In particular, they can help project teams assess market conditions, portfolio composition, and individual project performance.

To conclude, infrastructure reduces isolation and allows economic agents to interact and benefit reciprocally from comparative advantages. In the long-run, it may also enable the exploitation of economies of scale and produce positive spill-over effects thanks to the spread of technology and knowledge. This is the rationale behind the growing need for connectivity, and infrastructure is the main tool to achieve this aim. History repeats itself: the Romans, almost two millennia ago, considered connectivity as an essential engine for the growth and the stability of the Empire, with an extensive network that has shaped the pattern of contemporary urbanisation and industrialisation. Today, at the peak of this wave of globalisation, infrastructure is increasingly perceived and used as a geopolitical tool to project the influence of the major powers on the global stage. This nevertheless might determine asymmetric relationships that could harm the economic prospects and threaten the political independence of the weakest countries. The real goal to be delivered is the creation of a level playing field at the global level: reciprocity, reduction of barriers to market entry, protection of intellectual property and universal standards are what really matter to ensure the role of infrastructure as a core driver in improving the long-term economic outlook of countries.

1. THE IMPACT OF TEN-T COMPLETION ON EUROPEAN ECONOMY

W. SCHADE, S. MAFFII, S. SCHÄFER, S. MADER

Infrastructure and especially new transport infrastructure have a marked effect on a country's economy. From a physical perspective, improved infrastructure creates better connectivity between regions and countries and hence reduces travel times. On the European level, the development of the Trans-European Transport Networks (TEN-T) has always been a major component of the common transport policy.

On behalf of the European Commission, a study has been carried out by M-Five, TRT, and Ricardo with the objective to assess the growth, jobs and greenhouse gas emissions impacts arising from the completion of the TEN-T core network[1]. In this article, the applied methodology and the evaluated economic impacts of the TEN-T completion on the European economy are presented.

METHODOLOGY OF THE ASSESSMENT

The analysis is based on an integrated approach applying two models: the European multi-modal transport network model TRUST and the integrated transport-economy-environment assessment model ASTRA. Linking them together aims to achieve two goals:

- The addition of economic and social dimensions to the analysis of impacts of transport policy measures, simulated in detail on a network basis.
- The evaluation of the transport impacts of infrastructure projects on the network.

Overview of the ASTRA model

The Assessment of Transport Strategies (ASTRA) model is a System Dynamics model designed for the assessment of impacts of various transport policies and strategies with the economic system[2]. It is one of the few

tools integrating the full transport system. It comprises a transport demand model, a vehicle fleet model, an environmental model, and a fully-fledged macro-economic model. ASTRA is, therefore, able to model different levels of effects: (1) the direct effects of a transport policy taking place within the transport sector itself (*e.g.* transport flows and modal-shift), (2) the direct effects of infrastructure policies in the economy (*e.g.* on the construction sector), and (3) the indirect effects occurring anywhere in the economy usually with some delay after the initial impulse.

The macro-economic modelling from ASTRA relevant for this project can be roughly differentiated into four core elements:

- The demand side with private consumption of households, investments and the trade balance differentiated by 25 economic sectors (NACE-CLIO system) and government consumption.
- The supply side with capital stock, labour supply and total factor productivity (TFP).
- The input-output tables depicting the sectoral interactions and enabling to estimate sectoral gross-value-added (GVA) and sectoral employment.
- The micro-macro-bridges linking the bottom-up calculations of the transport system with the various elements of the macro-economic module.

At the core of the macro-economic modelling in ASTRA is the determination of GDP for each future year, which results from the interaction between the supply and demand side of the national economy of each Member State. The level of GDP and the taxation systems of the countries determine disposable income and subsequently the sectoral spending behaviour of households, which is also affected by spending for the transport sector that is determined by the results of the transport models. Sectoral final demand, as well as energy and transport-related impacts, affect the sectoral value-added through the input-output tables, which in turn constitutes a driver of sectoral employment. On the supply side, the most relevant variable is Total Factor Productivity (TFP), which is driven by sectoral labour productivity, type of investment goods demanded, and national average freight transport time.

The Transport Module in ASTRA follows the classical four-stage modelling approach with generation, distribution, modal split and assignment. Using transport cost and transport time matrices, it calculates the modal-split for five passenger modes and four freight modes. Influencing factors are such as travel speeds, structure of vehicle fleets, transport charges, fuel price, or fuel tax changes. Results are vehicle-km per mode and country based on passenger and freight transport performance[3].

Major outputs of the Transport Module, are provided to the Environment Module (ENV) of ASTRA. These inputs and information from the Vehicle Fleet Model are used to calculate the major greenhouse gas emissions and air pollutants from transport at the national level.

Overview of the TRUST model

The TRansport eUropean Simulation Tool (TRUST) is a transport network model allowing for the assignment of Origin-Destination matrices at the NUTS-III level for passenger and freight demand for the EU and the neighbouring countries. The model has been used for many years to support studies at EU level, and it is calibrated to reproduce tonne-km and passenger-km by country consistent with the Eurostat Transport in Figures statistics, apart from the intra-NUTS-III demand, which is not assigned to the network.

Base year matrices are based on those estimated in the ETISplus project while future matrices are derived by applying ASTRA model demand growth rates. The road assignment algorithm distributes demand for each origin/destination pair among available alternative routes according to their utility using a logit model where the utility of each route is measured in terms of generalised cost.

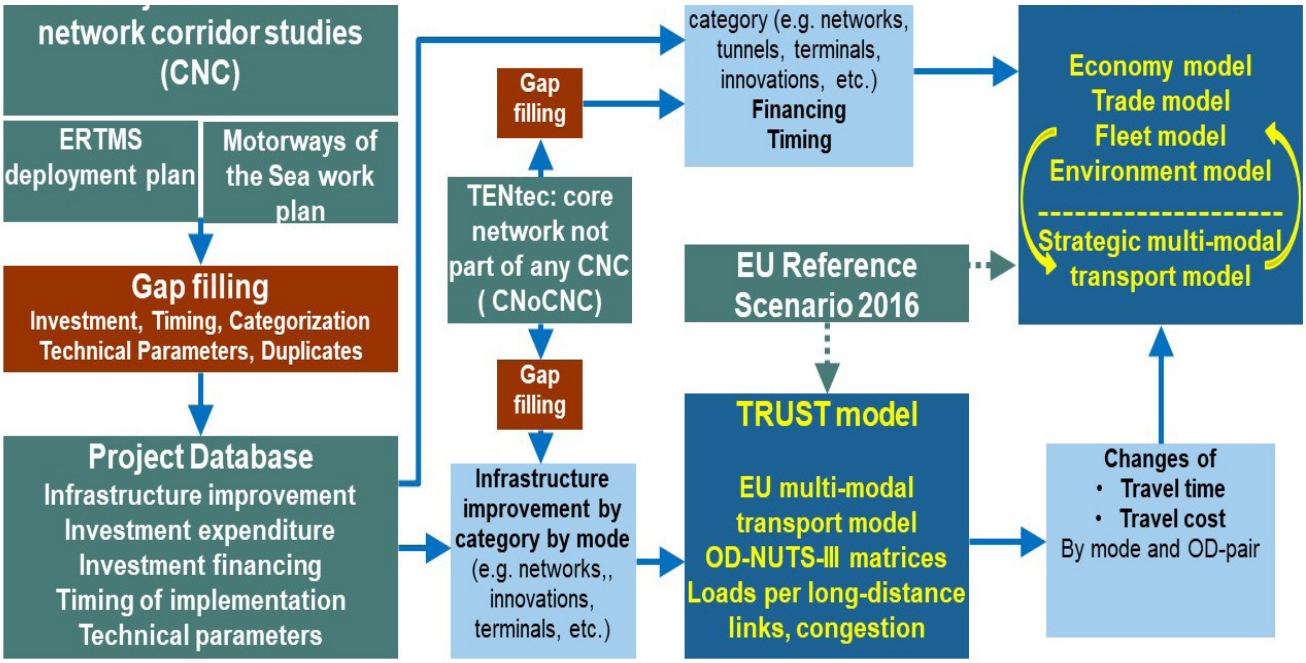
The rail network, which does not consider capacity limitations, includes different link types (conventional, high speed, border rail link – by demand segments where allowed) as well as intermodal terminals where loads are transferred between road and rail. Inland and maritime waterways are modelled as feeder modes. Demand is segmented according to types of traffic that correspond to different train types in terms of occupancy of rail capacity.

Interaction between TRUST and ASTRA

Figure 1.1 presents the interactions between TRUST and ASTRA as well as the main inputs used in this study. Both models are calibrated to an update of the EU Reference Scenario 2016[4] in terms of demographics, economic growth, energy, and transport sector developments. This scenario, which assumes that all the projects are completed by 2030, is compared with a Baseline Scenario that assumes that no further core TEN-T network investments are implemented beyond 2016 and is built by subtracting from the EU Reference Scenarios all interventions to be implemented beyond 2016.

Assumptions on the implementation of the TEN-T core network over time constitute the major specific input to both ASTRA and TRUST. Assumptions are derived from a Projects Database developed by building upon various sources (see Figure 1.1).

FIG. 1.1 - MAJOR ELEMENTS OF THE PROJECT METHODOLOGY



Source: M-Five

Investment, financing, and timing of investment directly alter the corresponding variables in ASTRA, which then generate new estimates for GDP, income, consumption, transport activity, etc. Assumptions on the evolution of the CNCs over time are fed into the TRUST model and changes of travel times and cost in the Reference Scenario are compared with the Baseline Scenario and are converted from the spatial concept of TRUST (link level) into the NUTS I level and fed into ASTRA. Finally, investment into TEN-T and other transport infrastructure is considered as part of the government budget. The investments for cross-border projects are split according to the involvement of the respective countries.

Combining TRUST and ASTRA allows transport to be analysed at two levels: the network level by TRUST, and the strategic level by ASTRA. With such a combined modelling approach it is possible to capture both the direct effects of the new or improved infrastructure in the transport sector, as well as the indirect effects on supplying industries and wider economic impacts induced by mechanisms such as higher productivity diffusing to other economic agents and into future years. The latter also captures growth and job impacts.

ECONOMIC IMPACTS OF TEN-T IMPLEMENTATION

The analysis of the TEN-T implementation builds on the projects along the core network corridors which remain to be implemented between 2017 and 2030 in order to achieve full completion of the core network. These projects represent a total investment of €556 billion in 2005 prices. The economic impacts are analysed from three different angles:

- Impacts for the whole EU until 2030
- Impacts for the different Member States
- Impacts of individual CNC

The impacts of investments go beyond the transport system. The modelling exercise shows a wealth of economic impacts:

- Infrastructure investments have a positive impact on value-added and employment in the construction sector and its supply industries.
- Investments in technology such as alternative fuels or components of the ERTMS foster growth and employment in those industries.
- Transport time savings increase the productivity of supply chains and create new opportunities for business trips, which improves productivity.
- Sectoral productivity gains due to higher sectoral investment in technology. Inputs increase total factor productivity, with positive impacts on GDP.
- Increased GDP leads to second-round impacts, with additional income spent.

Economic impacts for the whole EU

ASTRA simulates these macroeconomic impacts through key indicators including GDP and employment. Table 1.1 shows that GDP at EU28 level goes up by 1.6% in 2030. It also shows that the economic impacts are not evenly distributed across the European Union: GDP in EU13[5] Member States increases by 4.2% in 2030 relative to the Baseline, whereas for the EU15[6], the GDP increases by 1.4%.

Employment in the EU13 is 0.4% higher in 2030 with respect to the Baseline and 0.1% higher in the EU15. For the EU28, 797,000 additional jobs[7] are created in 2030 thanks to the completion of the core TEN-T network.

Tab. 1.1 - Changes in GDP and employment in the Reference scenario relative to the Baseline due to the TEN-T core network implementation between 2017 and 2030

Changes in the Reference scenario relative to the Baseline	GDP		Employment (FTE)	
	2020	**2030**	**2020**	**2030**
EU15	0.3%	1.4%	185 200	509 600
EU13	1.9%	4.2%	155 300	287 500
EU28	0.4%	1.6%	340 500	797 000

Source: ASTRA

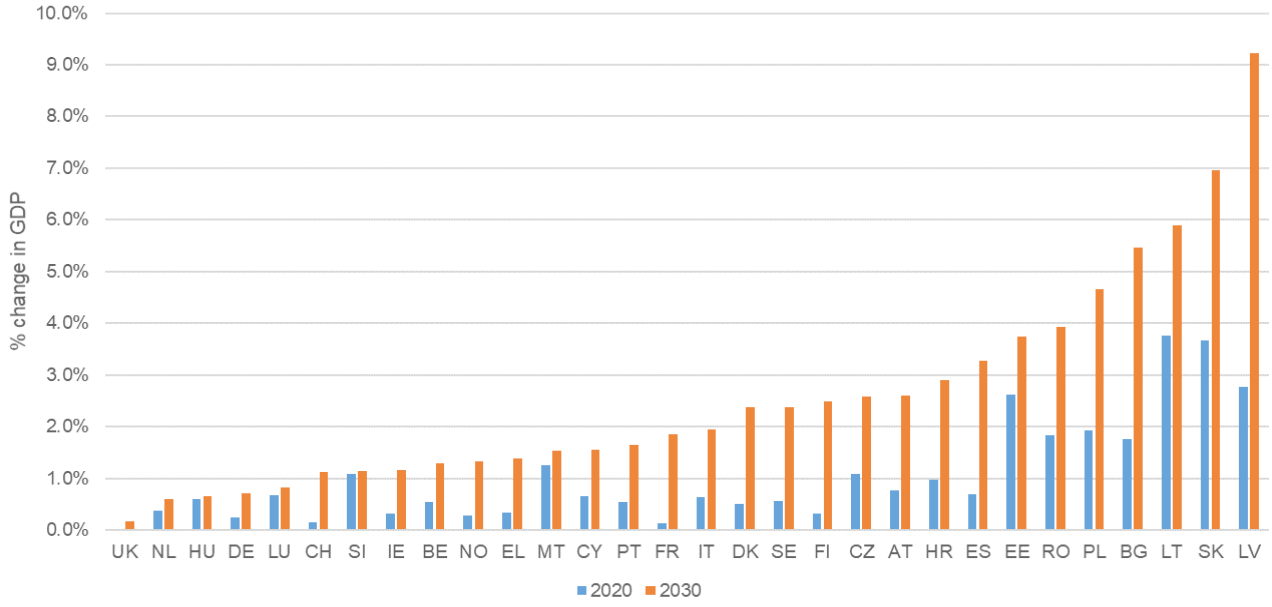
Economic impacts on Member States

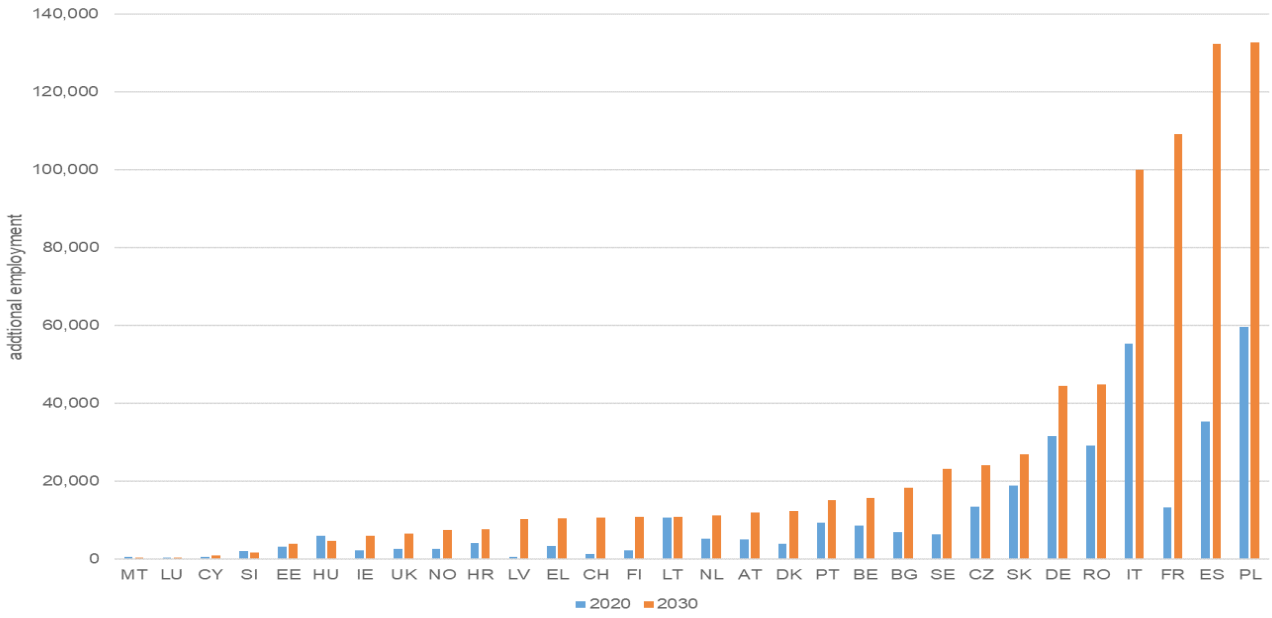
At Member State level, the impacts depend on factors such as: the size of TEN-T investment in relation to GDP or to their total investment; the sectoral structure of their economy; the specific improvements of transport performance; the dependency on trade and the trade structure. The time profile of TEN-T investments and thus of improvements in travel time is different between countries. As a consequence, the impacts on GDP and employment vary. Moderate increases in GDP of around 1% in 2030 relative to the Baseline are projected for several EU15 countries, while substantial increases of more than 3% in GDP are shown for many EU13 countries. Countries like Luxembourg, Slovenia, and Hungary reveal positive impacts on GDP that are similar in 2020 and 2030 (Figure 1.2), showing that most of their benefits are from direct effects. Conversely, countries like Bulgaria, Denmark, Sweden, and Latvia have GDP impacts that triple between 2020 and 2030, benefitting from second-round effects.

