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How Solvency II supports infrastructure investments: A tighter connection between insurance companies and the real economy.

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The significant problems we face cannot be solved at the same level of thinking we were at when we created them

Albert Einstein

Abstract

The herein dissertation deals with the regulatory, institutional and market-based initiatives taken at European level with the view of enhancing the access of insurance companies to infrastructure investments and of limiting the impact of the factors that are likely to prevent the demand and the supply for infrastructure assets to meet, with a specific referral to the European economy. Two sets of regulatory barriers are pointed out, namely technical and regulatory limits to long-term investments. For each of these, the main solutions proposed by the European Institutions, represented by the European Investment Bank and the European Commission, are scrutinized. The Juncker Plan, born with the objective of raising €315 billion of additional long-term investments in all European Member States, and the recent amendments to the insurance companies' Solvency II prudential regulation to include the category of qualifying infrastructure debt and equity investments in the market risk module of the standard formula, are discussed in their essence of important and significantly effective steps that the European Union has taken toward the objective of closing its infrastructure gap. In addition, other smaller scale public and private initiatives are scrutinized, including the European Investment Bank's Infrastructure Aggregation Platform (not yet launched), the International Finance Corporation's Managed Co-Landing Portfolio Platform and the UBS Archmore Infrastructure Debt Platform. These initiatives share the goal of enabling small and medium-sized insurance companies to better and easier access high-quality low-risk infrastructure debt investments.

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Introduction

The World needs more of infrastructure. Most underdeveloped countries lack the facilities for the accommodation of basic human needs like the access to potable water, electricity, education and healthcare. On the other side, in most cases, advanced countries have accumulated significant backlogs in the maintenance and modernization of their old and obsolete infrastructure systems. Infrastructure works include roads, railway systems, waterways, gas pipelines, telephone lines, electricity transmission and distribution systems, hospitals, schools, prisons, public parks and other administrative buildings. In general, infrastructure is whatever long-lived capital-intensive asset enabling the provision of essential services to people and their communities. Infrastructure plays a crucial role in supporting the socio-economic growth in all of the World's countries, as it enables the connections among people and cities, multiplying the occasions for socio-economic exchanges, improves input factors' productivity, enhances the quality of people life and their life expectancy, creates employment. Demand for infrastructure investments to face the great challenges that the XXI century is bringing about, including the call for sustainable development, will be as sizeable as never in the history of humanity. The issue is constantly included in the agendas of global and European policymakers. According to the influential estimations of the McKinsey Global Institute, the World demand for the construction of new infrastructure facilities and for the upgrading of the existing works amounts to $3.300 billion a year until 2030, only to accommodate the projected growth of the global GDP. This translates in a global infrastructure investment gap of $1000 billion a year, of which the European economy faces roughly one third.

Traditionally, governments have represented the main source of infrastructure financing, given the important positive socio-economic effects and externalities that infrastructure works are likely to bring about. Nonetheless, developed countries' governments have progressively withdrawn from the field, inaugurating a shift toward a financing model heavily relying on investments of private market players. This has depended on many factors, including the spreading belief that private investors would have been able to perform investments more efficiently and to better manage infrastructure facilities. More recently, concerns have also arisen about the sustainability of the extremely high levels of public indebtedness and high government deficits that have been characterizing several developed countries, especially European ones. The 2007-2008 financial crisis and the 2011 sovereign debt crisis have complicated things even more. Reduced tax revenues, recessions and the constraints imposed on European governments by the austerity policies have obliged governments to postpone important expenses until national balance sheets had appeared better.

Relevant changes have been occurring also within the private sector. In particular, during the last decade, also the flow of bank capital, which has traditionally represented the primary source of infrastructure debt financing, has been dwindling in consequence of the financial crises. The deleveraging process banks are going through and the contraction of the lending flow to the real economy, especially on a long-term basis, can be going to assume a structural nature, as a consequence of the entrance into validity of the new prudential framework Basel III.

As a partial solution to these issues, an important historical discontinuity is arising for what concerns the role and the investment function of institutional investors. Institutional investors are large players pooling money from several sources and directing it toward financial and real investments. Among them, a particular importance has to be given to life insurers and pension funds. These investors look for conservative income-generating long-term assets to match their long-term liabilities. In this moment, they are also struggling to find investments that can allow them higher yields with respect to traditional sovereign and investment-grade corporate bonds, in order to survive in the extremely low interest rate current environment. Hence, they have turned their attention toward alternative real assets, including infrastructure and SMEs investments.

Investment decisions are taken on the basis of three elements: expected return, risk appetite, desired cash profile. Given this premise, high-quality low-risk infrastructure asset may represent valuable investment opportunities for institutional investors. The assets in question are categorized as core infrastructure assets and consist of conservatively structured long-term income-generating assets, exhibiting no construction risks, limited post-completion risks (low market risk, low technological risk) and attractive risk-adjusted returns, if compared with traditional fixed-income instruments. Low-risk high-quality infrastructure assets are likely to provide investors with stable and predictable streams of inflation-linked cash flows, in the context of a regulated contractual framework. In addition, they have proven to be very resilient to the upturns and downturns of the economic cycle and to be weakly correlated with other asset classes, hence they are ideal in the pursuance of a desirable level of portfolio diversification.

The society as a whole, the underlying economic system and institutional investors can all take huge advantages if quantitatively and qualitatively adequate infrastructure investments are carried out. Provided that there is excess demand for infrastructure assets and significant unexpressed supply, it is important to identify the factors that prevent them to meet, and to design adequate solutions to limit their negative impact. In particular, it is essential to design an economic environment that does not prevent institutional investors from exploiting their long-term investment potential.

There is so much at a stake, here. Institutional investors globally manage thousands of billions of capital and even a minimum shift of their asset allocation strategy toward infrastructure investments is likely to translate in injections of several millions of new infrastructure financing. In Europe, insurance companies represent the main category of institutional investors. By 2015, the European insurance industry had almost €10.000 billion under management, of which only the 0,3% was invested in infrastructure assets.

The *objective of this dissertation* is hence to analyze the institutional, regulatory and market-based challenges and incentives that insurance companies find in the European environment when committing themselves to infrastructure investments. In the pursuance of this goal, particular importance will be attributed to the treatment of insurers' infrastructure investments under the European prudential regulation Solvency II, determining risk-based capital and qualitative requirements for insurers on the basis of the investments they perform and of the way these investments interact with the structure of their balance sheets. In addition, the description of some institutional and market-based initiative, aimed at removing infrastructure investments obstacles for insurance companies and other institutional investors, will deserve an important focus along this treatise.

In the context of Chapter 1, infrastructure works are introduced, defined and described. Paragraph 1.1 draws a complete picture about what infrastructure is, what its characteristics are and to what extent it can contribute to the socio-economic development of countries. There, the status of infrastructure endowments in the World countries is represented and the double-way relationship between infrastructure and sustainable development is analyzed. Paragraph 1.2 lists and scrutinizes the network infrastructure-based industries, making a subdivision between economic and social infrastructure sectors. In the context of Paragraph 1.3, the competition regulation applying to network industries (and hence interesting infrastructure assets' operators) is described. The global imbalance between demand and supply of infrastructure investments, representing a crucial element of this dissertation, is discussed and quantified in Paragraph 1.4, whereas the infrastructure gap in Europe is discussed in the subsequent Paragraph 1.5.

Chapter 2 provides a description of the asset class of infrastructure, including the determinants of infrastructure assets' risk-return and cash profiles and the elements of interest for institutional investors. Paragraph 2.1 lays down the asset class' basic characteristics, in absolute and as an asset class in the category of alternative asset classes. It describes its expected benefits and elements of concern, while stressing the heterogeneity of the assets therein encompassed. Paragraph 2.2 introduces the market participants that are likely to target infrastructure investments, making a distinction between public and private investors, as well as between institutional and strategic

investors, with a stronger focus on the formers. Paragraph 2.3 lists and scrutinizes the different types of financing instruments for infrastructure assets, namely project finance, corporate finance and market-based instruments. Paragraph 2.4 discusses the elements that contribute to the determination of infrastructure assets' risk-return profile, including their industrial sector, geographical location, life stage, financial structure and contractual arrangement. Paragraph 2.5, instead, analyzes the expected benefits from investing in infrastructure, including low demand risk, protection of cash flows from inflation, low correlation with the economic cycle and with other asset classes, attractive risk-adjusted returns. Along the Paragraph in question, it is specified that the bulk of these positive features are a prerogative of core infrastructure assets, as opposed to opportunistic or value-added infrastructure investments. The expected return from these is considerably higher, and so is the risk taken, as most of the elements of stability characterizing core exposures are missing.