The impacts on employment presented in Figure 1.2 show that in Italy, France, Spain, and Poland more than 100,000 additional jobs are created in 2030 relative to the Baseline, mainly because of second-round effects.

The relative magnitude of direct or second-round effects depends on (1) the share of imports and exports in the sector benefitting from the investment, (2) the share of domestic input to construction, (3) growth of income and thus consumption, and (4) stimulus of total factor productivity in that country. In particular, the two final effects are mutually reinforcing and can foster medium-term growth dynamics. As a result, demand and productivity effects can significantly exceed direct effects.

FIG. 1.2 - CHANGES IN GDP AND ADDITIONAL JOBS CREATED IN 2020 AND 2030 IN THE REFERENCE SCENARIO RELATIVE TO THE BASELINE



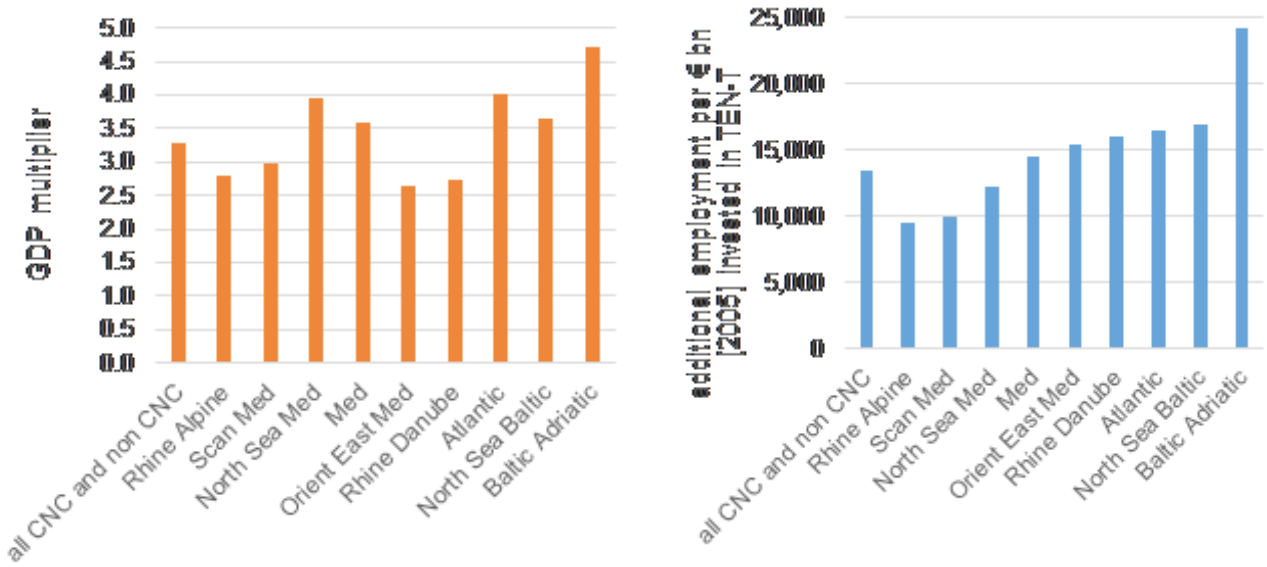


Economic impacts from individual core network corridors

Economic multipliers are used as an indicator to understand the economic impact of TEN-T implementation.

Figure 1.3 shows multipliers for individual corridors that provide an indicator of the additional GDP and jobs created by each euro respectively per billion euro invested over the period 2017 to 2030. These range from 2.6 for the Orient-East-Med CNC to 4.7 for the Baltic-Adriatic CNC. The GDP multiplier for the whole TEN-T core network over the period 2017 to 2030 is 3.3.

FIG. 1.3 - GDP AND EMPLOYMENT MULTIPLIERS FOR THE TEN-T CORE NETWORK IMPLEMENTATION BETWEEN 2017 AND 2030



Source: ASTRA

The high employment multiplier of the Baltic-Adriatic corridor results from large investments placed in Poland that shows a large impact due to its sectoral structure, as well as their relatively lower labour productivity (see Figure 1.2). Low employment multipliers are projected for the Rhine-Alpine and the Scandinavian-Mediterranean corridors. The reason is that they pass through countries with comparably high labour productivity, so the same increase in investments translates into a lower impact on employment[8]. The average multiplier for the whole TEN-T core network is above 13,000 additional job-years per billion euro invested (in 2005 prices).

CONCLUSION

The study has analysed the full TEN-T core network implementation by 2030. In terms of economic impacts, EU GDP would increase by 1.6% in 2030 relative to the Baseline and an additional 797,000 full-time equivalent jobs would be generated. GDP growth impact differs substantially between the EU13 (+4.2%) and the EU15 (+1.4%). These large differences between countries are linked to (1) the share of TEN-T investments in the total investments undertaken in a country and (2) country-specific economic structures.

The GDP multiplier of the TEN-T investments amounts to 3.3, which indicates that for every euro invested, €3.3 of additional GDP are created. In terms of employment, for every billion euro invested into the TEN-T core network between 2017 and 2030 an average of 13,000 additional job-years are generated.

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3. Transport results and the greenhouse gas impacts are not included in this paper but are available from the main study.

4. The Reference Scenario has been developed with the PRIMES-TREMOVE model by ICCS-E3MLab (Capros et al. 2016).

5. Bulgaria, Croatia, Czech Republic, Cyprus, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovak Republic, Slovenia

6. Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxemburg, Netherlands, Portugal, Spain, Sweden, United Kingdom

7. Employment numbers are provided as full-time equivalent (FTE).

8. To derive employment from value-added the latter needs to be divided by the productivity in euro/FTE. High values for productivity then lead to small numbers for employment.

2. THE FUTURE OF TEN-T IN EUROPE AND BEYOND

CARLO SECCHI

Transport infrastructures are of vital importance for Europe because they support the possibility of implementing a truly unified single market while reducing the impact of distances and geographical obstacles. As a matter of fact, the Treaty on the European Union, by identifying the four fundamental freedoms of movement (of citizens, goods, capitals, and services), implicitly puts transport infrastructure as a top priority, especially since the Treaty of Rome of 1957 provided for a "common transport policy".

However, while a pan-European detailed plan is now available, the fundamental problem is how to finance the increasing infrastructure needs. That is the reason why this paper will mainly focus on how to mobilise resources – both public and private – to this end.

We are at present approaching the final year of the current multi-annual financial framework (MFF) of the European Union (EU), to be concluded at the end of 2020. This also refers to the financial support available for the transport infrastructure of the Trans European Network – Transport (TEN-T)[1]. The legal basis is given by two Regulations, one on "Union guidelines for the development of the trans-European transport network"[2] and the other on establishing the "Connecting Europe Facility (CEF)"[3]. The TEN-T system is organised in nine "core network corridors"[4] plus two horizontal priorities (Motorways of the sea and Deployment of the European Rail Traffic Management System – ERTMS), each one under the responsibility of a European Coordinator.

The EU has jointly set with its Member States and the European Parliament very ambitious goals to realise a "core" trans-European transport network by 2030 and a "comprehensive" network by 2050[5], which are currently being implemented. This translates into estimated investment needs between 2021 and 2030 of around 500 billion euro. It is evident that these investments cannot be financed only by grant funding

from the Community, even with an increased budget for the CEF. On the contrary, while trying to maximise the impact of the amounts available also through innovative financial instruments and their joint-use (the so-called "*blending*"), it is of vital importance to mobilise, alongside to the lending activity of the European Investment Bank (EIB)[6], also private resources through the financial market and in other ways. This requires the development of a favourable context through a variety of measures.

For this reason, at the request of the Informal Transport Council held in Milan in September 2014, two European coordinators (Kurt Bodewig and the author of this article) together with the late Henning Christophersen (a former Commission Vice-President also in charge of transport)[7], presented in June 2015 an "*Action Plan on how to make the best use of new innovative financial schemes*". It includes twelve sets of concrete recommendations on how to improve the investment framework for infrastructure projects in Europe. In January 2018, a Progress Report on this Action Plan was published, taking stock of the developments that took place by then and making additional recommendations. Finally, a Discussion Paper on "*Enabling the up-take of the TEN-T project pipeline by the financial market*" was presented to the Informal Transport Council of Bucharest (27 March 2019) with the ambition to prepare new recommendations as a basis of the work programme of the new European Commission which will take office towards the end of this year.

Meanwhile, the renewal of the CEF Regulation is in the legislative pipeline, in view of approving the new "CEF II" Regulation with the new MFF for the period 2021-2027, while the TEN-T Regulation (whose final year for the core network is 2030) will be reviewed and updated between 2022 and 2023 to build on the experience learned and to make it possible to reach the target set for the end of the next decade.

THE TRANSPORT INVESTMENT FRAMEWORK AND THE IMPLEMENTATION OF THE TEN-T

Even though much progress has been made to improve the transport investment framework in Europe, there are still a number of obstacles. Firstly, the financial sector and project investors have different views. The former although considering money for investments sufficient, do not see the transportation projects enough mature to invest in. The latter instead replies that there is still room to improve the EU granting system in view of the discrepancy between the number of investments needed and the budget proposed for transport for the period 2021-2027 under the CEF and under InvestEU (initially known as the "Juncker Plan"). As a matter of fact, the topic of financing is evolving fast, and a number of communications, reports, and studies have also been published by different entities[8].

It is important to keep the ongoing discussions open with all stakeholders, as well as within the European Commission and the European Parliament – in particular with representatives from financial institutions, the EIB and national promotional banks, investors' groups, etc. – in order to identify measures to improve the transport investment framework.

For the period 2021-2027, the Commission indicated a wish to focus on three main policy areas:

1. Jobs & Growth,
2. Sustainable Development and Climate Change, and
3. Defence Protection.

Transport would be formally placed under the second pillar, but actually responds to the needs of all three areas. Indeed, smart and sustainable transport investments create jobs and growth, contribute to the decarbonisation agenda and, last but not least, with its "military mobility" component of CEF II it also adds value to the defence protection of European Member States. This new chapter proposed for CEF II is very important, so because it is a first interesting case of "dual-use", which distinguishes transport infrastructure.

Five European funding instruments will support transport investments in the next MFF framework: the CEF II, including its blending facilities, Horizon Europe, the European Structural and Investment Funds, the EIB regular loan activities, and InvestEU. However, even if the proposed budgets for transport under these instruments would be doubled or tripled, there remains considerable gap to reach the 500 billion euro needed to complete only the core TEN-T network. It is therefore essential to increase the level of magnitude at which the market is currently picking up transport infrastructure projects. To this aim, the Commission, the Member States, and the project promoters need to address a number of challenges, some of which we will try to elaborate on in this paper.

THE EVOLUTION FROM CEF I TO CEF II

The implementation of CEF I has shown a high level of innovation with regard to the use of financial schemes. Indeed, for the first time, 1.4 billion euro of EU grants have been allocated in the form of blending calls. These calls were published in 2017 and 2018, successfully attracting project proposals and leading to 74 projects selected for a grant component, which are expected to mobilise up to 7.9 billion euro in investments.

Building on this positive experience, the European Commission is currently working on the establishment of a CEF blending facility for alternative fuels and ERTMS (European Rail Traffic Management System), to become operational around fall 2019 as a pilot before the start of Invest EU. It is expected to include different implementing partners, not only the EIB. The challenge will be to give an "optimal" grant level, to be set up

front so as to speed up the bank's due diligence, and minimise the administrative burden for applicants in closing the financial package. By "optimal", it is meant the level which is just sufficient to make the project attractive enough for banks and institutional investors (*i.e.* to properly mitigate the risk and increase the financial viability), but not more, in order to maximise the number of projects that can be supported.

Along with it, the Commission presented in June 2018 its proposal for a CEF II Regulation, which is currently under negotiation with both the Council and the European Parliament. The CEF II Regulation foresees three possibilities: to blend grants with InvestEU financing, to scale up the blending facilities, and to continue blending calls.

Moreover, there is a positive evolution of the regulatory context of EU financing. For example, in May 2018, the European Commission came forward with a proposal for a new Cohesion Policy under the next MFF 2021-2027. With regard to ex-ante conditions, it proposes to replace them with so-called "enabling conditions". The key differences are fewer conditions (from 35 to 20), clearer conditions, and a tighter link to policy.

Such conditions are strongly appreciated as long as they will not be a step backwards to less stable planning. Indeed, stable planning is extremely important to lower the political and regulatory risks for private investors. Certainly positive in this regard is the fact that the conditions are proposed to be followed up throughout the implementation of the project and not only at the beginning.

FROM EFSI TO INVESTEU

In December 2017, the Council and the European Parliament adopted Regulation (EU) 2017/2396 extending the life of the EFSI (European Fund for Strategic Investments, initially the "Juncker Plan") programme until end-2020, while introducing provisions to improve its additionality and transparency. At the same time, the European Commission published a call for the provision of technical assistance to strengthen the EFSI Advisory Hub.

In June 2018, the European Commission also presented its draft InvestEU Regulation with InvestEU to replace EFSI over the next financial programming period 2021-2027. InvestEU represents a positive development of EFSI: it will be policy-, rather than demand-driven, it will integrate under one roof all EU financial instruments and advisory services, and dedicate specific emphasis to sustainable infrastructure. More importantly, it will aim to open up the guarantee mechanism to national promotional and commercial banks on top of the EIB, which was one of the concerns expressed by many stakeholders.

While EFSI has been demonstrating positive results overall, it has shown rather low support of transport infrastructure projects. This is partly explained by the fact that many transport activities show low levels of rentability because it is difficult to apply the "user pays" (and the "polluter pays") principle. The transport

sector has historically been positioned as a public service that the citizens are expected to use more or less freely, having contributed to it with their taxes. However, public budgets have been reduced, and transport infrastructure have become much more costly and sophisticated, and still, citizens are reluctant to contribute directly through user fees or higher ticket prices. Therefore, many project promoters, notably in rail and in urban infrastructure, still rely on public resources and implicit guarantees, and thus their risk profile is unfit for the use of EFSI and similar high-leveraged financial instruments.

A change of mentality and habits is necessary, although it cannot be expected that this situation will change overnight. Hence, it is important that investment support programmes such as EFSI (and InvestEU in the future) dedicate special care to sustainable transport (and other sectors which pose similar challenges). Moreover, it is necessary to avoid that the EU support instruments address projects which would have been picked up by the market anyway. They should rather intervene where the market sees too high risks and too low returns. The EU granting system needs to be improved towards this goal.

THE ACTION PLAN ON FINANCING SUSTAINABLE GROWTH

Following the final report of the High-Level Group on Sustainable Finance in January 2018, the European Commission came forward in March 2018 with an "Action Plan on financing sustainable growth". It contains ten specific actions, the most important one for transport being the establishment of an EU classification of sustainable activities, which is referred to as the "green taxonomy", and the establishment of green standards for the bond market. This taxonomy is being developed and is currently under public consultation in its first round.

Importantly, it also covers all the transport activities that can help fight climate change and broadly addresses environmental challenges, among other things, by giving rise to a new asset class in the financial markets. Another important action is to foster investments in sustainable projects. This is addressed by the Sustainable Infrastructure Window of InvestEU.

BEYOND THE EU

The financial efforts put in place by the EU and the EIB also refer to other Countries outside the Union, like the members of the EFTA (European Free Trade Association), the candidates for membership, and those included in the "neighbourhood policy". The main purpose is to contribute to their development, but also to keep them involved in the internal single market.

The underlying strategy is not only economic but also political, with the purpose of intensifying relations with these Countries by keeping them involved in the developments of the single market and other EU acti-

vities, and of contrasting the economic and geopolitical interests of other important international players. The most obvious case refers to China and its "Belt and Road Initiative", a project also known as "One Belt One Road" (OBOR). China shows a keen interest in strengthening relations with European and neighbouring Countries through investments, in particular in infrastructure, as well as elsewhere in the world (like in Africa), also thanks to the financial means of its Asian Infrastructure Investment Bank (AIIB).