Chapter 3 hosts a treatise about the impact of the European environment on the investment choices of insurance companies, with referral to infrastructure investments. Paragraph 3.1 describes the European insurance sector as a potentially huge source of infrastructure financing and long-term investments in general. Paragraph 3.2 subdivides long-term investment barriers preventing insurance companies to fully exploit their investment potential in technical and regulatory constraints and offers a description of both. In response, Paragraph 3.3 describes some of the measures that have been taken by the main European Union institutions in an attempt to overcome long-term investment barriers, with a particular focus on the Juncker Plan and its results. In Paragraph 3.4, different types of regulatory provisions are listed and described to understand their possible impact of investors' behaviors. Laid down the opportune premises, in Paragraph 3.5, the Solvency II prudential regulation is introduced and its main characteristics are analyzed. Along the Paragraph, the focus is progressively narrowed from the general features of the framework to its first Pillar (quantitative requirements) and the standard formula for the computation of the Solvency Capital Requirement, therein included. A description of the treatment of infrastructure investments according to Solvency II can be found in Paragraph 3.6, where each risk module of the standard formula is analyzed, together with its implications for the specific treatment of infrastructure investments. In Paragraph 3.7, the provisions included in Articles 164a and 164b of the EU Delegated Regulation 2015/35, as amended by the EU Delegated Regulations 2016/467 and 2017/1542, are thoroughly analyzed to understand what are the criteria imposed by the European regulator to make a distinction between "standard" infrastructure investments and infrastructure exposures that are eligible for a preferred treatment dedicated to qualifying equity and debt investments in infrastructure. Once qualifying infrastructure investments have been identified, Paragraph 3.8 describes the additional requirements that the European regulation imposes on insurance companies in order for them to actually access the favorable

treatment set up for qualifying infrastructure investments. In particular, the Solvency II look-through approach is introduced, namely the provision according to which insurance companies keep responsible for the compliance of each of their exposures independently from whether they are gained directly or indirectly. According to the approach in question, insurance companies have the encumbrance to gather enough data to demonstrate to their national supervisors the eligibility of their infrastructure investments for the facilitated treatment. Paragraphs 3.9 and 3.10, therefore, reports three examples of institutional or private initiatives taken in order to facilitate insurance companies in their effort to invest in Solvency II compliant infrastructure assets and getting the information required by the look-through approach.

Chapter 1

1.Infrastructure assets and socio-economic development

1.1 Definition of infrastructure 1.1.1 Infrastructure megaprojects 1.1.2 Infrastructure in the World 1.1.3 Sustainable infrastructure and the UN 2030 Sustainable Development Goals

1.2 Infrastructure industrial sectors 1.2.1 Economic infrastructure and utilities 1.2.1.1 Transport infrastructure 1.2.1.2 Energy infrastructure 1.2.1.3 Water infrastructure 1.2.1.4 Waste management infrastructure 1.2.1.5 Telecommunication infrastructure 1.2.2 Social infrastructure

1.3 Competition regulation in infrastructure-based network industries

1.4 The infrastructure gap: where we are and where we need to go

1.5 The infrastructure gap in Europe 1.5.1 Infrastructure can raise back the European economy

"You built a factory out there? Good for you. But I want to be clear: you moved your goods to market on the roads the rest of us paid for; you hired workers the rest of us paid to educate; you were safe in your factory because of police forces and fire forces that the rest of us paid for. You didn't have to worry that marauding bands would come and seize everything at your factory, and hire someone to protect against this, because of the work the rest of us did."—

Elizabeth Warren, 2011

1.1 Definition of infrastructure

Infrastructure is whatever facility, structure, network, system, plant, property, equipment, or physical assets emerging as vitally important, if not absolutely essential, to people having the capabilities to thrive as individuals and participate, among others, in social, economic, political, communal, familial roles – as a citizen, worker, friend, neighbor, family or household member, or customer or consumer – in ways critical to their own well-being and that of their society, and the material and other conditions which enable them to exercise those capabilities to the fullest.

It represents a critical enabler for people in the World to travel and move objects from a geographical place to another, communicate and share information from the distance and participate to all economic, social, communal, religious, household activities ennobling them as individuals and as active members of their communities. They make business creation, management and expansion possible and offer valuable contributions in terms of cost reduction and efficiency enhancing, with positive consequences on economic systems as a whole. Importantly, infrastructures are the means for people to ready access sufficient potable water and healthful food; a safe, comfortable, functional shelter; health-preserving and welfare improving medical systems. Last, infrastructure works and facilities are the essential structures providing citizens with protection from harm and other either humanly-induced or natural sources of danger; granting them the possibility to improve their knowledge, skills, capacities, expertise and experience; ensuring that they have access to enough sources of energy to engage in listed activities and enjoy related benefits. [1]

The term "infrastructure" was first used during the XX century in the military, where it came to represent the buildings and permanent installations supporting the operations of military forces, but the underlying concept was already well known to civil engineers living many centuries before. Ancient Egyptians used to build systems of transportation and irrigation of canals and dams. Their pyramids, as well as Greeks' and Romans' roads and aqueducts, have survived until today to witness the greatness of those early civilities, whose development and hence glory, were indeed brought about by their acquired capability of providing themselves with state-of-the-art infrastructures.

[1] Beeferman, Larry; Wain, Allan – "*Infrastructure – Defining Matters*" – January 2016

Modern infrastructures include roads, tunnels and bridges; railway systems; ports, waterways and canals; airports, including air traffic towers; telephone lines and cellphone towers; dams and reservoirs; hurricane barriers, levees and pumping stations; electric power lines and connections; fire stations and related equipment; hospitals, clinics, emergency response systems; schools, libraries, universities and other educational and cultural buildings; law enforcement and prisons; sanitization and waste removal facilities; post offices and mail delivery systems; public parks and other administrative buildings. [2]

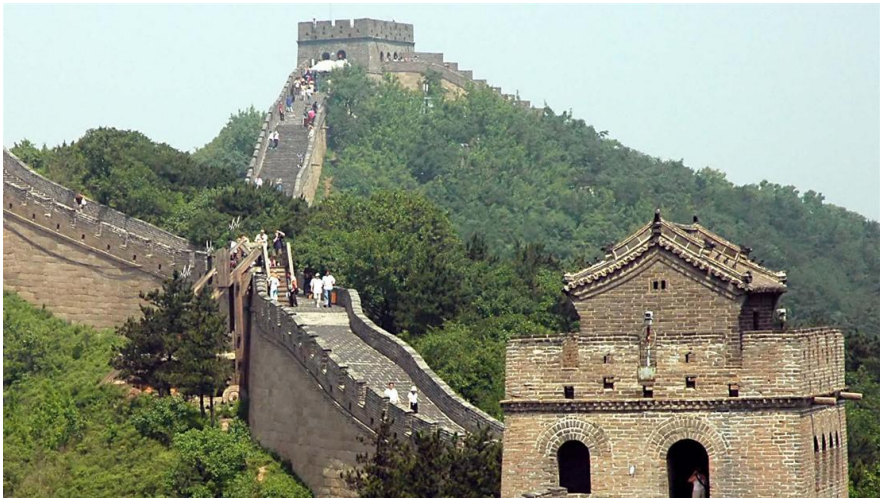
Economic systems, today as in the past, make extensive use of infrastructure, especially when it comes to expand trade, attract foreign investments and implement global value chains spanning multiple countries. Once infrastructures have been identified as a mean to offer essential services enabling social development and spurring population well-being, it comes along that one of most important measure of state leaders' achievements can be represented by the level and type of infrastructural development they engage in compared to the agitation of the people and the available resources.[3] [4]

A qualitatively and quantitatively adequate stock of infrastructures represents a real necessity for growth. Infrastructure reduces costs, supports economic activity, increases factor productivity, strengthens capital durability and connects cities to national and international markets, hence widening the scope of consumption and production possibilities of economies. In addition, it boosts employment, both directly (for building and maintenance) and indirectly (thanks to the vitality it impresses to economic systems). Infrastructure is also an important mean for social development and other important achievements, as it increases intra- and inter-regional trade, reduces poverty, increases both demand and supply for healthcare and education, improves human relationships.[5] [6] On the other side, inadequate infrastructure slows and even reverses economic growth, driving unemployment, crime, and urban decay. It can fuel urban tensions by widening divisions among ethnic or income groups or between long-time residents and recent immigrants. Infrastructure gaps can foster a general malaise that drains a city's vitality and spirit. [7]

[2] ThoughtCo – Craven, Jackie – "*The importance of infrastructure*" – March 2017
[3] Global TrendLab 2015 – "*Overcoming the infrastructure gap*" - 2015
[4] Oyedele, Olufemi Adedamola – "*The challenge of infrastructure development in democratic governance*" – May 2012
[5] The World Bank – Woetzel, Jonhatan; Pohl, Herbert – "*Infrastructure – Doing More With Less*" – May 2014
[6] Fay, Marianne; Toman, Michael – "*Infrastructure and sustainable development*" – June 2010
[7] KPMG International – Chism, Nick - "*Bridging the Global Infrastructure Gap: Views from the Executive Suite*" – January 2009

1.1.1 Infrastructure megaprojects

Major infrastructure works whose initial value supersedes one billion dollars are called "megaprojects". Megaprojects are crucial for the future of cities, states and individual livelihoods and have the power to be economically transformative and strategically essential. Having them built is all but an easy matter and often projects run out of time and/or budget. Nonetheless, their potential benefits often make it worth the effort. [8] Analyzing the economics of megaprojects is out from the scope of this dissertation, but some examples can be used to describe certain of their characteristics that can be generalized to all infrastructure works.



The Chinese Great Wall is one of the Seven World Wonders and represents, without any doubt, the infrastructure megaproject for excellence. It is the longest wall around the World with its more than 21.000 kilometers of length and was built 2300 years ago to protect China from Mongolians' assaults and to preserve the Silk Road trade. Indeed, in the past, the use of infrastructure works to define and strengthen national boundaries and identity was not rare. Actually, rather than a simple wall, it consists of an integrated defensive system with watchtowers, fortresses and beacon towers. It embodies most of typical characteristics of megaprojects: long physical life, high capital intensity, massive deployment of raw materials and labor. Today more than 30% of the original structure has disappeared due to natural and human damages but it is still one of the most important human works, attracting 70.000 visitors per day.[9]

[8] McKinsey&Co – Garemo, Nicklas; Matzinger, Stefan; Palter, Robert – "*Megaprojects: the good, the bad and the better*" – July 2015

[9] China highlight – "*The Great Wall of China – All thing you want to know*" – October 2017

The Panama Canal is one of the most renowned megaprojects of the modernity. It is an 81 kilometers long artificial canal connecting the Atlantic to the Pacific through the Panama Isthmus and allowing ships to go from one side to another of the American continent in four-to-five hours, instead of circumnavigating Southern America.[10] It accounts for a significant share of the country's GDP and has recently undergone a seven-years expansion process concluded in June 2016. The expansion project has involved 20.000 people and huge quantities of steel and concrete. While the value of goods in transit through the channel was of around $270 billion per annum until 2016, that value may be growing threefold in upcoming years, in force of the recent intervention. This is likely to bring $5 billion of revenues each year for the Autoridad del Canal de Panama (ACP), the public operator of the canal. Besides positively affecting the Panama economy and stimulate huge increases in trade flows, the new Canal is also likely to foster international and national investment in port facilities, ships and waterways.

The California high-speed rail is an 837 km long railway meant to enable high-speed bullet trains to travel from Los Angeles' Union Station to San Francisco's Transbay Terminal (along a route providing up to 24 stops) in less than three hours, giving to travelers a concrete alternative to their own cars and short-distance flights. It has taken around twenty years to design it and get necessary approvals and it is expected to be ready by 2029, after around 14 years of works. Its $64 billion value makes it one of most expensive United States' megaprojects ever and problems arising in the construction phase are not few, including political challenges from the Trump administration. [11]

[10] Nautica Report – "*Il canale di Panama*" – January 2017

[11] Curbed San Francisco – Tinoco, Matt – "*California High-Speed Rail: everything you need to know*" – November 2017

Infrastructure reveal indispensable when it comes to minimize negative effects associated to natural disasters, as they enable fast delivery of emergency supplies and medical care. On the other hand, poorly maintained infrastructure can lead to devastating losses of life and property. [2] The Italian Vajont

dam sadly represents an example of the devastating effects that may derive from bad infrastructure planning. It took three years to build, from 1957 to 1960: three years to rise up the a "portentous example of the Italian engineering". At the time, it was the highest double-bow dam in the World, with its 260 meters of height. The dam was expected to bring eulogy and prosperity. Hundreds of local people found a job in the building site. It was actually an engineering masterpiece built in the wrong place, namely beneath an unstable mountain (the Toc mountain). Indeed, on October 9th 1963, it was hit by a terrible landslide, five times bigger that what the dam could have withstand. The huge volume of rocks and debris that fell in the water caused a series on abnormal waves which flooded the surrounding area, killing almost 2000 people and causing damages for the equivalent of billions of euros.[12]

1.1.2 Infrastructure in the World

Modern economies cannot properly work and develop if they are not supported by an adequate endowment of infrastructure. Differences of World countries under this aspect are remarkable and appear consistent with their stage of economic development and social welfare. Causality runs both ways between income and infrastructure. Indeed, most infrastructure services are both consumption and intermediate goods. For example, demand for electricity, telephones and cars increase in consequence of increases in disposable income.[13] If a country succeeds in providing itself with a critical endowment of infrastructures, it will be likely to have enough raw material, skilled workers and financial resources to build new infrastructure providing further benefits.

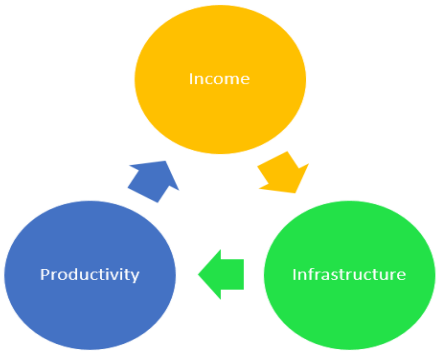


Figure 1.1 – The virtuous cycle of infrastructure and development

[12] Corriere delle Alpi – "*Vajont 1963-2013*"
[13] Fay, Marianne; Toman, Michael – "*Infrastructure and sustainable development*" – June 2010

The following chart provides a graphical representation of all countries' 2011 *per capita* stock of infrastructure

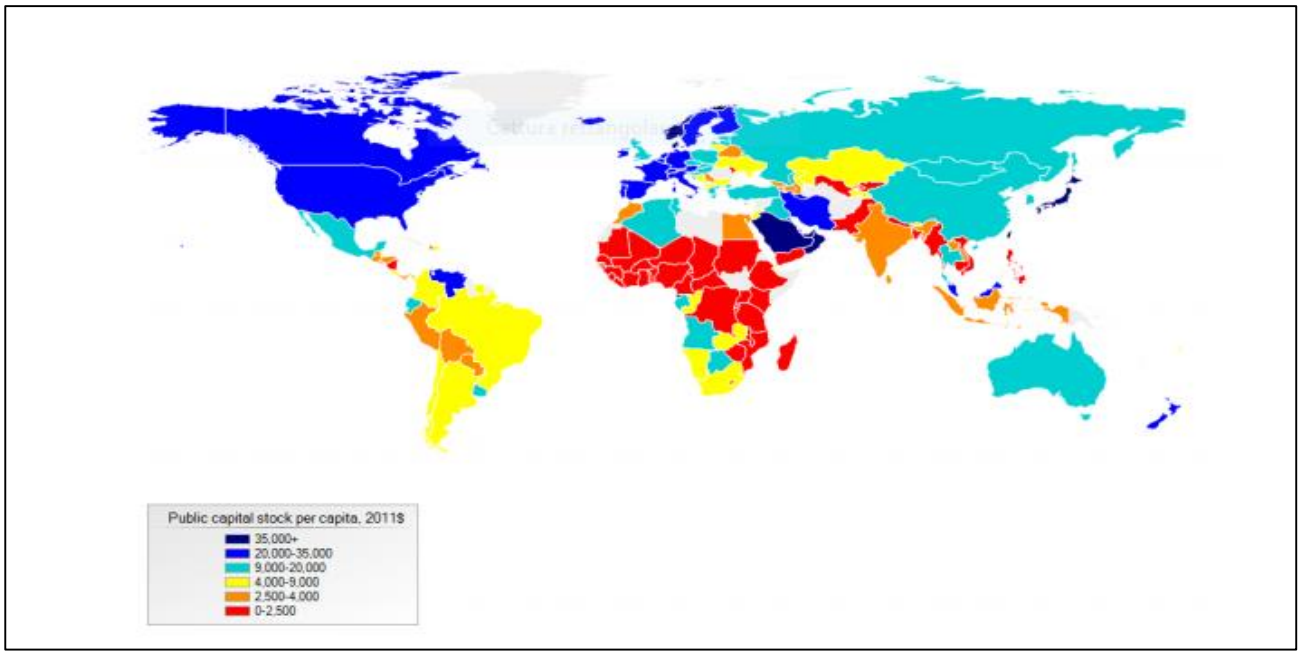


Figure 1.2 – Map of World countries' per-capita endowment of infrastructure
Source: International Monerary Fund
2011 data