For the EU it is necessary to find an adequate balance between the goal to have reciprocally satisfactory economic and political relations with China and, at the same time, to avoid some dangerous activities in the field of investments in infrastructure, as well as in that of productive investments, in order to have a true reciprocity in economic behaviours (like in procurement) and to safeguard its strong points in technology (like that concerning ERTMS).

As far as transport infrastructure are concerned, recently it was agreed by both parties that the European Commission and China would support a study (to be delivered by the World Bank by the end of this year) on how to better connect the European corridors (starting from the EU's external borders) to the Chinese network (that is, to China's external borders). This indeed is a promising sign, and it shows good will on both sides. In addition, the Chinese Authorities have also agreed to present in the coming months their transport infrastructures planning in an open event in Brussels.

The European transport and infrastructure policy so far has supported European companies in enjoying the benefits of the single market and in strengthening their competitive position at the global level. Citizens have also greatly benefited from it, in terms of more liberty and higher welfare levels. This should continue to be the case also with a more important role by other players, through the development of a balanced cooperative environment to the interest of all parties involved, while contrasting the risks stemming from unfair competition and potential dominant or even quasi-monopolistic situations.

1. Although, the commitment of the European Institutions in this field dates back to the European Council of Essen (9-10 December 1994), when the first "Priority Projects" were agreed upon. The present policy framework is the result of the evolution taken place since then, in particular after the approval of the "White Paper on Transport" in 2011.

2. Regulation (EU) No 1315/2013 of the European Parliament and of the Council of 11 December 2013.

3. Regulation (EU) No 1316/2013 of the European Parliament and of the Council of 11 December 2013.

4. Of these, four cross Italy from North to South and from West to East: Baltic-Adriatic, Mediterranean, Rhine-Alpine, and Scandinavian-Mediterranean.

5. The "core" network connects cities, ports (both maritime and inland), airports, rail road terminals which qualify above a given threshold (in any case at least one for each Member State), while the "comprehensive" network is more of national and regional interest, ensuring accessibility for all regions to the core one.

6. On the EIB web site many documents and studies on infrastructures investments are available, including the reports of the EPEC (European PPP – Public Private Partnerships - Centre).

7. The last names of the three original authors explain the acronym (CBS) used for the Report and for its subsequent revisions.

8. All relevant studies and documents both of a general nature (including the Work Plans of the Core Network Corridors) and specific to financial issues can be found in the website of the D.G. "Mobility and Transport" of the European Commission.

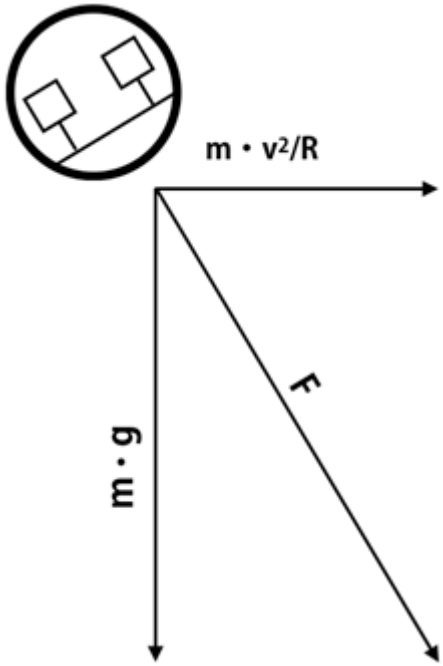
HYPERLOOP TECHNOLOGY A POTENTIAL BREAKTHROUGH*

CARLO DE GRANDIS

Hyperloop is currently a potential new transport mode based on individual pods carrying passengers (~24-100 people) or containers at very high speed (passengers services up to 1080-1200 km/h), using (passive?) magnetic levitation, in a confined near-vacuum tube (~100 Pa[1]); its technology stems from previous high-speed guided transport models for low-pressure environment, starting back to the XIX century[2], with an underground network for medium distances studied more recently in Switzerland[3].

These elements make the proposed system almost frictionless – allowing in principle very high speed and high energy efficiency, the latter depending largely on the following factors:

- the efficiency of kinetic energy conversion into electric power through a regenerative braking system
- the energy needed to keep the infrastructure in a quasi-vacuum state (and pressurising stations).



F = force (resulting); m x g = force of gravity, m v^2 / r = centrifugal force (the two forces do not add up in intensity, being orthogonal, and the result is an overall force that is only slightly higher than the larger of the two - hence the possibility of containing the radii of curvature).

In terms of transport performances, every pod would have a single origin-destination per journey, thus minimising the journey time – different pod size would provide a more distributed connectivity to poles along the route.

** The views expressed are purely those of the writer and may not in any circumstances be regarded as stating an official position of the European Commission.*

Such a technology would connect a series of nodes along a route and not just the main poles – hence its potential for complementing high-speed rail and air services contributing to a balanced territorial development of the polycentric fabric of the EU.

An often ideological debate has taken place on the suitable routes and morphology fit for Hyperloop, which could serve a wide series of poles connecting destinations of up to 100 km in few minutes and a range of 1000 km in ~ an hour.

Tilting pods could fit into routes comparable to high-speed (radius of ~20-30 km), considering the combined action of gravity and centrifugal force (see picture) – the resulting force on the apparent vertical axis would yield less than 5% increase to gravity. With an adequate radius, Hyperloop is potentially fit to connect nodes at different height without additional energy supply: a pod running at 300 m/s could use 5% of its kinetic energy to "climb up" by 500 m.

In terms of Capacity, it depends on pods capacity, frequency (safety braking margins – virtual couplings): estimates differ widely – according to the promoters the range is between 3,600 to some 20,000 passengers/h per direction.

In terms of potential services offered, priority would be considered for complementing/integrating high-speed lines and nodes (airports and urban areas), which might be confronted with very high opportunity costs of new runways / new high-speed connections *e.g.*:

- connections between airports and nodes (Paris - CDG - Orly, London - Heathrow - Gatwick, Milan - MPX - LIN - BGY);
- complementary routes to high-speed and commuters (*e.g.* Nancy - LGV Lorraine - Metz - Luxembourg);
- linking Capital cities with no high-speed connectivity – (Oslo - Stockholm - Helsinki - Tallinn; Budapest - Bratislava - Wien - Prague - Berlin).

Research and technological development activities for this greenfield technology can yield useful outcome to other automated transport technologies, *e.g.*:

- fully-automated high-performance control system, with real-time positioning and speed-metering integrating vehicle-to-vehicle and vehicle-to-infrastructure low-latency communication, and a responsive traffic management system;
- advanced (passive) magnetic levitation (leading to quasi-frictionless land transport);
- high-efficiency regenerative braking.

Europe has a potential linked to a sound IP regime, a strong industrial and engineering basis, and the possibility to set-up world-wide standards for risk assessment and authorisation purposes – these reasons underpin the current development of three test sites and at least three development centres in the EU[4] .

It is therefore of the uttermost importance to foster the development of European intellectual property on Hyperloop, in spite of the currently marginal role on it – EU RTD funding shall be considered as a priority.

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1. Pa is the Pascal, a small unit of pressure equivalent to 1 kg / m s^2 (International System) = ~ 1 / 100,000 atmospheres (100 Pa is one thousandth of Atmosphere - going down requires great effort in terms of pumping and holding, for minimal results.

2. https://en.wikipedia.org/wiki/Beach_Pneumatic_Transit

3. https://swissmetro.ch/fr/project/

4. Sites under construction. Test sites: 2 in France, 1 in Spain; components (testing / assembly): Spain, Italy, Slovakia.

3. STRATEGIC INFRASTRUCTURE AND INVESTMENT RESTRICTIONS

STEFANO RIELA, ALESSANDRO GILI

Free capital movement is one of the axioms of modern global capitalism, and attracting Foreign Direct Investments (FDIs) is a prime objective for policymakers. FDI refers to the flow of capital between countries and it associated with a resident in one economy having control or a significant degree of influence on the management of an enterprise that is resident in another economy[1]. Therefore, FDI distinguished from portfolio investment in that, as well as "lasting", it means that the investor has control over the assets invested in. Countries generally welcome FDIs, and almost all of them have established national promotion agencies to attract foreign investments. FDIs increase the capital stock in host countries, setting the conditions to create more and better job opportunities thanks to technological spillovers capable of increasing the economy's productivity, thus boosting he host country's GDP. However, FDIs are increasingly perceived and used as a geopolitical tool, and they have recently triggered the introduction or the strengthening of existing screening procedures and restrictions for foreign investments in the so-called strategic sectors.

FDI INVESTMENTS HAS MORE THAN DOUBLE IN THE LAST DECADE

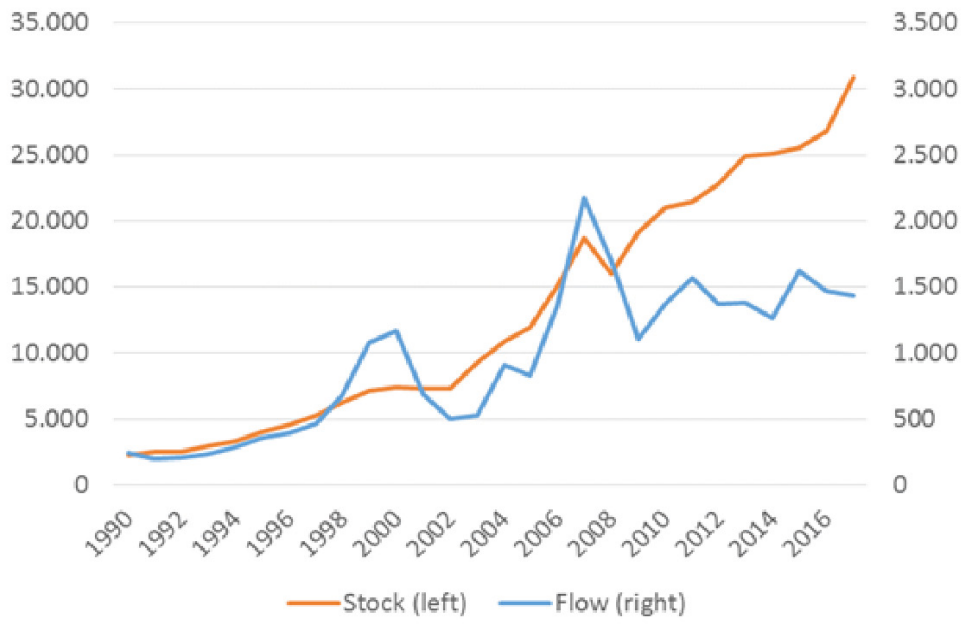
From 2006 to 2017, the worldwide stock of FDI has more than doubled, reaching the overall value of US$31.5 trillion. After the historical peak in 2007 and the collapse of 2008, FDI inflows recovered and registered in 2017 a value of US$1.4 trillion (Figure 1.1).

Despite the potential economic effects of FDIs, some countries identify the sectors and assets dubbed as “strategic” and foresee different screening procedures and restrictions mainly on brownfield[2] FDIs depending on the target sector and on the nationality of the investor.

The ownership of strategic assets involves vulnerability concerns, *i.e.*, the risk to be exposed to an "unfriendly" strategy by foreign States or actors. For this very reason, restrictions to FDIs are explained by two dimensions – national security and economy – that, despite this formal division, are substantively intertwined.

Firstly, the military industry is generally highly protected since the unavailability of weapons and munitions reduces the effective defence capability (not to mention the offensive one): the helping intervention by an allied country cannot be as immediate and effective as a domestic force. Secondly, infrastructure such as those that provide services of general economic interest[3] is relevant for both the security and the economy of a country. Telecommunication, transport, energy, and water infrastructure are the backbones of a country's economy and security, and the services they provide can be barely imported from abroad. Finally, some assets can be relevant for an economy due to their weight on national export (*e.g.*, commodities), their low degree of substitutability (*e.g.*, land), and their relevance for competitiveness (*e.g.*, patent filings and databases).

Fig. 1.1 - Worldwide Foreign Direct Investment: inward and outward flows and stock, annual (bnl, usd)



Source: Unctad

In general, an FDI, like any other type of financial investment, is undertaken by an economic agent with a focus on profitability from a medium-term perspective. In those few cases when a firm can benefit from terminating the sale of services of a newly acquired firm abroad, competition and antitrust authorities should block that acquisition thanks to *ex-ante* concentration control systems. Therefore, there should be a negligible risk that a foreign owner finds an incentive to stop electricity or telephone services, especially in those highly-regulated services where penalties are imposed if quality conditions are not met.

The incentives for investors might be different when they are not rooted in a market economy, especially when it comes to State-Owned Enterprises (SOEs). In this case, the medium-term profitability can be sacrificed on the altar of a long-term geopolitical strategy by the government of the country of origin. Therefore, for example, a foreign investor that gets the control of the national electricity grid and shrinks the electricity availability in the target country (hich experiences a loss) can put the target economy in jeopardy and favour firms in the country of origin. In the host country, such an FDI could lower the GDP, increase the unemployment, and diminish tax receipts. Private firms in a market economy cannot define that investment as "rational" if not subsidised by the only agent that can use non-market resources such as taxpayer money in States where freedom is restricted.

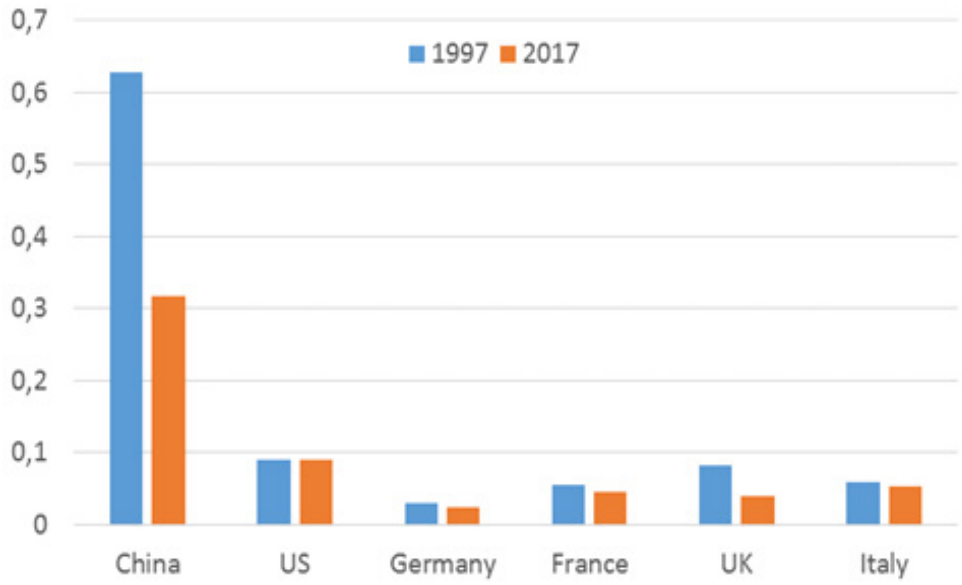
SCREENING OF AND RESTRICTIONS ON FDIs

The OECD annually publishes an index to evaluate countries' openness to FDIs in 22 different economic sectors[4]. The most protected sectors are aviation, maritime and, to a lesser extent, production and distribution of energy. From a geographical standpoint, the index registers higher restrictions in the Middle East and Asia (Saudi Arabia, China, India, and Indonesia), whereas the EU reports a marked degree of openness.

A wave of increasing restrictions against FDIs followed the wide privatisation process in the 1990s and 2000s since States lost direct control through the ownership of firms in sectors deemed as strategic such as transport, energy, and telecommunications. From 1997 to 2017, the reforms undertaken to liberalise entire economic sectors in several countries (Figure 1.2), especially in Asia, have been linked to a decrease in the index: *e.g.*, from 0.63 to 0.32 in China. However, the difference in restrictiveness between big trading countries is clear, thus raising the issue of (the lack of) reciprocity.

In order to evaluate a potential FDI, countries have adopted different procedures. The most stringent approach is the partial or full prohibition of FDIs in defined sectors; this type of restriction applies mostly to the defence sector and to the production of chemical and radioactive materials. The second approach, adopted by a rising number of countries, involves an *ex-ante* review by governments concerning the investment

Fig. 1.2 - FDI Regulatory Restrictiveness Index 1997-2017



Source: Unctad

proposals and requires a preventive authorisation to takeovers. Finally, the third approach is a scrutiny system on individual transactions that are later subjected to reviews.

FDI PROTECTION IN THE UNITED STATES

The Committee on Foreign Investment in the United States (CFIUS) was established in 1975 to defend the US against threats to security arising from the takeover of American companies by foreign investors. Three are the main threats analysed by CFIUS: *a)* the leak of sensitive technologies to a foreign company or government which may use it or sell it with harmful effects for national security; *b)* the possibility that a foreign investor – independently or on the instructions of its government – delays, denies, or attaches conditions to the supply of goods and services; *c)* when the takeover could represent an entryway to the American industrial system, in order to steal information or conduct surveillance. Those concerns have even more grounds in case of SOEs[5]. In 2018, the US Congress approved the Foreign Investment Risk Review Modernization Act (FIRRMA) to enhance the powers of the CFIUS[6] and to restrain the exportation of "foundational and emerging" technologies, whose sharing with a foreign buyer may undermine the American leadership in key

industrial sectors. In particular, FIRRMA requires the release of a biennial report on Chinese investments in the US and whether the principle of reciprocity is fulfilled[7].