From the observation of the above chart, World countries can be divided in:

- Best performers (> $ 35.000 per capita): Japan, Saudi Arabia, United Arab Emirates and Norway;
- Good performers (> $ 20.000 per capita; <$ 35.000 per capita): Most OECD countries, including USA, Canada, Ireland, continental Europe, together with Iran, Venezuela, Malaysia and few others;
- Moderate performers (> $ 9.000 per capita; < $ 20.000 per capita): Russia, Mongolia, China, Australia, Mexico, United Kingdom, Ecuador, Uruguay, Algeria and some others;
- Poor performers (< $ 5.000 per capita; < $ 9.000 per capita): Kazakhstan, Ukraine, Brazil, Argentina, South Africa, Zambia and few others;
- Very poor performers (< $ 4.000; > $ 2.500): India, Egypt, Morocco, Peru, Bolivia, Paraguay and few others;
- Almost completely unequipped countries (< $ 2.500): Pakistan, Turkmenistan, Philippines and most African countries, including Niger, Mali, Chad, Sudan, Rwanda, Ethiopia, Somalia and others.

As a complement to the above figure, the following chart represents the recorded relationship between countries GDP *per capita* and the quality of their infrastructure systems, represented by the value scored for infrastructure quality in the World Economic Forum's Global Competitiveness Index (See ANNEX B). The consistency of results with respect to the previous chart does not come unexpected, given that part of the quality of an infrastructure endowment is determined by whether it is quantitatively adequate or not, but it confirms the correlation between economic development and infrastructure development. It also reveals that countries showing the same levels of GDP per capita sometimes exhibit different levels of performance for what concerns the quality of their infrastructure system.

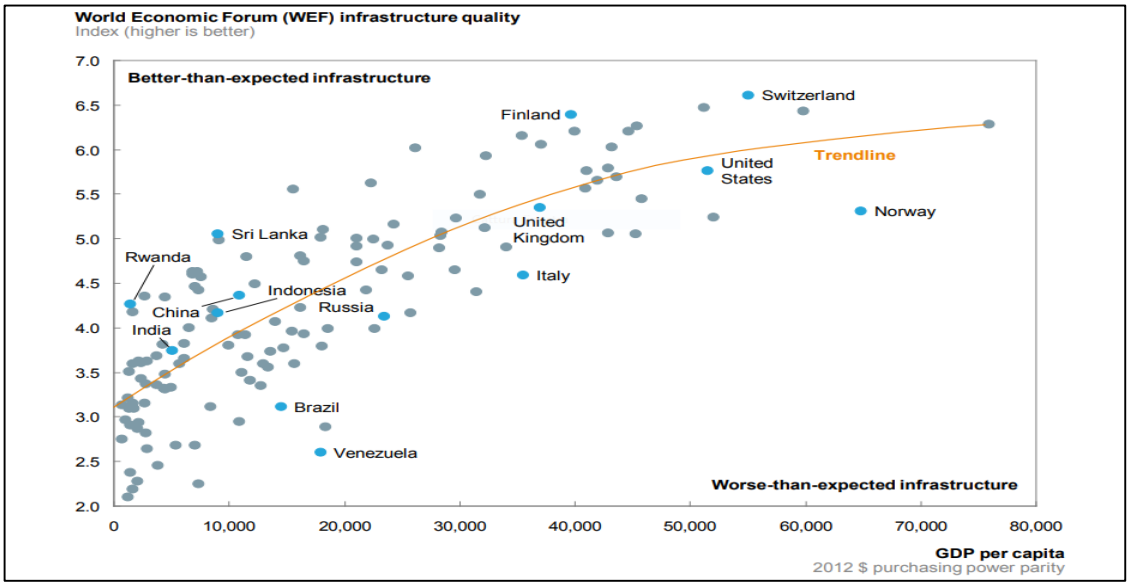


Figure 1.3 – How the quality of infrastructure systems relates to the level of countries' GDP
Source: McKinsey Global Institute 2013

To make sure that a country's infrastructure system concretely supports its economy, its management needs to be oriented toward efficience, bottlenecks to be closed and receptiveness of the economic system to infrastructure-induced positive effects to be improved by creating an active and stable social, politic and economic environment. Differences under these aspects are likely to explain why equally rich countries perform differently in providing themselves with enough valuable infrastructure facilities.

1.1.3 Sustainable infrastructure and the UN 2030 Sustainable Development Goals

Infrastructure and sustainable development share the goal to meet the current needs of the society without hampering future generations' possibility to satisfy their exigencies. In the modern World, it is hard to imagine how they could exist without each other. Infrastructure works can be said to be both sustainability maker and sustainability taker, meaning that, on one side, they represent a precious instrument to pursue sustainable development objectives, while on the other, they have to withstand

new Environmental, Social and Governance challenges, imposed by markets, governments and the surrounding environment, from which they can derive both precious opportunities and dangerous threats. Sustainable infrastructure works have to be intended as sustainable under the social, economic and environmental points of view. Socially sustainable infrastructures are inclusive and respect human rights. They are expected to meet the need of the poor by increasing access, supporting poverty reduction and reducing vulnerability to climate change. Economically sustainable infrastructure provides job and boosts GDP. It does not burden governments with unpayable debt or users with excessive charges. It also seeks to strengthen capabilities of local suppliers and developers. Environmentally sustainable infrastructure mitigates carbon emissions during construction and operation and contributes to the transfer to a low carbon economy. It is resilient to climate change risks and also addresses local environmental challenges, especially the assurance of water supply and quality of air. Sustainable infrastructure can also employ different ways of meeting infrastructure service needs, such as demand-side managements systems and responsive power grids. [14]

United Nations 2030 Sustainable Development Goals represent an excellent benchmark to assess the potential positive effects of infrastructure works for economies and societies. These are a set of goals adopted by United Nations in September 2015, with the view to end poverty, protect the planet and ensure prosperity for all. Each goal is subdivided in a set of specific targets to be achieved from 2015 to 2030. [15] As critical providers of direct and indirect social, economic and environmental benefits, infrastructures can contribute to a different extent to the achievement of all these goals, besides being explicitly taken as the object of goal 9 (Industry, Innovation and Infrastructure).

Figure 1.4 – The United Nations 2030 Sustainable Goals

[14] McKinsey Global Infrastructure Initiative – Bielenberg, Aaron; Kerlin, Mike; Oppenheim, Jeremy; Roberts, Melissa - "*Voices on Infrastructure – Novel Solutions -> Financing Change: How to mobilize private sector financing for sustainable infrastructure*" – March 2016

[15] United Nations Official Website – "*Sustainable Development Goals – 17 goals to transform our World*"

First of all, by definition, infrastructure includes both traditional and renewable energy producing facilities (goal 7); hospital, clinics, medical centers (goal 3); tribunals, jails and police stations (goal 16). It is clear how these goals cannot be pursued if not through suitable institutions supported by adequate infrastructure systems.

Infrastructure sustains growth, employment and competitiveness (goal 8), enhancing both the short-term aggregate demand and the long-term productivity, hence resulting in higher income. According to a study of the International Monetary Fund on a sample of developed economies, devoting an additional 1% of GDP to infrastructure investing can make them earn an additional 1.4% of GDP in the same year and an additional 1.5% for each of the four subsequent years. Standard and Poor's estimates that the infrastructure investment multiplier on GDP is 1.4 for Italy, 2.5 for USA and 1.7 for UK.[16] According to McKinsey Global Institute, instead, in the long run, investments in infrastructures may have a socioeconomic return of 20%, thanks to boosted productivity, while some well-chosen works may show a cost-benefit ratio up to 1:20.[17] About employment, infrastructure has remarkable cross-industry spin-offs and hence creates jobs both directly and indirectly. The International Labor Organization has estimated that each billion dollar spent in developed countries on infrastructure can create up to 28.000 new jobs. According to the US Department of Transportation, for example, one billion dollar invested in federal highway and traffic scheme can create 13.000 jobs for one year, including jobs directly required by the projects and jobs created by increased demand for raw materials.[18]

Infrastructure favors social progress, education (goal 4), equal opportunities (goals 5 and 10) and welfare, as it grants access to basic social services which improve literacy and provide better life opportunities also for the poorest share of the population. A recent US-based study[19] has shown a negative correlation between investments in infrastructures and income inequality, observing a 0.003 reduction of the Gini coefficient of a country, on average, for each 7% increase on the public expense allocated to infrastructure, *ceteris* paribus. The study has compared, for each US state, the value of the Gini coefficient in different moments and the flow of investments in mobility and educational infrastructure during the previous ten years, along the 1950-2010 period. Said negative correlation has emerged to be even stronger for the 40% lowest income population. If this is true, an adequate infrastructure stock can even help to reduce social plagues arising from income inequality, like

[16] Laboratorio Infrastrutture Bocconi-Autostrade per l'Italia – "*Tavola Rotonda: Infrastrutture per la competitività: selezione, risorse, regole*" – January 2015

[17] McKinsey Global Institute in collaboration with McKinsey's Capital Projects and Infrastructure Practice– Woetzel, Jonathan; Garemo, Nicklas; Mischke, Jan; Hjerpe, Martin; Palter, Robert - "*Bridging Global Infrastructure Gap*" – June 2016

[18] Chatham House Report – Subacchi, Paola; Pickford, Stephen; Tentori, Davide; Huang, Helena – "*Building Growth in Europe: Innovative Financing for Infrastructure*" – September 2014

[19] Hooper, Emma; Peters, Sanjay; Pintus, Patrick A. – "*To what extent can long-term infrastructure reduce inequality?*" – March 2017

criminality and political apathy. In addition, the desirable effect of infrastructure investments on social inequalities can be expected to be much stronger in underdeveloped countries.

Goal 9 is about clean water and sanitization. Currently, in the World, one person out of nine has no access to safe potable water while 2,5 billion people have no access to proper sanitization. As a result, around 840.000 people die every year for consequences related to drinking dirty water or to unsafe wastewater management, which are in turn the cause of most illnesses in emerging countries. Building wells, pipes, depuration facilities and sewage pipes is the only way (necessary but not sufficient) to prevent water crisis in the World.[20]

Infrastructure can play a relevant role also in reducing poverty and hanger (goals 1 and 2). As much as 40% of food produced in Africa perishes before achieving markets where it should be sold, with terrible consequences for the already critical level of starvation concerning African countries. [21] Good roads would fix most of the problem, above all if coupled with an adequate and constant water supply.

The so called "green infrastructure" offer direct support to environmental protection (goal 13). It is the case of renewable energy producing plants, including solar power plants and wind farms. Infrastructure also provide indirect support to environmental protection. When plentiful high-quality infrastructures are there, citizens are incentivized to opt for environment friendly solutions, like choosing public means of transport rather than individual means of transport or using trains rather than private cars and airplanes, for middle distances (goal 12). Further, new or updated roads reduce congestion and related toxic emissions.

1.2 Infrastructure industrial sectors

Infrastructures support several business activities that could not be otherwise performed, and are hence essential assets in some network industries. A distinction can be made between economic and social infrastructure, according to the type of service they assist in supplying. The two categories tend to behave differently under several points of view, including the degree of public involvement and the risk borne by the infrastructure operator.

1.2.1 Economic infrastructure and utilities

Generally speaking, economic infrastructure and utilities are potentially self-sustaining businesses, under the financial point of view. In recent decades, they have seen an increasing commitment of the private sector for what concerns ownership, funding and operations. Utilities supply public essential

[20] Weber, Barbara; Staub-Bisang, Miriam; Alfen, Hans Wilhelm – "*Infrastructure as an Asset Class - Investment Strategy, Sustainability, Project Finance and PPP*" – II edition – Wiley - 2016

[21] Bocconi PPP monitor; BCG – "*Le infrastrutture hanno un grande ruolo economico e sociale*"

services including the provision of electricity, water and natural gas. The essentiality of supplied services induces strong dependence from both household and industrial consumers, so utilities tend to be price-regulated (see Paragraph 1.3). On the other side, they are often granted several forms of governmental support, including long-term concessions and inflation indexing of charged rates. Economic infrastructure works provide crucial services as well, but related sectors tend to work on competitive dynamics, so that the related demand is more sensitive to the short-term economic fluctuations. Economic infrastructures are mainly employed in the telecommunication and transport sectors. [22] [23]

Economic infrastructures' sectors and subsectors			
Transport	***Energy***	***Water***	***Communication***
By land -Roads -Rail networks -Public local transport **By air** -Airport service -Airline service -Air traffic control **By water** -Inland waterways -Sea -Canals -Ports **Multimodal**	**Generation** -Coal -Oil and gas -Nuclear **Transmission and distribution** -Electricity -Gas -Oil and fuels **Storage** -Electricity -Gas -Oil and fuels **Renewables** -Solar -Wind -Water -Biomass -Geothermal	**Supply** -Domestic -Industrial **Sewage** -Rain water -Domestic wastewater -Industrial wastewater **District Heating** ***Waste disposal*** **Domestic waste** **Industrial waste**	**Telecommunication** -Fixed networks -Mobile networks -High-speed internet -Towers (cell and broadcast) **Space** -Satellite network -Observation **Other services**

Figure 1.5 – Overview of economic infrastructure industries
Source: Weber, Barbara; Staub-Bisang, Miriam; Alfen, Hans Wilhelm – "Infrastructure as an Asset Class - Investment Strategy, Sustainability, Project Finance and PPP" – II edition – Wiley – 2016

1.2.1.1 Transport infrastructure

Transport and traffic infrastructure works include all the interdependent networks and facilities enabling people and goods to move from a place to another, within or outside from the starting region, country or continent. Transport can be performed by land, water, air or a combination of these (multimodal), and main transport infrastructure works include railways, road systems, highways, underground stations, canals, ports, airports, tunnels. In a not so far future, we will probably be able to include outer space transport infrastructures in the list.

Demand for transport services is high and growing and a critical level of transport infrastructure is one of the most noticeable achievements determining the development of a country. Interventions on transport infrastructure works are usually determined by political resolutions through long-term

[22] Morgan Stanley Investment Management – Bigman, Ted; King, Matt – "*Teorema di un'asset class strategica: I titoli infrastrutturali quotati nei listini globali*" – January 2016
[23] Weber, Barbara; Staub-Bisang, Miriam; Alfen, Hans Wilhelm – "*Infrastructure as an Asset Class - Investment Strategy, Sustainability, Project Finance and PPP*" – II edition – Wiley - 2016

master plans regarding the whole sector. Usually a transport ministry exists at central government level, who may be supported by additional governmental, semi-governmental or private agencies. The operators of transport infrastructures usually perform the underlying service on the basis of a long-term concession awarded by the government and enjoy related cash flows until its expiration. Cash flows arise mainly from patronage fees but some forms of governmental support can still be present somewhere. Indeed, while land and air transport are generally self-sustaining, transportation through railway is often a loss-making activity and needs to be subsidized. Customers pay for transport services either directly or indirectly. Direct contributions occur when consumers pay for a specific transport service (e.g. highway tolls, trains' and airplanes' tickets), while indirect contributions take the form of payments issued for ancillary goods or services (e.g. fuel, airport services).

The transport industry tends to be relatively pro-cyclical, with respect to other network industries, as it is continuously exposed to exchange and commerce and gets life from them. The degree of competition in related markets is potentially high, despite some sub-sectors behave like natural monopolies. When possible, the regulator has imposed unbundling to foster competition. [24] Transport systems are responsible for much of the pollution and consumption of dwindling natural resources, hence it is interested by a significant set of environmental rules.

There is a strong link between the transport industry and other important infrastructure-based industries, as the former is a massive user of energy and relies on communication technologies for the provision of transportation services. [22] [23] [25]

1.2.1.2 Energy infrastructure

Today energy is indispensable to almost all human activities, including business operations. Main sources of energy include gas, oil, coal, nuclear and various forms of renewables. Fossil fuels are still responsible for the production of 87% of World's energy and nuclear plants cover another 7%. In the category of energy infrastructure, besides nuclear plants themselves, there are either long or short-distance pipelines and grids; petrol, gas and gas derivatives collection plants; storage systems, extraction systems and many others. Several energy infrastructures, including extraction wells and long-distance transmission facilities, are particularly capital intensive and carry remarkable sunk costs.