FDI PROTECTION IN THE EUROPEAN UNION AND IN ITALY

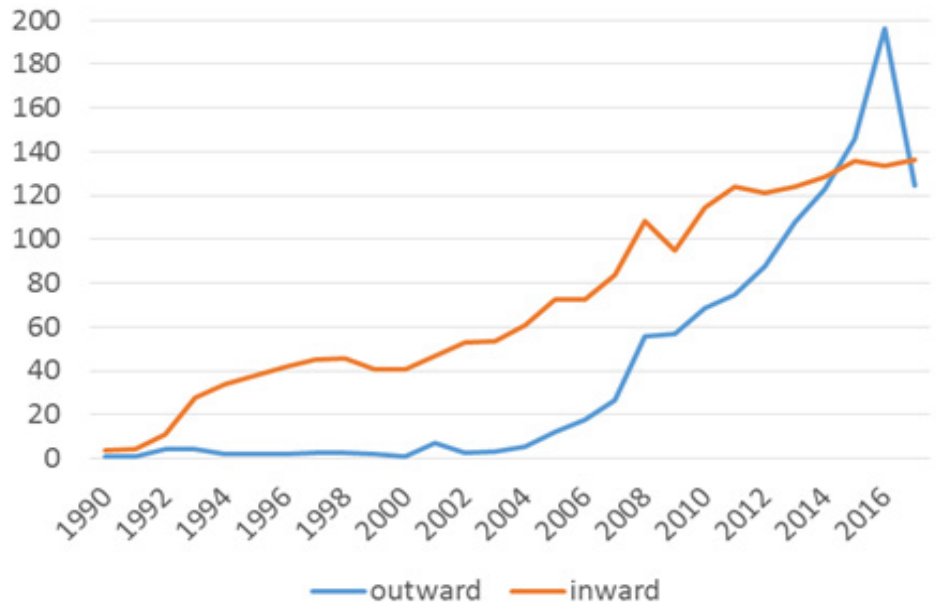
The European Union (EU) is the world's leading source and destination of FDIs and one of the most open regions for FDIs. FDI screening is an exclusive responsibility of the individual EU Member States, and not all of them are adopting a screening procedure. However, in 2016, a surge in takeovers of strategic infrastructure assets and EU firms producing cutting-edge technologies has been registered and, in 2017, France, Germany, and Italy published a "Proposals for ensuring an improved level playing field in trade and investment". That political momentum led to the proposal of a new regulation for an EU investment screening framework[8] to establish cooperation for information exchange between the Member States and the Commission[9]. However, for Germany and France[10], this cooperation is not enough to protect strategic assets unless every single EU Member State adopt a screening mechanism is as effective as theirs.

In Italy, the "golden power" system (Law Decree no. 148/2017) allows the exercise of powers and a review to any merger or acquisition affecting a company operating in a strategic activity in the fields of defence, national security, energy, transport, and communication – regardless of shares held by the State in the company. The Presidency of the Council of Ministers is the authority responsible for conducting the reviews. For investments relating to the national security and defence sectors, the review process requires the participation of the Ministry of Foreign Affairs, the Ministry of Infrastructure and Transport as well as the Ministry of the Interior and of Economic Development. The authority should assess whether the investor is effectively controlled by a foreign Government also through significant funding[11] and has the power to deny the transaction or apply conditions to it. In 2017, the Law 172/2017 widened the sectors deemed as strategic, high-technology sectors in particular[12].

THE SURGE OF CHINESE TAKEOVERS

China became a member of WTO in 2001 with a non-market economy status[13]; a status that, after its expiration in 2016, has been unilaterally confirmed by the US[14] and the EU[15]. Both argue that the role played by Chinese public authorities in the national economy gives an unfair advantage to national firms that compete in international markets through trade and investments. This concern found ground when, after the economic crisis, Chinese SOEs turned extremely active in going shopping especially in the US and Europe (see Chinese outward FDIs in Figure 1.3). This upsurge in FDIs is perfectly in line with the Government strategy "Made in

FIG. 1.3 - CHINESE OUTFLOWS AND INFLOWS FDI (BLN, US$)



Source: Unctad

China 2025" released in 2015. The initiative aims at establishing China as the leading global high-tech manufacturing power using government subsidies and pursuing intellectual property acquisition to catch up with, and then surpass, "Western" knowledge in advanced industries[16].

CONCLUSION

Free capital movement and FDIs are instruments of global capitalism. However, freedom should go hand in hand with fairness. Subsidisation of firms and lack of reciprocity in non-market economies generates asymmetries in FDIs that are not welcome in target market economies. Especially when, as in the case of China, the country of origin has a manifest industrial strategy to increase its competitiveness to the detriment of other countries such as the US and European States.

However, 2025 is now: China is already racing ahead in 5G technology, a key development for the efficiency of many industries and the deployment of the Internet of things[17]. Huawei – the Chinese telecoms equipment maker – is the global frontrunner in the 5G but due to alleged risk of espionage and sabotage[18] is already

banned in some States (*e.g.*, United States, Australia, New Zealand), while others are either considering a ban (*e.g.*, Germany, France, Canada) or have already introduced security checks (*e.g.*, France, United Kingdom).

Those defensive reactions are generating two types of problems: firstly, the postponement in the adoption of a disruptive technology capable of boosting productivity; secondly, the fragmentation of like-minded countries that, except for the US, individually sports a reduced bargaining power *vis-à-vis* China. In order to solve this trade-off between efficiency and security posed, in our example, by Huawei, EU Member States should at least coordinate their actions as proposed by the Commission in its recent recommendation[19].

This recent technology issue may be regarded as the symbol of the complexity in defining coherent and effective policies capable of tackling both security concerns and the compelling need to attract investments from different sources. Protectionist measures could not be the most efficient solution to the challenges arising from a more and more interconnected world. However, some forms of coordinated screening mechanisms are a temporary solution to the asymmetries of a globalised economy, with the final purpose to accelerate the establishment of a level playing field, where countries and firms may compete fairly on the global stage.

Annex 1. Protection of strategic sectors in selected countries
Sectors and activities associated with national security

China
- Security/national defence: defence goods production and security services
- Strategic enterprises: major equipment manufacturing industries
- Other sectors including infrastructure and transportation services, energy and resources, agricultural product, and key technologies

France
- Security/national defence: National defence and security; electronic telecommunications;
- Infrastructure: energy (supply of water, electricity, gas, hydrocarbons and any other source of energy); operations of telecommunications and transport services
- Others: public health and activities of vital importance under Defence Code; money gambling

Germany
- Security/national defence: production of war weapons, tank engines and crypto technology
- Other unspecified sectors or activities that threaten the "public order or security of the Federal Republic"

Italy
- Security/national defence (*e.g.* advanced weapons and aeronautical systems; aerospace and military propulsion systems; aeronautical and nuclear engines; satellites; command, control and information systems; nanotechnologies)
- Infrastructure: energy transport and communications

Japan
- Designated sectors relate to: i) Security/defence (*e.g.* weapons, nuclear power, aeroplanes, aerospace); (ii) Infrastructure (*e.g.* electric/gas/water utilities; telecommunications and railways); Public safety (*e.g.* private security service; biological chemicals); key domestic industries (*e.g.* agriculture, petroleum, maritime transport)

Russia
Over 40 sectors, which include:
- Defence (*e.g.* nuclear materials and devices; weapons and military equipment and technology; coding and cryptographic equipment; aviation and space; and security assessment and surveillance of infrastructure and means of transportation)
- Natural resources (*e.g.* activities affecting geophysical processes, exploration and development of subsoil areas of federal significance, fisheries)

- Media (including television and radio broadcasting and certain printing and publishing activities)
- Monopolies (activities of certain communications and railway companies and natural monopolies)

United Kingdom

- Mergers which may impact national security

United States

- "Critical Infrastructure" (defined under FINSA as "systems of assets, whether physical or virtual, so vital to the United States that the incapacity or destruction of such systems or assets would have a debilitating impact on national security"; this includes "major energy assets")
- "Critical technologies"(which include defence items controlled under the International Traffic in Arms Regulations; export controlled and dual-use items controlled under the Export Administration Regulations for national security, chemical and biological weapons proliferation, nuclear proliferation or missile proliferation reasons; items controlled under the Export and Import of Nuclear Equipment and Materials Regulations; and selected items controlled under the Export and Import of Select Agents and Toxins Regulations – *e.g.* activities that may threaten plant, animal or human health)
- Businesses that provide products, technical data, technology or services – either as a prime contractor, a subcontractor, or a supplier to prime contractors – to US government agencies, state and/or local governments
- Potentially any other sector or activity as long as the "covered transaction" is determined by the reviewing body that it may have an impact on the national security of the United States

Source: OECD

1. IMF, *Balance of Payments and International Investment Position Manual*, Sixth Edition, 2009, p.100.

2. Brownfield investments occur when a foreign entity purchases an existing facility while greenfield investments occur when a parent company or government begins a new venture by constructing new facilities.

3. See European Commission, *Guide to the application of the European Union rules on State aid, public procurement and the internal market to services of general economic interest, and in particular to social services of general interest*, SWD(2013) 53 final/2, April 2013.

4. FDI Regulatory Restrictiveness Index evaluates, on a 0-1 scale (where 0 stands for the maximum openness and 1 the total closure towards foreign direct investments), the openness degree of several economic sectors in each country. In OECD countries, the highest values are registered in the air sector (0.346), marine transportation (0.253), land transportation (0.212); energy shows an average index of 0.214. For data see http://www.oecd.org/investment/fdiindex.htm. Recent developments and latest available data in 2017 are included in T.S. de Mistura, I*s Investment Protectionism on the rise? Evidence from the OECD FDI Regulatory Index*, OECD, Paris, March 2017.

5. T. Moran, *CFIUS and National Security: Challenges for the United States, Opportunities for the European Union*, Peterson Institute for International Economics, 2017.

6. The Foreign Investment Risk Review Modernization Act (FIRRMA) was signed into law on August 13th by President Trump.

7. See G. Di Donfrancesco, "Cfius, il baluardo di Trump contro il "furto" di tecnologia americana", *Il Sole 24 Ore*, 3 July 3 2018; S. Zable, T"he Foreign Investment Risk Review Modernization Act of 2018", Lawfare Blog, 2 August 2018.

8. The regulation proposed by the Commission (COM(2017) 487) was approved in first reading by the European Parliament (14 February 2019) and by the Council of the EU (5 March 2019)

9. See European Parliament, Committee on International Trade, Working Document on the Proposal for a Regulation of the European Parliament and of the Council establishing a framework for screening of foreign direct investments into the European Union, March 2018.

10. See Bundesministerium für Wirtschaft und Energie; Ministère de l'Economie et des Finances, A Franco-German Manifesto for a European Industrial Policy Fit for the 21st Century, 19 February 2019.

11. See Article 2 Decree Law No. 21/2012. See also S. Alvaro, M. Lamandini, A. Police, and I. Tarola, *La nuova via della seta e gli investimenti esteri diretti in settori ad alta intensità tecnologica. Il golden power dello Stato italiano e le infrastrutture finanziarie*, Consob, gennaio 2019.

12. The Italian government has individuated as high-technology sectors to be protected: a) the critical infrastructure, storage of data and financial infrastructure; b) critical technologies, i.e. artificial intelligence, robotics, semiconductors, double-use technologies, network security, nuclear or spatial technologies; c) security of supply for critical inputs; d) access to sensitive information. See Law 172/2017.

13. According to the WTO, in non-market economies "the government has a complete or substantially complete monopoly of its trade and where all domestic prices are fixed by the State" (link).

14. S. Hsu, Rejecting China's Market Economy Status Could Have Huge Implications for U.S.-China Trade.

15. See the US and EU position regarding China's status in the WTO as reported by *The Economist* "China takes on the EU at the WTO", 7 December 2017.

16. See European Union Chamber of Commerce in China, *China Manufacturing 2025. Putting Industrial Policy Ahead of Market Forces*, March 2017.

17. The "Internet of things" (IoT) covers everything connected to the internet and is made up of devices – from simple sensors to smartphones and wearables – connected together. By com-

bining these connected devices with automated systems, it is possible to gather information, analyse it, and create an action to help someone with a particular task, or learn from a process.

18. Sabotage can involve disrupting communications during any future dispute, particularly as more things, from autonomous vehicles to domestic appliances, become interconnected with the IoT.

19. See European Commission Recommendation "Cybersecurity of 5G networks". C(2019) 2335 final of 26 march 2019.

4. CONSTRUCTION OF INFRASTRUCTURE IN EUROPE

ULRICH PAETZOLD

For more than 50 years, the EU has been gradually working on the opening-up of public procurement markets. Hitherto, this was more or less reserved to national or regional players. Previous work resulted not only in some packages of Directives (1971, 1989, 1993, 2004, 2014) but also in increased cross-border participation in public procurement tenders – those for major infrastructure projects in particular.

Throughout the decades, the goal has been to reduce or demolish the existing barriers in order to achieve fair and transparent cross-border competition in a single market. A neglected aspect, however, was that this single market might, one day, need protection against the procurement practices of some of its own members.

The underlying reason for such developments seems to be that many contracting authorities/Member States have been facing severe budgetary problems. This has also concerned the financing of construction and maintenance of infrastructure which is otherwise considered necessary for the sound development of Europe's industry, society, and cities. Any such lack of means is amplified by the EU's Stability and Growth Pact rules and the "additionality" principle (*i.e.*, EU funding must be complemented by national funding, not substitute for it).

Often, this has led to awarding contracts to the lowest bidder. Current directives make awarding a contract to the most economically advantageous tender ("MEAT") mandatory, but in practice, the lowest ones tend to be awarded the contract. This result, astonishing at first sight, is actually possible either by making price the only award criterion of "MEAT" (which the directives allow unless the national legislator restricts/forbids it) or by giving considerably more weight to price than to quality aspects. In this context, the expression "a well-prepared project" should certainly be re-evaluated.

In tender procedures with the participation of third country state-owned enterprises ("SOEs"), some evidence indicates that contracts might have been awarded to abnormally low tenders. Most surprisingly, in none of these cases this aspect has been examined in depth, either by national authorities or the European Commission.

More specific elements will be shown in the following examples.

EXAMPLE 1

Poland, motorway A2, Stryków (Łódz) - Konotopa (Warschau), 91 km total length, total budget €1 billion, EIB loan €500 million, in addition to the EU funds available for the country, 2009-2012.

Two lots of this motorway were awarded to a consortium led by the Chinese construction SOE "COVEC" at a price more than 70% below the estimated budget and more than 30% cheaper than the second lowest offer.

Both the procedure and the contents of the tender raised questions, most of which were addressed in the remedy procedures, which did not ultimately change the award decision. The tender was signed by a person without power. The court considered that this was mentioned too late.

The bank guarantee was drawn up with a Chinese bank not active in the EU. The Commission considered that no such condition for the bank guarantee had been published.

In the tender, 30 positions were priced "0 zł", despite the express indication in terms of calculation that each position had to be priced. The court considered that this was not an unconditional obligation.

COVEC offered US$100 million for the tender phase and more after the award until completion, but the qualification documents showed that the net value of COVEC amounted to only US$97 million. The Commission considered that even if this were the consequence of state aid, it would be irrelevant because the European rules were applicable only for EU Member States.

COVEC claimed it would not need any expensive European bank loans, as it and its owner had enough financial resources. This would also make it possible to purchase material, equipment, and services on a large scale immediately and thus achieve price advantages as well as immunity from cyclical price fluctuations. For logical reasons alone, these arguments do not explain the large price difference. As a result of significantly higher overall contract volumes in the Polish market, European competitors are likely to achieve considerably larger volumes and price advantages.

Other reasons given by COVEC were low general administrative expenses, efficient organisation of work, no need for risk margins, use of its own construction machines, cheaper costs of Chinese personnel, unique organisation methods and a low profit margin.

None of these reasons can convincingly explain the significant price difference.

COVEC also claimed that its price was calculated on the assumption that it might win two lots, so that it would benefit from considerable economies of scale.

Logically, this means that none of the two tenders was viable as such and should have been excluded.

Overall, it is astonishing that none of these elements triggered any serious investigation by national authorities or the Commission.

It is interesting to note that neither of these two contracts was completed. Both were terminated by both sides following a series of problems and differences of opinion, which also led to litigation. In view of the immovable date of the UEFA Soccer Championships 2012, the two contracts were re-awarded in an urgency procedure. The contract prices were 20% higher than the second lowest offer in the initial award procedure.

EXAMPLE 2

Croatia, Pelješac bridge, (2,4 km, EU financing €357 million), 2018-ongoing.

This project was awarded to a consortium of four Chinese SOEs. Their offer was 23% cheaper than that of the next consortium, led by a European contractor. The appeals of two European consortia were rejected.

This case also raised questions, but neither the national authority nor the Commission saw any reason to change the award decision.

Abnormally Low Tender (ALT)

In fact, the Commission considered that the contracting authority did not have sufficient reason to perceive this tender to be abnormally low, because all tenders were significantly above the budget estimation and none of the interested contractors lodged a complaint against the indicated price or asked for clarification of the price, despite several rounds of questions and clarifications.

None of these arguments is convincing.

Usually, such budget estimations are made several years prior to tendering and awarding, but they do not normally reflect the up-to-date market situation. Most regrettably, this argument looks like guidance on

how to ensure that the award to ALT cannot be contested successfully. On top of this, as the estimated budget is just an indication but not a limit or guidance value, there is not much reason to start conflictual discussions with the contracting authority at that stage.

With respect to the principles explained by the EU General Court (case T-700/14, judgement 26/1/2017, para. 54), major differences between the estimated budget and the tender prices can be taken into consideration for checking the reliability of tenders. If a contracting authority does not do this, it prevents itself from having an up-to-date basis for the correct assessment of tenders.

Prices of specific items

The successful tender contained specific items with excessively low prices, some of them as low as between 3.9% and 21.8% of the prices offered in the European consortium's tender, in other words between 96.1% and 78.2% cheaper. The Commission considered that the relatively low number of such cases compared to the total number of items would not provide conclusive evidence for the existence of an ALT.

This is not entirely convincing. The existence of a couple of inexplicable/unexplained examples, such as these extreme ones, should be reason enough for more thorough checks.

In the meantime, there is information that the winning consortium pays normal market prices to sub-contractors and suppliers. Obviously, this is a legal requirement, but one wonders how this can be achieved despite the excessively low prices tendered. In other words, what would have been the correct tender price if such specific items had been tendered for the same price which is being paid now?

State-Owned Enterprises (SOEs)

Another aspect which was not taken into consideration in this procedure is the fact that the winning companies are SOEs. This raises the question of whether these astonishingly low tenders might be the result of state aid or subsidies negatively impacting the competition.

That said, Commissioner Hahn is reported (FT, 6/3/2019) to have criticised the EU's decision to fund 80% of a bridge in Croatia being built by a Chinese company, which he said was "most likely being subsidised back home". It will be interesting to see whether the Commission has really changed its mind.

EXAMPLE 3

Bulgaria, railway "Elin Pelin to Kostenets", part of the "Railway-Sofia-Plovdiv-TENT-Orient-EastMed" TEN-T corridor, 85% financed by EU funds.

The published tender results can be summarised as follows:

The consortium led by the Chinese SOE CCCC had a score which was 41% lower in technical value and 28% cheaper than the second, a European consortium. In other words, the European consortium was 69% better in technical value and 39% more expensive.

In total, the winning consortium achieved 2% higher marks than the European one, thanks to a weighting of max. 60 points for price and max. 40 for technical value.

It will be interesting to see what reasons will be given as a justification for this 28% price difference and whether the award decision will be confirmed.

Possible ways forward

For the future, it will be crucial to ensure that both national contracting authorities and Chinese SOEs working in the EU Internal Market respect both the letter and the spirit of EU law, such as public procurement rules, posting of workers or state aid rules, as well as the fundamental principles of EU Treaties.

This requires the EU to develop clear positions for the defence of its interests, in order to be prepared for negotiations and situations in which other global players in world-wide trade will defend their interests vigorously.

More specifically, it seems necessary to adapt the public procurement rules to these developments, *i.e.*

- by introducing a threshold for mandatory verification (not automatic exclusion), for example if the difference between the preferred bidder and the second offer amounts to 20% or more;
- by introducing an obligation for effective, thorough analysis, transparent for verification by courts, if necessary;
- by introducing an obligation to exclude any bidder which cannot prove not to be an ALT;
- by applying EU state aid rules to any contractor wishing to work in the EU Internal Market;
- by assuming the existence of illegal state aid in any case of SOE participation.

This assumption can be lifted by proving that no illegal state aid is involved. Otherwise, there should be a mandatory exclusion of this bidder/SOE.

Other very important aspects, which will also have to be addressed by the EU, are all those linked to international trade and governed by the rules of WTO, OECD, etc. They have not been covered in this article given that it focuses on the EU Internal Market.

Latest developments

Very recently, the European Commission and the European Council published documents which seem to indicate that cases such as the ones shown above might have led to a change of mind and a more realistic, less naïve approach concerning the participation of third country state-owned enterprises in EU public procurement, in particular for important infrastructure, as well as concerning competition world-wide.

Commission communication "EU-China – A strategic outlook" (12/3/2019)

Action 6: To promote reciprocity and open up procurement opportunities in China, the European Parliament and the Council should adopt the International Procurement Instrument before the end of 2019.

Action 7: To ensure that not only price but also high levels of labour and environmental standards are taken into account, the Commission will publish guidance by mid-2019 on the participation of foreign bidders and goods in the EU procurement market.

The Commission, together with Member States, will conduct an overview of the implementation of the current framework to identify gaps before the end of 2019.

Action 8: To fully address the distortive effects of foreign state ownership and state financing in the internal market, the Commission will identify before the end of 2019 how to fill existing gaps in EU law.

Conclusions of the European Council meeting (22/3/2019)

(p. 2) Fair competition should be ensured within the Single Market and globally, both to protect consumers and to foster economic growth and competitiveness, in line with the long-term strategic interests of the Union. We will continue to update our European competition framework to new technological and global market developments. The Commission intends to identify before the end of the year how to fill gaps in EU law in order to address fully the distortive effects of foreign state ownership and state-aid financing in the Single Market;

(p. 3) The EU must also safeguard its interests in the light of unfair practices of third countries, making full use of trade defence instruments and our public procurement rules, as well as ensuring effective reciprocity for public procurement with third countries. The European Council calls for resuming discussions on the EU's international procurement instrument;

Memorandum of Understanding and projects signed between China and Italy on 23/3/2019

On the other hand, the signing of such an MoU and some 28 projects by Italy, one of the largest EU Member States and founding member of the EU, gives further reason for concern. As examples in Asia, Africa, and the Balkans show, even Chinese investment comes at a price, perhaps not immediately, but eventually. It is most regrettable that in addition to the EU Member States involved in the Chinese "16+1" project, Italy has now joined the new Silk Road project, believing this to be advantageous for citizens and business in Italy. We will see where all of this will lead to.

CLARIFICATION

In order to avoid any misunderstanding, the European construction industry federations FIEC and EIC always point out that they are firmly opposed to any form of protectionism and are in favour of fair competition in mutually open markets. Fair and healthy competition, based on contract conditions which allocate risks in a balanced way, contributes to progress and innovation. On the other hand, unfair and unhealthy competition, based on unbalanced conditions and the lowest price only, endangers the EU economy and society. They also stress that they are in favour of genuinely reciprocal market access opportunities and corresponding incentive measures (*i.e.* trade defence instruments) at EU level if international negotiations do not achieve tangible progress.

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5. CONDITIONS THAT FACILITATE INFRASTRUCTURE INVESTMENT

MARIA ELENA PERRETTI, SILVIA TRANFA

GLOBAL INFRASTRUCTURE INVESTMENT: NEEDS AND GAPS

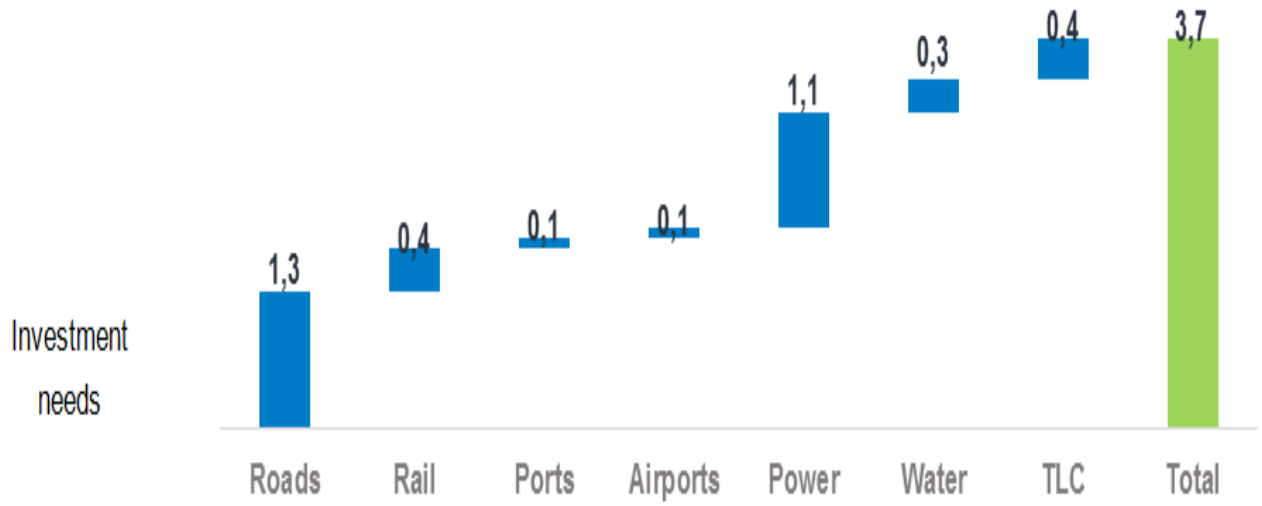
The global infrastructure environment is under pressure. The infrastructure supply struggles to chase the demand, which is constantly growing. In addition, emerging megatrends such as changes in demographics, technological advancements, and climate change, are shaping infrastructure needs in many ways, sometimes difficult to predict and anticipate.

What is certain today is that the global investment need is growing and the infrastructure spending gap, *i.e.* the difference between the investments needed and the current spending, is widening. Several estimates of these figures have been discussed over time, proving that if infrastructure investment needs are difficult to estimate, infrastructure spending gaps, are even more so.

Quantifying these data at the country or regional level is challenging as the process involves many and changing variables, requires numerous assumptions, and it can differ depending on the chosen time horizon and the included infrastructure sectors. Evidence provided by the economic literature over time, therefore, is meant to offer an order of magnitude of the investment need for infrastructure across countries and sectors rather than an exact estimate.

According to Oxford Economics' estimates, the global infrastructure investment need for the period 2017-2035 is about US$70 trillion, which equals to an annual average of US$3.7 trillion (about 3.5% of World's GDP). Considering the current annual infrastructure spending of about US$3 trillion, the estimated spending gap at the global level is about US$600 billion per year (Figure 5.1).

Fig. 5.1 - Global infrastructure spending (annual average 2017-2035, $ tln, constant 2017$)*



- % of GDP	1.3	0.4	0.1	0.1	1.1	0.2	0.3	3.5
Estimated spending	1.02	0.40	0.07	0.08	1.02	0.23	0.32	3.13
Spending gap	0.31	0.04	0.02	0.02	0.11	0.03	0.04	0.57

*NOTE: Numbers may not sum due to rounding

Data source: Oxford Economics

Wide regional differences characterized these investment needs and spending gaps and vary at the sectoral level. Roads and power, for instance, show the highest investment needs (respectively about US$1.3 trillion and US$1.1 trillion per year), but if in the power sector the current spending represents almost 90% of what needed, in the case of roads the former is only about 77%. Further, these data underestimate the future investment need since they do not include the additional spending required to meet the United Nations' sustainable development goals and to include new infrastructure needs associated to a number of technological disruptions such as the CASE (Connected, Autonomous, Shared and Electric) technologies in the automotive industry, the digitisation of logistics, etc.

In Europe, according to the European Investment Bank estimates, economic infrastructure investment needs for energy, transport, water and sanitation, and telecoms are as much as €688 billion per year and the annual infrastructure investment gap for the EU27 until 2030 is estimated at roughly €155 billion, including spending for social infrastructure (Table 5.1).

Tab. 5.1 - Infrastructure spending gap by sectors for EU27 (annual average for the period 2018-2030)

	€ billion	% of GDP	% of GFCF[1]
ICT (broadband and digitalisation)	50	0.38	1.86
Energy generation and grids	17	0.13	0.63
Water and waste	7	0.05	0.26
Social and affordable housing	6	0.05	0.22
Education	8	0.06	0.3
Health	17	0.13	0.63
Transport	50	0.38	1.86
Total	155	1.19	5.77

Source: EIB

All these data, although not fully aligned, move in the same direction, clearly suggesting the existence of a substantial scope to increase infrastructure investment and the importance for policymakers at the global level to attract capital to finance the infrastructure needs. At the same time, governments will face the challenging task of ramping up finance and making infrastructure spending more effective.

INFRASTRUCTURE AS AN ASSET CLASS

Over the past decade, investment in infrastructure in the European Union has been pro-cyclical, following the course of overall economic activities. During the global financial crisis, investment in infrastructure started to decline, mainly due to shortfalls in public infrastructure expenditure. Fiscal consolidation measures favored the shift in public spending from gross fixed capital formation towards current expenditure and, as a result, investment in infrastructure[2] in Europe has decreased by 20% after the global financial crisis, dropping from 2.2% of GDP in 2009 to 1.8% in 2015. Today, at 1.7% of GDP, overall infrastructure investment stands at about 75% of its pre-crisis level, showing a low recovery[3].

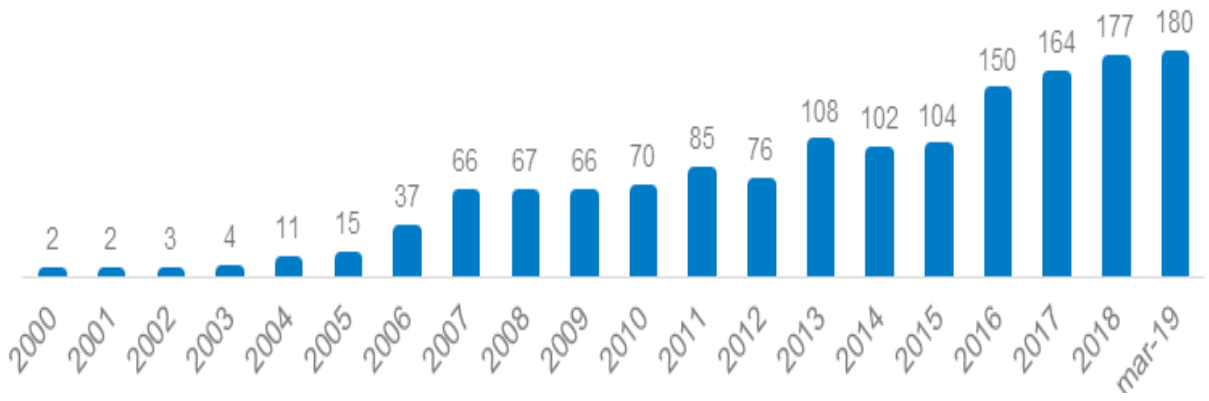
In this context of slow domestic economic growth, long-term investors such as public and private pension funds, insurance companies, and development banks, can play a key role in infrastructure financing.

From an investor point of view, infrastructures are an appealing investment for several reasons:

- Infrastructures offer reliable cash flow from long-life assets that generate revenue under secure service contracts and inflation-protected returns, allowing portfolio diversification from assets that are sensitive to the business cycle;
- There is a perfect fit between the long payback period associated with infrastructure investment and the availability of patient capital of institutional investors, which receive an additional return premium in exchange for the investment complexity and illiquidity;
- Infrastructure investment, when included in a portfolio of traditional financial assets, can offer a higher expected portfolio return for a defined level of risk.

Today, private investors show considerably high amounts of financial resources and therefore their potential involvement in infrastructure financing is substantial. According to the OECD, in 2015 pension funds and public reserve funds held €24.3 trillion in assets – well above pre-crisis level – but the average allocation to infrastructure investment was stuck at only 1.1% of total assets under management. Similarly, Preqin data suggest that 2018 has been a record year in terms of resources available for infrastructure projects. In June 2018, the infrastructure industry at the global level had Asset under Management (AUM) at US$491 billion, following year-on-year increases since 2007, and the industry more than tripled in size since the end of 2009. At the same time, the dry powder experienced strong growth, reaching about US$177 billion by the end of 2018 (nearly tripling with respect to 2009)[4]. This seems to highlight, on the one hand, the increasing interest of investors for infrastructure and, on the other hand, some difficulties in deploying resources appropriately (Figure 5.2).

Fig. 5.2 - Unlisted Infrastructure Funds: Dry powder ($bln)



Source: Preqin

HOW TO FACILITATE INFRASTRUCTURE INVESTMENTS

It has been estimated that, at the global level, institutional investors currently finance US$300-400 billion of infrastructure a year, but with the right incentives they could invest up to about US$1-1.5 trillion a year in the sector[5]. If infrastructure investments can offer diversification, long-term horizons, stability, and stable returns, why is there still such a large investment gap? How can we shape the attractiveness of infrastructure investments?