Energy is demanded by both households and firms. Industries cover half of the World's demand while the other half is subdivided among households, transport systems and commercial entities, as shown in the following graph, reporting data from 2011. Remarkably, demand for energy has increased by 60% from 1988 to 2014, showing an annual compounded growth rate of 2,5% over a 25-year period.

[24] Unbundling occurs when the owner of an infrastructure is forced by the regulator to allow its competitors to use it in exchange for the payment of a usage fee.
[25] Colangelo, Giuseppe – "*Markets, regulation and law*" – Teaching material - 2015

Providing citizens with a wide range of energy-related goods or services coming from several sources is one of main objectives of governments.

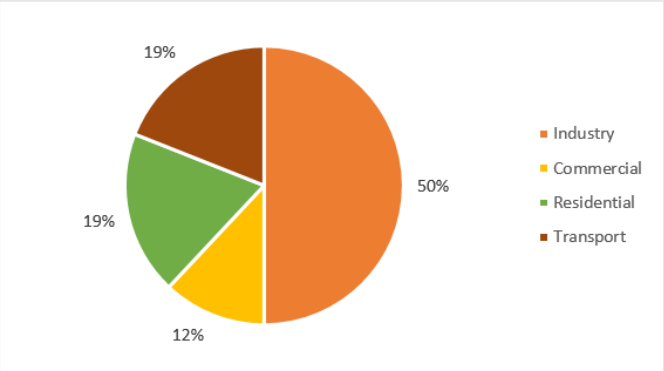


Figure 1.6 – Composition of the World demand for electricity
Source: Weber, Barbara; Staub-Bisang, Miriam; Alfen, Hans Wilhelm – "Infrastructure as an Asset Class - Investment Strategy, Sustainability, Project Finance and PPP" – II edition – Wiley – 2016
2011 data

As several sources of energy exist, the energy industry is composed by diverse sub-industries, each one characterized by a proper set of standards, technologies, inputs and outputs, regulation and infrastructure systems. Generally, each sector tends to rely on long-term contracts and to be regulated, while the exposure to raw materials' prices oscillations varies from sub-sector to sub-sector.

Electricity and gas are the main products of the energy industry. Electricity represents around 15% of global energy consumption and its usage is expected to experience a 75% increase from 2011 to 2030. The increase in demand is coming mainly from developing countries, above all China, while OECD countries are showing a stagnating demand over the same period.

Electricity is produced through other forms of energy, like heat or kinetic energy and its sources are used according to a least-costly-first criterion. Fossil fuels are responsible for 68% of the global production of electricity, hydropower for 16%, nuclear for 11%. Renewable sources, including hydropower, wind, photovoltaic, concentrated solar power, geothermal and ocean, still account for only 21% of total production (2013) but their weight over the energy sources' mix is expected to soar until covering half of the added capacity until 2050. Once electricity is produced from a primary source of energy, it is sold to energy distributors and conveyed towards its markets by Transmission System Operators through high-voltage grids that may cover interregional or international routes. After transmission, electricity is delivered to end users via both medium-voltage and low-voltage last-mile grids, according to retail contracts between end users themselves and retail distributors competing among each other. The supply-chain is still based on centralized power plants, unilateral transmission and distribution networks and reduced energy storability. Nonetheless, major changes occurring today may induce a progressive shift through an alternative model. In the future, each household or driver may be producing and selling electricity on an active market where prices fluctuate according to the interaction of demand and supply.

The electricity industry is characterized by strong natural monopoly elements, including a very inelastic demand, finite capacity and high entry barriers, hence national regulators have intervened to open the market and impose unbundling to network owners. The business is also characterized by a foreseeable cyclicality. Peak and off-peak moments alternate in the course of the days and of the year.

Gas represents both a final product of the energy industry and a source of other forms of energy. It is a highly substitutable commodity-like good whose demand is cyclical, showing peaks during cold periods of the year (final users mostly use gas for heating) and with high temperatures (peaks of gas consumption are associated to peaks of electricity consumption). The gas supply chain is supported by several infrastructure facilities including wells, storage facilities, pipelines, distribution mains. In 2014, natural gas covered 21% of global energy demand and was the third global source of energy, after coal and oil. In particular, demand for gas equals each year around 70% of demand for oil and arises mainly from USA, Europe and Russia. Gas consumption is expected to grow by a 2,8% compounded annual rate until 2030 because of increased power generation requirements but the European demand is experiencing no more than a slight increase.

Gas is extracted from natural wells or oil reservoirs and is usually processed in the proximity of the well to fulfil purity standards. Then, as it occurs for electricity, it is transmitted through high-pressure pipelines to retail sellers and distributed to end-users via low-pressure pipes. Given that transmission is generally performed through pipelines (68%), it can also be substituted by sea shipment of liquefied gas, although this is not a cost-effective choice. Storage is an important stage of the gas supply chain and differentiates it from the electricity supply chain, where it is still a marginal activity. Storage is performed underground in caverns, depleted reservoirs and aqueducts and allows to smooth price volatility, buffer supply and demand swings and keep an adequate supply always secure.[22] [23] [25]

As partly aforementioned, the most forecastable trend interesting the energy industry is the shift toward a model of production and consumption heavily relying on renewable sources of energy. Indeed, fossil fuels are on the path of depletion, they have volatile prices and are often located in politically troubled countries. In addition, public awareness about environmental consequences of the massive use of polluting sources of energy is increasing and there is agitation for the actual use of alternative sources.[26] As a response to this, by 2017, half of all infrastructure deals undertaken globally have been concerned the sub-sector of renewable energy, similarly to what has occurred in the previous years and consistently with a trend that has led to a 9% increase of the average yearly number of renewable energy infrastructure deals over last ten years.[27]

[26] Quercus–Renewable Energy – "*Investimenti infrastrutturali: una asset class attraente per I fondi pensione*"
[27] Prequin – "*2017 Infrastructure Deals*" – January 2018

1.2.1.3 Water infrastructure

Water is essential to human life, economic activities, health protection and wellness. Important infrastructures supporting this sector are wells, treatment plants, pipes, sewage plants, storage facilities, cisterns. Demand for water is expected to be growing by 50% during next ten years. Its 2014 composition is shown in the pie chart below.

The water supply chain takes its steps from the natural cycle of water precipitation and evaporation. Water is collected from lakes, rivers, springs, wells and groundwater sources and is channeled towards treatment plants where it is chemically treated according to its purpose. Than it is conveyed through final markets, where it is sold to customers and distributed through pumps. Once water has been used, it is handed back to the system in the form of wastewater and is brought by separate pipes to sewage plants, where it is physically, biologically and chemically treated before reusing it or discharging it into the sea.

This sector shows all the features that characterize a natural monopoly. Initial sunk costs are extraordinarily high in comparison with other infrastructure-based businesses and the combination between the regional coverage of distribution plants and decreasing marginal costs create high entry barriers. Therefore, the water industry is generally heavily regulated, especially on the basis of its inner essentiality for human life. Regulation aims at imposing universal service obligation, promoting efficiency and innovation and ensuring the stability of the service. Regulation may involve typical micro-economic regulatory tools like price-caps and rate-of-return regulation or self-regulation systems imposed by awarding multiannual concessions through tendering processes. Alternatively, the public sector can ensure consumers' welfare maximization through full or partial ownership of water utilities. Regulation is defined at national level but governance of water utilities has traditionally occurred at municipal level with some financial assistance from the central government.

Today, in the World many people have no access to clean water or suffer from illness related to scarce sanitization. By 2025, two thirds of the World's population are expected to be suffering from stress water conditions. This issue concerns especially underdeveloped countries, which are needing stunning investments to meet any standard of sufficiency, as some of them lack most basic infrastructures to ensure water provision. The estimated amount needed to close the "water gap" ranges from $200 billion to $1000 billion a year. This amount should also be deployed to enable countries to renovate old systems which cause every year the loss of astonishing quantities of water that could be otherwise used.