Pipeline and projects features

The first, and most debated in the economic literature, bottleneck to infrastructure financing relates to the supply of investible projects. One of the first issues private investors face when investing in infrastructure relates to the project pipeline: "investment grade" and quality projects are hard to find. One of the reason is that, for infrastructure projects, and especially in sectors with high technological content or financial risks, the planning, design, and financing phases are particularly complex. The former require a general agreement between numerous stakeholders for a long period and a high level of competencies.

Complex project structuring, however, is not the only reason. Often, in fact, project size is too small to be attractive to institutional investors, which usually invest large amounts of capital, and the potentially low returns – after discounting the risk and cost of project assessments – can deter institutional investors. Moreover, infrastructure investments have several risk factors to take into account, which may significantly change as the project evolves during the planning, construction and operational phases. The risk allocation is not always well calibrated between public sector and private investors. In this sense, transferring an excessive level of risk to private investors may affect the incentive to invest. Similarly, a misallocation of risk between public and private investors may deter investments or increase the cost of finance. For instance, the private sector is better placed to assume construction risk while the public sector is better placed to assume the legal and political risks.

In this respect, facilitating project procurement (by streamlining permits and reducing excessive red tapes), assisting local authorities in financing structuring through ad hoc agencies or partnerships with development banks, ensuring a right balancing of the risk sharing, and pooling together small projects for a single financing operation, could be useful in improving the projects pipeline.

Lack of knowledge and data

The lack of expertise in infrastructure projects turns out to be an issue not only for public stakeholders but also for the private sector. Among institutional investors, only the big ones can benefit from the proper expertise in long-term infrastructure investments and risk management. Investing in traditional assets, indeed, is very different from investing in alternative asset classes, and particularly in the infrastructure industry, where many risks (i.e. legal, political, construction risks) contribute to influence the performance of infrastructure investments.

This knowledge gap is further accentuated by the lack of historical, transparent and quality data on the investment characteristics of infrastructure. Often, in fact, institutional investors who are looking for opportunities among infrastructure projects, do not have enough elements to make informed investment and financing decisions. Despite being a mature asset class, infrastructure investments are still challenged by data scarcity and lack of empirical evidence on their purported benefits. Moreover, the lack of information often also relates to the absence of clear and predictable accounting standards, long-term metrics for performance valuations and compensations, and standardization in project documentation.

In this respect, policymakers can play a role in facilitating processes of data collection and availability for investors to make forward planning starting from empirical evidence. Projects such as the "*Infrastructure Data Initiative*", which pull together data from a wide variety of datasets are, thus, highly valuable[6].

The regulatory framework

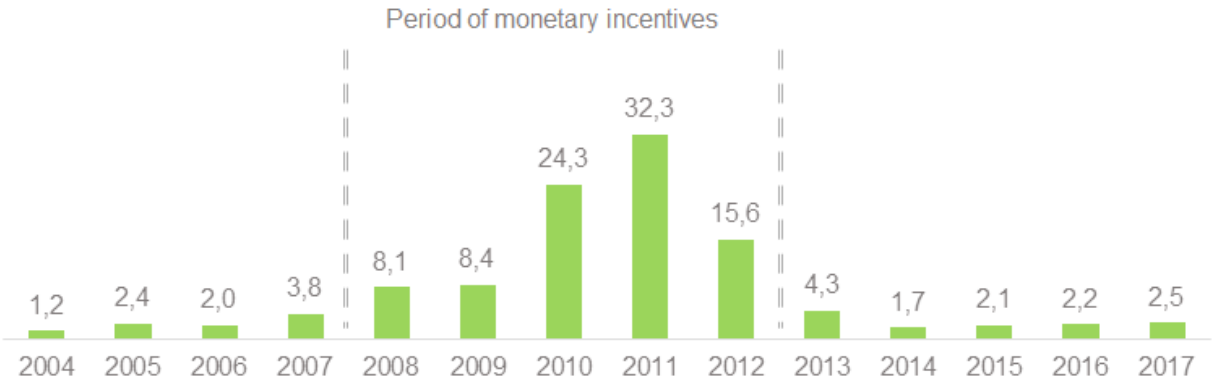
Policymakers can play a pivotal role in mobilizing more institutional capitals by getting the regulatory framework right.

In the last years, for instance, because of the financial crisis, prudential accounting rules and supervisory requirements have been introduced in Europe. On the one side, they might to minimize the excessive risks of a systemic crisis ut, on the other side, they encourage short-term rather than long-term investments. Recently, however, positive developments have been recorded. In this sense, the adoption of the EU delegated regulation that reduces by 25% the high capital charge for infrastructure investment, as implied by Solvency II for insurers, is an example of a step towards the easing of regulatory barriers to infrastructure as an asset class[7].

Furthermore, policymakers could stimulate investments through policy tools such as monetary incentives. As for clean energy investments in Italy, for example, the introduction of favorable incentives such as green certificates and solar "feed-in" tariffs during the period 2008-2012 was associated with a rapid growth of in-

vestments, although they returned to their pre-incentive levels after the reschedule of the incentives system (Figure 5.3). This suggests that monetary incentives can have positive effects in the short-term, but their influence is uncertain in the long run, as they are not always able to remove those structural constraints that only a proper regulation can shape.

Fig. 3 - Investment in Clean Energy in Italy ($ bln)



Source: Bloomberg New Energy Finance

Most importantly, with regard to the regulatory framework, governments should avoid short-term changes in rules and taxation, since institutional investors are ready to invest only in those infrastructure market characterised by clear regulations and stable political context. Investor appetite in infrastructure, in fact, is affected by uncertainty about the feasibility and reliability of infrastructure programs laid out by governments. Rising concerns about growing instability and political risk can significantly affect the attractiveness of infrastructure investments. As reported by the OECD, at the European level, political and economic developments such as Brexit, the possible end of quantitative easing, political instability in some EU Member States, can be factors of concern for investors looking for investment opportunities in infrastructure. In the United States, for instance, institutional investors are showing a rising interest in infrastructure investment, but face much uncertainty around whether the US government will actually commit to an extensive infrastructure program with a sufficient number of bankable projects[8] .

Government guarantees, credit enhancements, and long-term contracts are all risk mitigants to infrastructure investment, but investors need to have confidence in the long lifetime of institutions. In this sense, policymakers should anticipate and monitor the effects of their policy-making activities on infrastructure investments since private investors make their best to build portfolios resilient to policy shocks.

Green and sustainable investments

Climate change and environment issues are increasingly important factors in assessing investment's risks and returns. In recent years, governments have shown an increasing commitment to a sustainable development model, as proven by the numerous international agreements and actions adopted to mitigate climate change and ensure a sustainable development path. In order to achieve the strategic goals set out in the Paris Agreement and deliver on the Sustainable Development Goals, a radical shift in global infrastructure investment is essential. This change concerns all sectors of infrastructure, from energy and mobility services to buildings and social services. Future infrastructure needs to be socially, economically, and environmentally sustainable.

Aware of the role that sustainability plays in their investment, today, more and more investors, are interested in evaluating environmental, social, and governance (ESG) criteria when assessing their investment decisions and risk management processes. It is clear that the impact that infrastructure projects may have on the surrounding environment or their social aspects can affect the long-term risk profile of infrastructure assets. As a result, new infrastructure investments may be facilitated by a broader collection of ESG data. This data gathering could be very useful to investors, in order to evaluate to what extent a project meets wider policy objectives and how specific environmental aspects affect asset valuation and financial stability.

CONCLUSION

Future demand for infrastructure is considerably on the rise and, in most cases, difficult to predict. In the past, infrastructure projects tended to be large, fixed, government-financed, and aimed at supplying essential services, often through a natural or regulated monopoly. Today, several influential factors such as megatrends and technological developments are shaping investments' size, revenue streams, and management model, changing the way investors look at infrastructure investment. Megatrends, for instance, are expanding the infrastructure market to include a wide range of smaller, distributed, and tech-intensive infrastructure assets, which sometimes assume a service layer.

In a context of low public investment and rising infrastructure needs, private investors show an untapped potential for channeling new resources to the sector, and governments should be careful not to lose the opportunity of increasing private investors' role in the market. Despite their renewed interest in the infrastructure market, in fact, institutional investors still face difficulties in investing resources in infrastructure projects. As previously discussed, one of the main obstacles to infrastructure financing relates to the lack of "investment grade" and quality infrastructure projects. In this sense, on the one hand, infrastructure projects

should be well designed and correctly integrated into their economic social and territorial environment; on the other, the competences of stakeholders involved should be strengthened. As for the projects' size, in developed countries it is increasingly difficult to find big projects since many infrastructure interventions are brownfield projects (maintenance operations), and technology is leading to the creation of small-scale pipelines of distributed infrastructure (as for instance in the case of distributed generation grids). In this sense, integrated pipelines and small size projects pooled together could be the answer.

Regulation has to be solid and clear. Experience shows that the interest of investors is greater in the most effectively regulated sectors (such as energy for example). However, excessive regulation or political instability may have negative effects on infrastructure investments' returns, reducing their attractiveness. It is, therefore, necessary to "invest" in good regulation: only certain, stable and, as far as possible, standardised rules allow more solid economic-financial plans.

Attention to sustainable and green investment is another important lever for accelerating private involvement in infrastructure. In a context where the appetite for green investments grows and many investors dedicate specific instruments to sustainable interventions, the realization of projects that integrate elements of sustainability allows additional resources to reach the infrastructures.

To conclude, a stable dialogue between policymakers and private investors can prove to be key in a fast-changing environment like the infrastructure sector. As megatrends revolutionise infrastructure needs as we know them today, policymakers should not crowd out private investors but rather involve them in the policymaking process as early as possible in order to generate a well-informed decision-making process on infrastructure dynamics. Legislators need to have a sound understanding of the potential of long-term private investments, while private investors should communicate their needs to public stakeholders in order to make the infrastructure market work more efficiently and reduce regulatory and political risk exposure.

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1. Gross Fixed Capital Formation.

2. Measured as Gross Fixed Capital Formation.

3. European Parliamentary Research Service (2018).

4. Dry powder refers to resources that investors have raised but have yet to invest.

5. McKinsey (2016).

6. The OECD Infrastructure Data Initiative is a joint initiative of the OECD, Multilateral Development Banks, the Global Infrastructure Hub, and the Long-Term Infrastructure Investment Association, amongst others, which works on advancing data analysis on infrastructure to support well-informed investment decisions.

7. Commission Delegated Regulation (EU) 2017/1542 of 8 June 2017.

8. OECD (2017).

6. THE ROLE PLAYED BY MULTILATERAL DEVELOPMENT BANKS IN FINANCING INFRASTRUCTURE

PIERRE SARRAT

Infrastructure investment is a key component of the 2030 Agenda for Sustainable Development, and it is recognised as a crucial driver of economic development. In comparison to advanced economies, developing countries still lag in quality, quantity, and accessibility of economic infrastructure. Scaling up infrastructure investment is, therefore, a key pillar of many national development strategies. After the UN Sustainable Development Goals (SDGs) and the Paris Agreement on climate change entered into force, many developing countries have been introducing green, inclusive, resilient, and technology-driven infrastructure investments, mostly through public spending, but also by increasing private sector participation.

However, many challenges lie ahead: the difficulties sovereign and sub-sovereign agencies face to prepare a consistent pipeline of well-structured projects; the insufficient capacity and capability of governments and public investment management institutions to develop infrastructure; the lack of project sponsors due to the high costs associated with the preparation of bid proposals; and the absence of available finance for infrastructure development activities.

Bridging large infrastructure gaps thus requires tackling several problems in terms of project preparation, project selection and implementation, and the management of high risks throughout the project life cycle.

In this context, Multilateral Development Banks (MDBs) have been funding and championing a digital platform called "SOURCE", to speed up the delivery of public infrastructure across the developing world. SOURCE has been designed to help public sector agencies prepare, manage, and publish their infrastructure projects and thereby attract private sector investment. This cloud-based system allows to present information about all aspects of the development of an infrastructure project in a transparent, consistent, and efficient manner. The platform also provides immediate connectivity tailored to the needs of public contracting authorities at national and subnational levels.

The Sustainable Infrastructure Foundation (SIF) is a not-for-profit Swiss Foundation headquartered in Geneva that operates and coordinates the provision of SOURCE under the oversight of MDBs.

This article provides an outlook on the global infrastructure gap and the actions taken by Multilateral Development Banks (MDBs) to provide solutions for technical assistance and project financing. In addition, it highlights the importance of prioritising efforts and investments to prepare infrastructure projects with sustainable outcomes in developing countries. Lack of knowledge in project preparation, implementation, and operations is identified as one of the most significant issues in facing global infrastructure needs.

THE GLOBAL INFRASTRUCTURE GAP

Both economic and social types of infrastructure are crucial for human development and economic growth. Water and sanitation, transport, energy, agriculture, and healthcare are key infrastructure sectors that play an important role for development.

The Global Infrastructure Hub (GIH) estimates that global infrastructure investment needs will reach a total cost of US$94 trillion between 2016 and 2040 to meet economic and demographic changes across the world. Asia alone will account for nearly 54% of the estimated infrastructure investment requirements by 2040. An estimated investment gap of US$15 trillion has to be covered by 2040, if the UN SDGs are to be achieved[1].

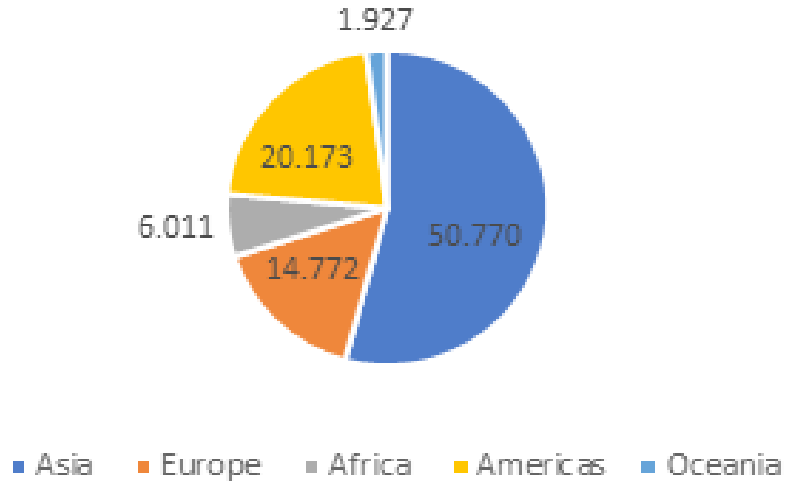
Furthermore, industrial activities associated with infrastructure development have followed an unsustainable path that has led to rising climate change threats and negative impacts on society. More than 700 million people live under extreme poverty (with less than US$1.90 a day) without having the possibility to cover essential infrastructure needs[3] If the current climate change effects continue, more than 100 million people will be living in poverty by 2030[4].

For this reason, closing the existing investment gap also implies a smart management of infrastructure investments in order to deliver sustainable outcomes, thereby maximising social and economic benefits and offsetting environmental burdens. This involves delivering bankable projects that enable strong performance and impactful results to cover universal access to essential services.

Therefore, adequate preparation of such projects – from conceptualisation and feasibility analysis to deal structuring and transaction support – is essential to ensure high performance and successful project operations, and consequently to help address the global infrastructure gap.

However, financing needs for project preparation translate to US$4.7 trillion over the period 2015-2040, or US$188 billion annually[5] Even if financing plays a significant role in project preparation, especially in develo-

Fig. 6.1 - Global infrastructure investment needs (2016-2040 US$ billion)



Source: Global Infrastructure Outlook, World Bank 2017[2]

ping countries, one of the major constraints remains the lack of support to develop the right knowledge for developing bankable infrastructure projects.

THE ROLE OF MULTILATERAL DEVELOPMENT BANKS (MDBS)

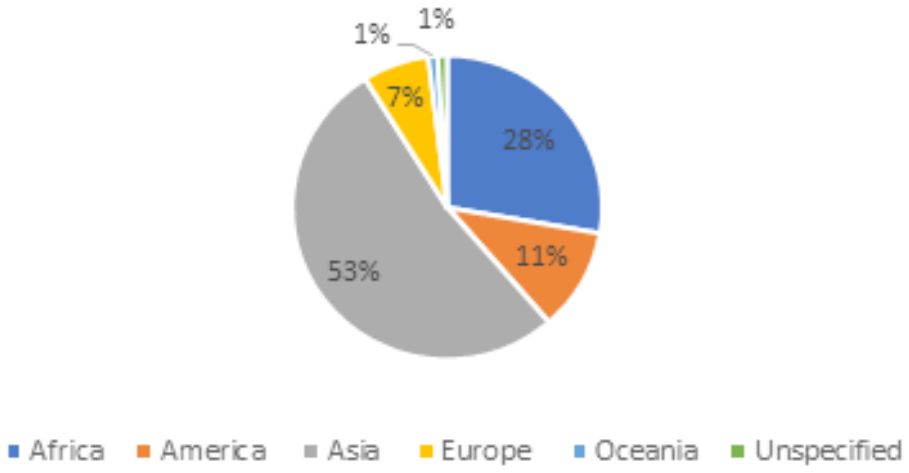
Broadly speaking, MDBs6 are development finance institutions that provide financial and technical assistance to developing countries, primarily to promote economic growth and prosperity.

Financing the global infrastructure gap is a crucial component of MDB's current scope of work. MDBs help governments improve their general enabling environment for investments and develop specific infrastructure sectors. They also fund various initiatives such as project preparation facilities, project facilitation platforms, and blended finance mechanisms for infrastructure development[7].

MDBs also provide equity, loans, guarantees, and technical assistance to prepare bankable projects and reduce project risks. They cooperate to co-finance projects with governments, commercial banks, export credit agencies, and other private sector investors. Mobilising private sector financing for infrastructure is very relevant for MDBs. For instance, the World Bank introduced the "Maximizing Financing for Development Strategy (MFD)" with the aim to deliver infrastructure projects by reducing the reliance on public funding and mobilising greater amount of commercial financing[8].

According to the latest statistics developed by the Organization for Economic Cooperation and Development (OECD), infrastructure finance provided by national and international Institutions (including MDBs), totalled $66 billion in 2016. Figure 6.2 depicts the total flow of infrastructure finance commitment by region[9].

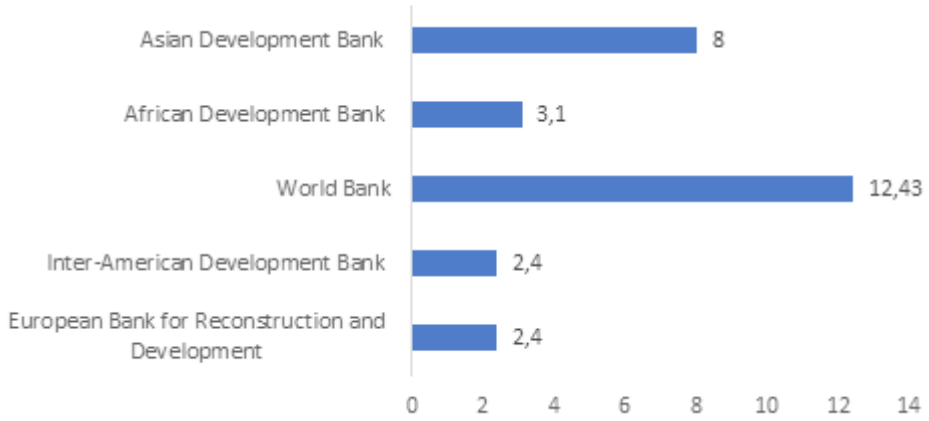
Fig. 6.2 - Infrastructure finance total commitments by region 2016



Source: OECD 2016

MDBs provide financing and technical assistance for the development of infrastructure projects where there is a relevant deficit in project preparation. Figure 6.3 shows the total infrastructure finance delivered by the World Bank and other regional multilateral banks.

Figure 6.3 - Total infrastructure finance delivered by selected MDBs-2016 (US$ bln)



Source: OECD 2016

MDBs orientate their support to develop different delivery models for infrastructure development. These vary from conventional procurement, concessions, or different Public-Private-Partnership (PPP) models[10], which transfer a number of risks and infrastructure activities to the private sector.

However, choosing the right model for the public sector is a very challenging task, as each country has concrete infrastructure needs and unique economic, social, and regulatory conditions. Moreover, public sector knowledge of infrastructure assets and services required by the population is crucial to understand the right pipeline of projects and their most suitable delivery models[11].

THE ROLE OF THE PRIVATE SECTOR AND PUBLIC-PRIVATE PARTNERSHIPS (PPPS)

As available funding from traditional sources falls far short of the required amount of investment for infrastructure, governments around the world have turned to public-private partnerships (PPPs) to design, finance, build, and operate infrastructure projects. While PPPs have not been extensively introduced as a procurement vehicle, they constitute an important channel to attract private sector financing into infrastructure projects. However, these models can also be highly complex, depending on their project scope and size, and governments may suffer from a lack of capabilities to prepare, procure, and manage them. This constitutes an important barrier to attracting private sector investments.

Therefore, governments require a significant amount of knowledge and capacity in project preparation when embarking into a PPP or any other large infrastructure project. Project preparation involves ex- and post-ante assessments, as well as the management of the activities throughout the entire project cycle. These normally include project inception strategies, feasibility studies (including needs analysis, financial analysis, value and economic assessments, etc.), due diligence (including social and environmental evaluations, project viability, etc.), procurement (pre-qualification, request for proposal, etc.), as well as project delivery programmes.

Furthermore, an appropriate macroeconomic environment, an adequate legal framework, good governance, and anti-corruption procedures are extremely important for the preparation of bankable projects across different sectors.

The World Bank recently conducted a study called "Procuring Infrastructure PPP Report 2018" to assess the strength of regulatory frameworks and institutional arrangements to prepare, procure, and manage PPP infrastructure projects in 135 economies. This study highlights significant regional and income group differences in the maturity of project preparation activities. Among the high-income countries surveyed, project preparation activities received an average score of 63 (out of 100), Middle-income and lower-income countries received

lower scores on average for project preparation, ranging from 48 (out of 100) for upper-middle income countries, to 44 (out of 100) for lower-middle income countries, to 39 (out of 100) for low-income economies[12].

This highlights the fact that all groups of countries require significant support in project preparation. Low-income countries have the widest knowledge gap. Preparation for sustainable infrastructure projects requires a significant amount of financing, besides the resources needed for actual implementation and operation. Therefore, the introduction of innovative solutions to overcome these issues are vital not only for MDBs but also for all key stakeholders involved in developing infrastructure.

SOURCE, THE MULTILATERAL PROJECT DEVELOPMENT PLATFORM

By acknowledging the need for smart solutions that enable a successful preparation of sustainable infrastructure projects, major MDBs13 created an innovative platform called "SOURCE", coordinated by the Sustainable Infrastructure Foundation (SIF).

SOURCE is a web-based platform that scales up the knowledge required for project preparation across different infrastructure sectors for lower- and middle-income countries. It provides a comprehensive map of all aspects that have to be taken into account when developing quality and sustainable infrastructure, spanning through governance, technical, economic, legal, financial, environmental, and social issues. The platform uses sector-specific sets of questions covering all the stages of the project cycle, from project definition to operation and maintenance. SOURCE's objective is to strengthen the capacity of project developers by providing:

1. An online, secure and collaborative project management software, with servers under the jurisdiction of the United Nations, that can be connected to other databases, initiatives, platforms and tools;
2. A structured and standardised methodology integrating multilateral best practices and standards, as well as practical access to curated knowledge products and tools;
3. A communication platform between project stakeholders, reducing preparation and transaction costs, promoting transparency and consistency through the project cycle;
4. A project promotion tool developed in liaison with the private sector and investors;
5. A standardised database structuring infrastructure project information to develop automatic analytics and indicators on the performance and sustainability of infrastructure

The platform integrates international standards and guidelines issued by international organisations on sustainable infrastructure development such as the G20 Principles for project preparation14 , the OECD Principles on PPP Governance15 , the APMG PPP Guide , and the IADB's Sustainable Infrastructure Criteria, among others.

So far, around 246 projects with an overall estimated capital expenditure of $US57 billion are managed on the platform. Over 1,850 users across all five continents are connected to SOURCE, improving communication between all key stakeholders involved in each of the projects.

SOURCE GOVERNANCE AND KEY STRATEGIC OBJECTIVES

SOURCE was created by the Asian Development Bank in 2009, before being transferred to the Sustainable Infrastructure Foundation (SIF), a not-for-profit organisation registered in Switzerland, with the objective of making it an international tool to be widely used by all the interested parties. The platform in its current form was launched globally in 2016.

SIF was created specifically to coordinate the long-term provision of SOURCE services to global users in a sustainable basis, while all powers concerning the development of SOURCE platform are within the SOURCE Council, which is entirely comprised by MDBs. The four MDBs that currently compose the SOURCE Council are the Asian Development Bank, the European Bank for Reconstruction and Development, the European Investment Bank, and the Inter-American Development Bank. These fully-supportive MDBs control all relevant approvals for the strategy, oversight, and budget of SOURCE under SIF's constituency.

In April 2018, SIF and its partner MDBs initiated a new strategy to scale up the global impact of the platform. This strategy aims to operationalise and customise the SOURCE platform to countries' regulatory framework and project development processes; hence enabling its adoption at the national level, and across all agencies involved in the development, funding, and management of infrastructure projects. Following successful piloting in the Philippines, the strategy has already been implemented in several countries from Africa, Asia, Europe, and Latin America, which have expressed formal interest.

In such a way, MDBs strategically provide financial support to boost the technical capabilities required for the development of infrastructure projects that deliver the SDGs. Thus, SOURCE opens up an array of opportunities and potential to make substantial progress on the global infrastructure gap.

CONCLUSION

Innovative strategies and new approaches are required by key stakeholder groups in order to make progress in closing the global infrastructure gap. Good practices, guidelines, and tools should be increasingly incorporated and implemented by governments, the private sector, and other infrastructure developers across the world.

Furthermore, the use of new technologies and IT platforms prove to be successful ways to scale up the knowledge required for smart infrastructure investments that result in positive economic, social, and environmental impacts.

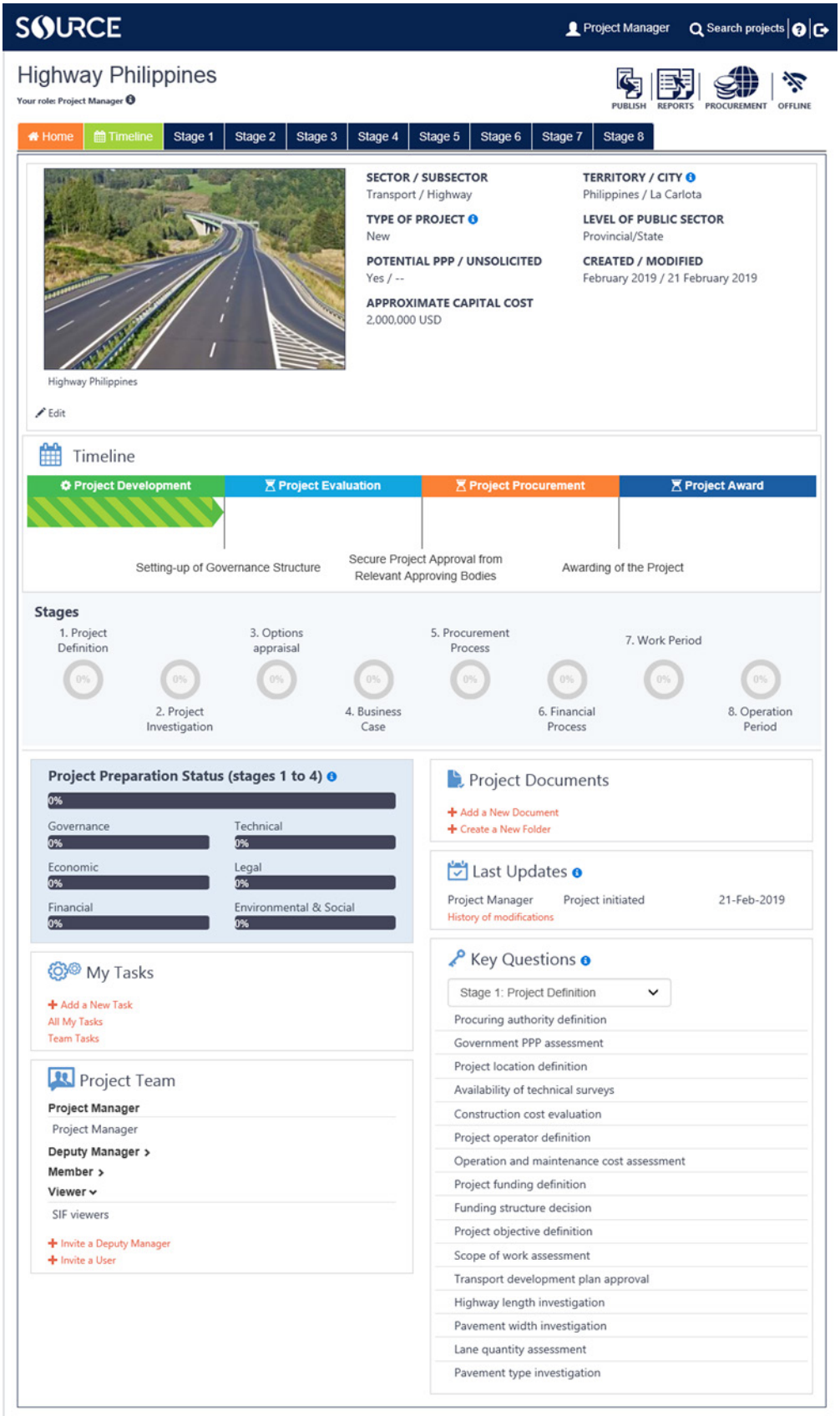
SOURCE is an example of such an approach, where fundamental information on project preparation and project management tools are available for countries that need the most support. The functionalities of SOURCE have been continuously improved to target the needs of this group of countries. Additionally, the platform will be available in more countries at national and sub-national levels. To achieve this, an increasing number of strategic partnerships have been established with international organisations.

In such a way, MDBs and their partners have taken an important step in developing a harmonised platform to prepare projects that deliver sustainable results.

However, this is only a starting point to support the lack of knowledge and amount of financing required to a sustaining delivery of infrastructure services.

If global infrastructure investment needs are expected to be covered by 2040, more actions and cooperation between key stakeholder groups should be fostered. This cooperation should aim at developing strategies that actually scale up the implementation of infrastructure projects, where scarce resources are used efficiently, and sustainability is enhanced.

FIG 6.4 - PROJECT HOME PAGE ON SOURCE



1. The global investment gap results from the difference between the estimated global infrastructure needs ($US 94 trillion) and infrastructure investments under current trends ($US 79 trillion) from 2016 to 2040. Global Infrastructure Hub, *Global Infrastructure Outlook, Infrastructure investment needs 50 countries, 7 sectors to 2040*, 2017.

2. The infrastructure needs cover seven sectors and 50 countries in five regions. World Bank, *Forecasting infrastructure investment needs for 50 countries, 7 sectors through 2040*, 2017.

3. World Bank, *Poverty*, 2016.

4. World Bank, *Rapid, Climate-Informed Development Needed to Keep Climate Change from Pushing More than 100 Million People into Poverty by 2030*, 2015.

5. Global Infrastructure Hub (GIH) 2019, *Project Preparation – Introduction: Laying the foundations and charting a way forward*, 2019; Global Infrastructure Hub (GIH) (2017).

6. Multilateral Development Banks (MDBs) are international finance institutions comprised by a group of countries to finance and enable capacity for development. There is a total number of 25 global, regional, and sub-regional multilateral development banks. (Overseas Development Institute (ODI), 2018).

7. OECD, *Infrastructure finance by bilateral and multilateral development partners*, 2019.

8. World Bank, *Maximizing Finance for Development (MFD)*, 2019.

9. OECD, *Infrastructure finance by bilateral and multilateral development partners*, 2016.

10. Public-Private Partnerships are normally medium- to long-term agreements between the public and private sectors, involving the sharing of risks and benefits of multi-sector skills, finance, and expertise to deliver policy objectives on infrastructure development.

11. Deloitte, *Building flexibility. New delivery models for public infrastructure projects*, 2008.

12. World Bank, *Procuring Infrastructure Public-Private Partnerships Report 2018*, 2018.

13. SOURCE is financed and chaired by major MDBs: the African Development Bank Group (AfDB), Asian Development Bank (AsDB), Brazilian Development Bank (BNDES), Development Bank of Latin America (CAF), Development Bank of South Africa (DBSA), European Bank for Reconstruction & Development (EBRD), InterAmerican Development Bank (IaDB), Islamic Development Bank (IsDB), Public–Private Infrastructure Advisory Facility (PPIAF) and World Bank Group (WBG).

14. http://www.g20.utoronto.ca/2018/principles_for_infrastructure_project_preparation.pdf

15. https://www.oecd.org/governance/budgeting/PPP-Recommendation.pdf

16. https://ppp-certification.com/ppp-certification-guide/about-ppp-guide

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7. HOW TO BUILD INFRASTRUCTURE EFFICIENTLY

ANDREA GOLDSTEIN, PAOLO ROMITI

The pressing need to build new infrastructure and renew existing ones is evident in the face of global challenges such as poverty eradication, climate change, and urbanisation. So is the fact that new-generation infrastructure must be built and maintained differently. They are increasingly complex and modular and must be sustainable from many and possibly conflicting angles: environmental, social, and financial. What is more, infrastructure is becoming increasingly trans-national – when not global in nature – meaning that large construction companies like Salini Impregilo must rethink commercial and contracting strategies to avoid negative effects that they might have on pricing, risk management, and project outcomes.

Based on our long experience in building some of the world's biggest projects, we strongly suggest that procurement agencies accept that the infrastructure market is quite different from what they have seen in the past. Years ago, when projects were fewer, clients could issue a large, complex package – on their preferred terms – and expect sound competition from highly qualified bidders. In the current market, that procurement environment does not exist anymore, and in all likelihood will not return in the foreseeable future.

Procurement strategies are outdated, and many contractors have full order books – to say nothing of the fact that very few have sufficiently strong balance sheets to assume the challenge of major new projects. This excessive strain is manifest all along the supply chain. The high volume of work increases direct costs due to competition for limited resources such as a specialised workforce or engineering equipment, especially when projects include local content requirements.

Capacity is also rapidly becoming a challenge. The reality is that there are very few major construction companies in any market with the size and experience to deliver megaprojects successfully. We see this in Australia, where the country is investing in a portfolio of giant infrastructure projects, many valued at more

than US$2 billion. This means that some project owners are forced to choose between paying more for an international consortium of qualified and experienced contractors or taking a risk by accepting inexperienced, overloaded, or financially constrained local players.

All such factors combined make it imperative to limit costs and drive value for money. It is easy to observe that qualified and reputation-conscious contractors are becoming increasingly selective about the projects they choose to take on. What is emerging is a global construction landscape populated by two classes of contractors: high-quality ones – that are increasingly risk-adverse, preferring to say no to new opportunities in challenging geopolitical environments rather than jeopardise their hard-won reputation and financials; and upcoming challengers, more often than not from emerging economies, that accept almost any risk and show almost unlimited appetite for aggressive pricing or challenging program assumptions.

These constraints, if not managed prudently, can hinder competition in the construction market and value for projects. Already, quite a few high-profile/high-risk projects have been adjudicated with limited competition, sometimes forcing fundamental repackaging of the procurement model and risk allocation. Although this continuous adaptation of the rules may, in the end, attract sufficient competition, it is a sub-optimal solution to the industry's structural problems.

CUSTOMISING PROCUREMENT REQUIREMENTS

The truth of the matter is that circumstances – such as demographics, politics, economics, and technology– change continuously and require clients to carefully and regularly consult with the market. In light of these fast-paced and unpredictable dynamics, procurers should ask themselves how to contract projects in a way that will attract a competitive field of adequately qualified contractors. The appropriate strategy is to conduct such consultations to customise procurement requirements before going to the market for actual procurement. Moreover, clients should maintain a deep and precise understanding of actual market conditions. Market sounding is becoming essential to cultivate the construction market and try to gain prominence over all other projects on the market.

This means moving from pre-set, conflictual, and firm procurement and contracting strategies to customised contracting approaches that consider the widest possible range of packaging, procurement, and risk allocation solutions. Then, clients should try to test them repeatedly in the market, in order to continuously evaluate projects and package different solutions according to the specificities of discipline, risk type, geographic or site location.

These changes in approach pose new challenges to clients, who should increasingly serve as sophisticated interface managers, aligning multiple packages and contracts to meet overall project objectives and deli-

verables. This translates into new procurement skills and often new management, endowed with the right commercial, financial, and project management expertise to support the procurement process. Perhaps not surprisingly, capability is also becoming a problem, particularly at the management level. Indeed, as projects become bigger and bigger, it is becoming increasingly difficult to find individuals with sufficient experience in managing projects of such massive scale and complexity.

DUE DILIGENCE OF LOCAL CONDITIONS

As flexible contracting models are increasingly adopted, management is confronted with new demands in the way clients manage cost, scope, and risk. Clients must also pay growing attention to wider legitimacy gaps or community concerns over their projects. Confronted with plenty of choices about which projects to pursue, contractors are becoming picky and shy away from those that present substantial social, political, or sovereign-type risks. In the age of social media, any accident can spread rapidly and ruin the reputation of a company. For this reason, performing due diligence of local conditions and knowing local players, even when they appear prima facie unsavoury for a multinational executive, are essential de-risking actions. Together with a sound communication strategy for all the project life, to control and manage reputational risks.

In addition, a major feature of the contemporary infrastructure market is that, while construction needs are exploding, private investment in infrastructure is always, or at least quite frequently, an issue. For a range of reasons, the Public-Private Partnerships (PPPs) pipeline is an increasingly attractive option. But it is not automatic, nor is it the only available option: clients should be careful in analysing where and when PPP, or other financed delivery formulas, should be applied. Ultimately, clients need highly skilled, experienced, and integrated project procurement teams that live and understand the market – and these teams need to be backed by a full suite of procurement models adaptable and responsive.

In particular, as artificial intelligence multiplies the possibilities for turning data into business insights and opportunities, massive opportunities will emerge for clients that plan, own, and operate infrastructure. Indeed, over the coming few years, we expect human and financial resources to be directed at technological projects that uncover new ways to translate Big Data into unprecedented efficiency gains across the life cycle. We do not realise yet the revolutionary impact of using analytics to unlock operational efficiencies – extending asset spans, reducing operating maintenance costs, and empowering users. However, it would be erroneous to see these changes only from a purely technological perspective. What is happening is also made possible by a cultural shift: decision-makers are starting to put greater trust in their forward-looking analytics, rather than relying solely on outdated quantifications, short-lived trends, or political instincts. Data-driven efficiency is not easy stuff, and investments into enhanced data and analytics likely will not com-

mand any photo ops or grab any headlines. However, we believe that it will almost certainly unlock massive value for infrastructure owners, operators and – most importantly – the end-users.

Against this backdrop, planners will be expected to improve and reinforce the alignment between supply and demand, but also to increase the overall effectiveness of the planning process. In this brave new world, regulators will be expected to better govern and oversee delivery. And investors will have no excuse if they fail to monitor and assess the value resilience of their investments.

CROSS-BORDER MEGAPROJECTS

Finally, over the past few years, we have seen a fair number of megaprojects, of greater scale and complexity than ever before, being proposed. In 2018 alone, high-profile examples include the new bridge linking Hong Kong to Macau Zhuhai, Thailand's Eastern Economic Corridor, Australia's Inland Rail project, and Dubai Solar Park. As megaprojects become standard and increase in size and complexity, lessons are emerging. One, in particular, is that most such megaprojects know no national borders and that cross-border projects require unprecedented levels of collaboration between governments.

As projects get bigger and more complex, they are becoming inherently riskier. That makes it increasingly difficult for project promoters to keep their nerves steady when things start to go wrong. Rules do exist to constrain unwieldy parties, but with populism and nationalism mounting, few governments are keen to be seen as subject to rules of engagement. Everyone is looking for a fast, win-win situation, and nobody admits that the politicisation of megaprojects invariably leads to escalating conflicts.

In sum, the landscape for global infrastructure shines with the lights of technological progress and the realisation that investing in roads and broadband, ports and water systems, means opening new opportunities for socio-economic advancement. This does not mean that there are no clouds on the horizon, from capacity constraints to divisive politics. We expect to see clients lend new attention to benchmarking, performance analysis, and learning lessons from other successful projects as they seek to defend projects against political and financial pressures. A final note of caution: given all these factors, we may be rapidly approaching the effective limits of project size and complexity – unless new approaches to project delivery are developed.

8. HOW ANALYTICS CAN DRIVE SMARTER ENGINEERING AND CONSTRUCTION DECISIONS

GARO HOVNANIAN, KEVIN KROLL, AND ERIK SJÖDIN

The construction business faces a major productivity challenge. While labor productivity in the global economy has increased by an average of 2.8% a year over the past two decades, and in manufacturing by an impressive 3.6%, the construction sector has registered a mere 1-percent annual improvement. As the capital-project partners responsible for execution, engineering and construction (E&C) firms are well positioned to drive changes that can help close this troubling gap.

To do so, some are turning to data-driven solutions that have already revolutionised many other corners of the economy. These techniques are emerging as vital tools for improving capital project outcomes and reducing risk. By enabling E&C companies to leverage the vast amounts of data they already collect, analytics can uncover critical insights that both speed up and improve the quality of management decisions. In particular, they can help project teams assess market conditions, portfolio composition, and individual project performance.

Admittedly, adopting analytics tools may pose challenges for project-driven businesses in the construction sector. Unlike manufacturers, for example, which tend to follow predictable and repeatable processes, E&C firms face high variability. Progress-tracking systems sometimes change mid-project, causing incompatibilities and inconsistencies in the collected data. Parameters such as scale, materials, and subcontractors involved also vary significantly from project to project, making it difficult to establish benchmarks.

The cultures and processes within E&C organisations can pose additional barriers. The industry tends to put trust in individual experience and expertise over empirics, and few companies have data analysts on staff who can take ownership of advanced analytics initiatives.

In time, predictive analytics, machine learning and artificial intelligence solutions will likely usherin bigger changes to the ways E&C firms bid on and deliver projects. For now, three applications illustrate how companies are beginning to embrace data solutions while establishing a foundation for more ambitious initiatives in the future.

"SHOULD WE BID ON THIS PROJECT, AND IF SO, HOW MUCH?"

Usually, E&C firms must decide whether to bid on a project based on incomplete information. Major construction projects often have a 5- or 10-year timeline, if not longer, which makes it difficult to accurately define the scope and predict likely complexities or complications up front. What's more, bidders don't know how market shifts may affect their costs between the time of the bid and the project's start. Companies rely on staff experience to weigh potential risks and profitability, but those judgments are subject to inherent biases and may be affected by ambitious growth targets or individual incentives.

Misjudging risks and underestimating costs can prove disastrous. In a business with typical margins of 5 to 7%, underestimating a bid by 10% without the ability to recover the extra costs can make the project an expensive money-loser for the E&C firm. Conversely, overpricing a project by building in too big a contingency cushion will likely mean the loss of the contract – something a firm can ill afford in an industry with win rates of merely 15 to 25%.

Data modelling can replace cognitive bias and flawed assumptions with fact-based insights about a project's statistical chances of success. By analysing historical information such as types of labour and contract arrangements, regional spending trends, and project size, analytics can assess the probabilities of project outcomes. Those, in turn, will enable teams to better evaluate the attractiveness of a given project, re-balance the portfolio away from jobs that tend to underperform, and calculate the right level of contingency to include in a bid.

One company, for example, leveraged data from more than 100 of its past projects. It combined internal data on project locations, asset classes, contract structures, and profit margins with external information such as total spending in a given sector or geography and statistics on local workforce size and unionisation. Analysing these factors in aggregate, the company uncovered project characteristics that influenced profit margins in ways that conventional analysis could not illuminate. For example, while companies often look to factors like region or project type to predict profitability, those variables may be merely correlated with more influential factors such as contracting strategies, craft unionisation, or regional public sector budgets.

Using the insights from this analysis, the organisation developed a dashboard of risk variables that could affect project margins. The system creates a scorecard that identifies potential risks based on past patterns – for example, if the venture is in a region with a history of low-margin projects, or if it entails working with a public-sector owner with different requirements than typical private-sector partners.

During pre-bid meetings, teams rely on this information to help them decide whether the project is sufficiently attractive to make a bid, estimate the costs, and calibrate the size of the contingency to assign to the bid.

"ARE THE SUBCONTRACTOR BIDS REASONABLE?"

When E&C firms receive bids from subcontractors, they turn to procurement specialists to assess the quotes. These individuals often rely on parametric estimates to evaluate the quoted costs and tap the expertise of project managers, slowing down the process. Complex estimates pass through multiple reviewers, with each one adjusting the estimate based on his or her own experience and judgement (as well as potential bias).

Despite these extensive consultations, the lack of an empirical foundation makes it hard for engineering companies to credibly challenge a subcontractor's estimates beyond relying on generalised rules of thumb. In addition, while many companies maintain (and subscribe to) databases of parametric cost factors for bidding, they rarely follow up with the actual costs at the end of their projects to gauge the accuracy of those estimates.

Analytics can provide a solution to these problems. By analysing individual drivers of past project costs, such tools can enable E&C companies to rapidly assess a realistic level of effort and cost for a project and compare those figures to subcontractor quotes.

One large U.S. infrastructure owner took the initial contracts from 17,000 past projects, incorporated amendments and adjustments, and created a comprehensive database of all final costs by work breakdown structure, both in time and materials. It then built a multi-variate statistical model to determine the factors that would most accurately predict final project costs, such as the likely number of structural engineering hours required for a bridge replacement, or projected materials cost for an additional lane along a four-mile strip of rural arterial highway. The result is a procurement tool that benchmarks a project's final cost. When bids come in, managers immediately know if these are within the expected range for that type of work. Today, leaders can gauge an accurate price for procured contracts within an average of two days, down from an average of 60 days often spent in labor- intensive negotiations.

"IS THE PROJECT ABOUT TO RUN INTO TROUBLE?"

Traditional project controls often lag the incurrence of costs by days or weeks, which makes them an effective tool for retrospective reporting but not for managing ongoing projects. The controls also don't account for the interconnectivity of different metrics and the unique combinations that may have outsized effects on performance. For example, lagging crew productivity can often be recovered through special planning activities; but late material delivery or multiple days of adverse weather might exacerbate crew productivity losses and require a different intervention from management.

Unable to continually track and grapple with all the data a project generates, managers tend to follow a few key performance indicators. The resulting incomplete picture of the project's daily progress can lead to flawed decisions on the ground.

Analytical tools can deliver a significant improvement on this front by allowing companies to quickly and continuously analyze project data and assess progress, enabling managers to react faster to potential problems. With real-time or near-real-time project controls in place, an E&C firm can track events or problems known to correlate with the erosion of bid margins, such as a one-day weather delay or three consecutive days of a subcontractor's failure to complete designated tasks.

Industry leaders have created an approach, statistically correlated with erosion of margins, to monitor their project performance. On a daily basis, the analytics model crunches the day's project data and looks for these red flags; if enough of them appear, management is alerted immediately to intervene before the problem even materialises.

* * *

As we have written elsewhere, engineering and construction firms wishing to prepare for the digital age will need to establish a new operating model.

Such a shift requires treating digital initiatives as part of the core strategy, adapting processes and organisational structures, and ensuring staff have the necessary training to deploy, troubleshoot, and lead digital initiatives. But the first step in such transformations is applying analytics to assess current operations and performance.

Often, the greatest hurdle to implementing such solutions is the one-time backward reconciliation of data. Most firms have collected lots of information over the years, but it's stored in disparate systems and inconsistent formats. As such, the first step should be to take stock of what they have – many companies will find

they have a lot more data than they realise, such as accounting records and purchase order history – and put it into a form they can digitally analyse. This may be a tedious and resource-intensive process, but it will set the foundation for more sophisticated data collection and analytical techniques down the line. What's more, this one-time work will create a foundation for structuring data – into data lakes, for example – that will make future analytics initiatives easier.

Companies also need to establish standards for the data they collect in the future. Whether it's a full-fledged data management system or simply a standard way of tagging and collecting information, standards for what you want to collect and how you collect it are critical to a long-term analytics strategy.

As digitisation penetrates all parts of the economy, including engineering and construction, capitalising on the insights hidden in data will become essential. E&C companies reluctant to invest in the systems and skills needed to harness what they have collected should remember that competitors who have successfully made the move are already reaping significant benefits. Firms that embrace analytics can make sharper bids, thus avoiding unprofitable projects and increasing their win rates on those with strong margin potential. They conduct savvier negotiations with subcontractors, reducing costs and increasing decision speed. And they anticipate problems with ongoing projects, allowing managers to intervene before potential delays and cost overruns turn into real ones. As the industry increasingly deploys these tools, the companies that get in early will likely emerge as leaders.

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Pierre Sarrat is a qualified Civil Engineer and experienced Project Director in transportation and infrastructure planning, with a proven track record of delivery in emerging market environments. He has more than ten years of experience, spanning definition of operation and maintenance strategies, economic and financial appraisal of projects, transaction advisory, and asset management. Before joining SIF as Chief Operating Officer, Pierre was PPP Specialist at the Asian Development Bank, and supported the development of transport infrastructure in Asia as transaction advisor, as well as the provision of institutional support to PPP Units through ADB's Asia Pacific Project Preparation Facility (AP3F).

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Stefanie Schäfer has been working as a scientific consultant since October 2017. She is part of the transport modelling team of TRIMODE. In the field of TEN-T corridors, she contributed to the study about the impact of TEN-T completion on growth, jobs, and the environment. During her master program, she worked as a research assistant for the Fraunhofer Gesellschaft in the field of new mobility solutions. Before that she gathered experience as part of the project management of large-scale infrastructure projects, both during her working for Schüßler-Plan GmbH and RiskConsult GmbH.

Carlo Secchi is vice president of ISPI since 11 July 2005, and head of ISPI Infrastructure Centre. He is professor emeritus of European Economic Policy at Bocconi University in Milan, where he was rector (2000-2004) and full professor (1983-2011). He was the chairman of the Italian Group of the Trilateral Commission (2003-2016). On behalf of the European Commission, in 2009-2013 he was European coordinator for infrastructural Priority Projects (TEN-T) between France, Spain and Portugal and since March 2014 he is European Coordinator of the Atlantic Core Network Corridor. In addition, he was the chairman of the High-Level Group on Business Services (DG Industry and DG Internal Market) (2013-2014). He served as vice president of the Economic and Monetary Affairs Committee at the European Parliament (1994-1999).

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