The percentage of leakage ranges from a modest 7% of Germany to an unacceptable 29% in Italy. [22] [23] [25]

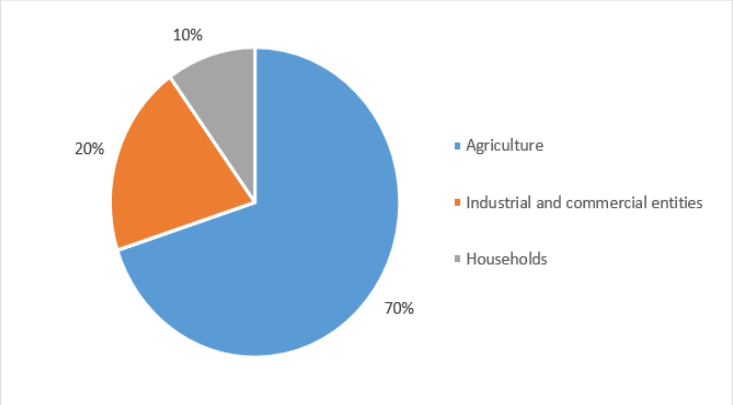


Figure 1.7 – Composition of the World demand for water
Source: Weber, Barbara; Staub-Bisang, Miriam; Alfen, Hans Wilhelm – "Infrastructure as an Asset Class - Investment Strategy, Sustainability, Project Finance and PPP" – II edition – Wiley – 2016
2014 data

1.2.1.4 Waste management infrastructure

Broadly speaking, waste is whatever object, substance, residue or leftover that anyone wants to get rid of. It can be defined as a good that has given away its utility and has been expelled from the process of production or consumption. Solid waste (as opposed to wastewater and industrial liquid collateral products) is produced by industries, mining, construction and municipalities. Municipal waste comes from households, commercials and municipal services. In Europe, production of solid waste has increased from 60 kilograms per person in 1950 to 480 kilograms per person today, meaning an overall yearly quantity of 2,5 billion tons.

Infrastructure works enabling waste management are above all transfer plants, landfills and treatment plants. Their investment cost is relatively low. The waste management supply chain can be divided in two macro-activities: collection and treatment. Collection involves separation, gathering and first transport of waste. The treatment of waste differs according to the nature of waste itself and is performed in specific treatment plants to minimize the environmental impact.

As for electricity, water and communication, the waste sector has traditionally been run by public entities, at municipal or regional level, until 1990s, when several sectors were privatized and liberalized to different extents. The collection phase is often characterized by sizeable economies of density, depending on the number of withdrawal points in any given area. Economies of density significantly lower the marginal cost of gathering waste and progressively rule out the economic feasibility of in-the-market competition. Therefore, while competition may be in place for industrial and commercial users, companies performing waste gathering for households usually face for-the-market competition. This is consistent with low incumbents' market power, low sunk costs, an easily assessable quality of the service and low information asymmetries. This is not the case of the disposal and treatment activities, instead, where sizeable sunk costs are faced by incumbents. They often enjoy economies of scope when several categories of waste can be processed in the same plants and may face in-the-market competition although the sub-sector shows higher entry barriers. Revenues enjoyed

by waste management operators arise from both final users and governments' payments. Price schemes can be either single-tire or multi-tire and vary substantially among countries.

Waste management and disposal is an important service involving several environmental and ethical considerations. Conceptually speaking, the existence of waste itself may be seen as the result of an inefficient process involving a double cost, namely the cost of producing and the cost of disposing. Landfills are often overexploited and sometimes they lack protection systems to avoid that polluting substances achieve groundwater and hence humans and animals. Moreover, the main way to get rid of waste is burning it. This cause polluting and carcinogenic gases like dioxin to spread in the air.

Some specific categories of waste can be used to produce electricity by exploiting the energy resulting from the burning process. This occurs in the context of the so-called thermo-valorization process. Waste that can participate as an input of this process are plastics and other petrol derivatives, purposely chemically and physically treated. Other categories of waste that could contribute to energy generation is organic waste, whose controlled degradation can be used to produce biogas. The diffusion of this kind of practices may help in reducing pollution and provide new more sustainable sources of energy. Hopefully, in the future, the quantity of waste that will be converted into energy and raw materials or reused will represent a big portion of the total waste produced.

Developing countries are pursuing the goal to minimize waste environmental impact by minimizing the quantity of waste that is actually produced. This goal is embodied in a globally agreed on hierarchy of activities, identifying preferred treatments for waste and treatments to be pursued on a residual basis. The hierarchy has the goal to reduce waste, at first, and then reducing the environmental impact of the (hopefully reduced) waste that is still produced. The hierarchy has been adopted in Europe since 1980, together with the precautionary principle, the polluter pays principle and the cooperative principle. The interaction of these principles puts the responsibility for the negative effects that a product may have for the environment during its whole life and its disposal on the producer, who is required to minimize impact in conjunction with all involved subjects, including but not limited to customers, governments, distributors.

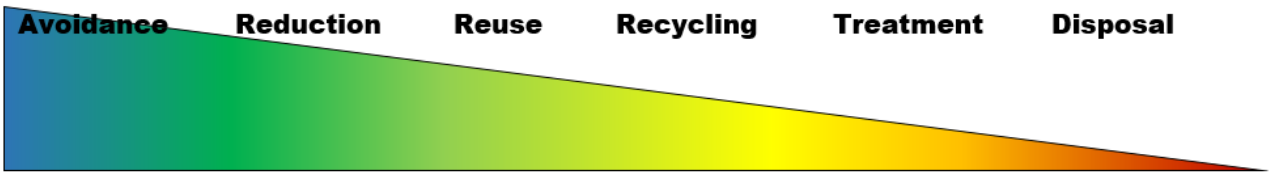


Figure 1.8 – Waste management hierarchy
Source: Weber, Barbara; Staub-Bisang, Miriam; Alfen, Hans Wilhelm – "Infrastructure as an Asset Class - Investment Strategy, Sustainability, Project Finance and PPP" – II edition – Wiley – 2016

Also the waste management sector is concerned by a gap between demand and supply. The urban rate of waste collection still ranges from only 10 to 40% in poorest countries and around 85% in developing ones.[23] [28]

1.2.1.5 Telecommunications infrastructure

Communication is the transfer of information from a source to a recipient according to an established connection. Telecommunication is communication performed through cables, radio of whatever optic or electromagnetic system. A telecommunication system allows several terminals (phones, mobiles, computers and other devices) to communicate with each other thanks to network systems including intermediating nodes.[29] The telecommunication industry offers a wide range of services to businesses and consumers and is gaining growing importance because of the advent of the so-called digital revolution. People can now have constant access to a virtually unlimited flow of data and information and get in contact with each other at any moment and from any place in the World. A situation like this would have been unthinkable a few decades ago. During last ten years, fixed and mobile networks' subscriptions have soared in almost all World countries and broadband networks have remarkably spread. Currently, more than five billion people own one or more SIM cards.

The telecommunication sector is supported by capital-intensive essential infrastructures, including wirelines, towers, wireless technologies, broadband networks. Network quality is an important element of discrimination among service providers. The inclusion of the sector within the category of listed infrastructure industries is anyway not unanimously recognized, given that the industry works according to traditional competitive dynamics among (usually few) market players, which put in place strategic behaviors and marketing strategies to create their own identity, retain customers and increase their customer base. Customers' experience management takes on average 68% of telecom companies executives' efforts. The sector is completely self-sustained and the public intervention emerges only in its role of regulator. Regulation is aimed at ensuring universal service obligation and unbundling, so that any operator willing to enter the market can rent the use of incumbents' networks. One of the most important principles imposed to telecommunication operators is net neutrality, providing that information must circulate democratically on the internet without any manipulation or paid premium treatment.

Infrastructure widening and upgrade is an important necessity of telecom companies' managers. Breakneck changes having interested the industry during last decades, disruptive innovation and changes in consumers' preferences have imposed to accommodate a much bigger quantity of more complex requests. In developed countries, increased competition has lowered the overall cost of

[28] Ecoage.it – "*Energia dai rifiuti*"
[29] Uniroma2 - Salsano, Stefano – "*Reti di telecomunicazione 1*"

telecommunication services and customers have shifted their demand from calls to data. Data flow has increased by 55% from the end of 2015 to the end of 2016. Most important goals for the future are the empowerment of outer space communication systems and ultra-fast broadband World coverage. [30] [31]

1.2.2 Social infrastructure

Social infrastructure works are considered as a category of infrastructure on its own, allowing for the provision of social services. Social services are an important component of public expenditures in countries' GDP. They are purchased by governments through public budgets and made available to the whole population. Every taxpayer pays for them and whoever can take advantage of them, possibly subordinately to the fulfilment of certain conditions. Most social infrastructures are still under the government control and ownership, as the management of social infrastructure operations is meant to enhance welfare and pursue social goals, rather than financial ones. This translates in the application of an availability-based payment scheme or mixed schemes including a small contribution from the final users, who are usually required to cover much less than the economic cost of the service supplied. Social infrastructures are mainly present in the following sectors:

- *Health*: hospitals, clinics, surgeries, elderly housing, diagnosis
- *Education*: schools, universities, libraries, theatres, museums, students' housing, cultural centers
- *Public administration*: buildings and offices, administrative facilities
- *Security and justice*: police stations, firemen stations, tribunals, jails, barracks
- *Social housing*

Lately, also social infrastructures are experiencing an increase of the private sector's commitment, especially in the education sector. Investing in social infrastructures can be assimilated to the investment in government long-term bonds, as they show both the lowest risk and the lowest expected return within the asset class of infrastructure. Social assets are characterized by very low asset specificity. This means that their economic destination can be modified *in itinere* without great difficulty and low cost. It is the case of an administrative building that is adapted to become a school or a dismissed barrack that starts to be used as a sport center. Low asset specificity screens investors against changes in demand that may arise because of demographic, technological and regulatory changes, hence increasing the predictability of future demand. [23]

[30] Wired – Parlangeli, Diletta – "*7.5 miliardi: nel mondo ci sono più SIM che persone*" – March 2017
[31] EY – "*Global telecommunication study: navigating the road to 2020*" - 2015

It is worth noticing that some exceptions are there in the grouping of the infrastructure sub-sectors that are traditionally considered social industries. The health system is a case in point. The World Health Organization has defined the universal health coverage as a system where everyone has access to quality healthcare and is protected from the financial risk associated to accessing it. Currently, 32 out of 35 OECD countries have adopted health systems consistent with this definition. Around the World, health systems are subdivided in single-payer and two-tier systems, according to the degree of government support received by citizens for the coverage of medical expenses and to the extent to which people are used to ask complementary coverage from insurance companies. In single-payer systems, the State funds a wide range of medical services through tax revenues. It is the case of Sweden, where the government ensures that no more than the equivalent of $100 per annum is paid by citizens for healthcare. In Germany, workers contribute up to 15% of their salaries to sickness funds and so in France, where medical expenses are first paid by individuals and then totally or partially refunded. In two-tier systems, governments grant limited support to more strictly selected categories of citizens and the coverage is often complemented by private insurance contracts. In Australia the insurance health coverage is optional but 57% of adult citizens have one, as most people has to pay even to see a general practitioner or for ambulance services. In some countries insurance coverage is mandatory and people are legally required to sign either a public or a private insurance health coverage policy. In Japan, employers usually pay for the health insurance of their employees but if they don't, individuals have to provide themselves with insurance coverage. In the United States some special insurance regimes exist since mid-1960s for elderly and poor people but insurance coverage is mandatory and a penalty is charged to transgressor. In 2011, under the Obama administration, the United States health system got closest than ever to resemble WHO's universal health coverage but costs are now on the path of increase and uninsured people are about 26 million. In addition, president Trump has showed the intention to abolish the former Obamacare and to actually reduce back the public support. This threatens to further increase the number of uninsured in United States.[32]

1.3 Competition regulation in infrastructure-based network industries

Most infrastructure industries are structured as network industries: their existence is based on a physical or virtual network to which customers need to attach in order to benefit from the underlying service, like a power grid, a gas pipeline, a water main. Network industries enjoy network externalities and sizeable economies of scale. The formers determine a tendency of larger networks to grow faster than smaller ones, while economies of scale determine a progressive reduction of the total average

[32] The Guardian – Holder, Josh; Torpey, Paul; Cage, Feilding - "*How does US healthcare system compare with other countries?*" – July 2017

cost of providing the service as the customer base increases, given that the provision of an additional unit of the service comes to carry a negligible cost. Infrastructure usually have a relatively high capacity and before congestion, no would-be competitor can approach the market with a reasonable hope to earn a fair return on its investment. In addition, infrastructure works provide essential services whose demand tends to be inelastic. It means that final consumers tend to under-react to increases in prices at most by reducing their level of consumption, but less than proportionally.

All these factors, together, impress a natural monopolistic structure to most infrastructure sub-sectors, pushing players toward concentration and granting them some market power and monopolistic rents. The more an industry tends to be concentrated and the lower the degree of choice that final customers have about whether purchasing the underlying service and from whom, the more incumbents will be likely to act within a regulated environment. As a direct consequence, players in infrastructure industries often operate within the regulated firm framework, according to which the regulator sets a target level for any key parameter, such as the allowable maximum price, and applies a *laissez-faire* approach to all other economic and strategic choices that infrastructure operators are to take. Regulatory authorities can exert their power through far reaching *ex-ante* instruments like price and product approval.[33]

Regulators pursue the goals of contributing to create a stimulating environment for sufficient investments, in order to supply the optimal level of capacity and output, and promote efficient management to minimize costs and then prices for final users. Another goal, logically linked to the first two, is the one of ensuring full coverage of costs faced by the supplier and a fair rate of return on its investments. In summary, the regulator is responsible to create a surplus-maximizing regulatory environment. Surplus is given by the sum of consumers' and producers' surpluses, added with government's tax surpluses. Often, a greater weight is attributed to consumers' surplus. This may even culminate in the total indifference toward producers' surplus or, in extreme cases, in a politically-driven downward pressure on regulated firms' profits. Moreover, governments are likely to have much broader public interest objectives than those set for regulators. Instructions to regulators have to be straightforward and clear to enable good regulation and avoid confusion, but the underlying problem is likely to be multifaceted. For what concerns infrastructures, complexity is induced, among other things, by the fact that infrastructure investments present both positive and negative externalities interesting several subjects, as well as possible shadow pricing problems. For example, each new infrastructural investment impacts consumers' choices among substitute facilities and is likely to show

[33] Weber, Barbara; Staub-Bisang, Miriam; Alfen, Hans Wilhelm – "*Infrastructure as an Asset Class - Investment Strategy, Sustainability, Project Finance and PPP*" – II edition – Wiley - 2016

both negative and positive environmental impacts. [34] All these consequences have to be taken into account while designing a regulatory policy. Regulators act on behalf of the government through the issuance of statutory provisions and ordinances, usually on an industry-specific basis. Line or network-based industries whose network is hard to replicate are more likely to be influenced by regulation. This is the case of most industries where infrastructures are present, like telecommunication, transportation, gas, oil, water, power. According to the impacted parameter, regulation systems can be divided in volume, price and revenue regulation, where price regulation can be either price-cap regulation or rate of return regulation. In all cases, regulatory schemes are affected by drawbacks and problems like asymmetric information, difficulties in estimating parameters (e.g. costs) and assessing the quality of a service.

Volume regulation occurs when the regulator limits the number of players in a market by subordinating the access to licenses and concessions, like in the case of taxi cabs and tobacco sales. It is also the case of service obligations or prohibitions introduced to extend or reduce the size of the market. Infrastructures operators are often interested by the universal service obligation. This provision regards essential services that are economically self-sustaining but turn unprofitable under certain time and/or space circumstance. Given that said services are important for the whole community, independently from the supplier's profit, the universal service obligation leaves no room for cherry-picking and protects weakest citizens from negative effects of market liberalization by imposing the operator to run the business in both profitable and unprofitable conditions and to always apply a reasonable price for the underlying service. For example, connecting poorly populated peripheral areas to each other may be unprofitable but the regulator is likely to be willing to make sure that the service is granted anyway at the regular cost of a bus ticket. In this case the operator may be asked to cross-subsidize loss-making activities with profits earned by performing profitable activities. Otherwise, he could receive subsidies from a public body interested in insuring the provision of the concerned service. For its nature, volume regulation may generate monopolistic position by rising institutional entry barriers.[35]

Price regulation operates through the imposition of price caps, corresponding to the maximum yearly increase of the price charged by the utility to final consumers. The price-cap is set for a three-to-five-year period for a given basket of services. Using the basket price as referral allows the operator to change prices within the basket as he likes, as long as the average percentage increase does not exceed the price cap. Price regulation is sometimes defined as incentive regulation, because once the

[34] Seventh Conference on Applied Infrastructure Research – Forsyth, Peter - "*Infrastructure regulation and investments*" – October 2008

[35] Colangelo, Giuseppe – "*Markets, Regulation and Law*" – Teaching material - 2015

price is fixed, the enterprise is incentivized to increase efficiency in order to retain all consequent savings. A price cap formula is a mathematical tool to determine the price constraint that the regulated firm faces over a given period and is usually represented by the formula: $P_t^B \leq P_{t-1}^B * [1 + (RPI - X + K + Q)$, where $1 \leq t \leq n$ and *n* equals the years of validity of the cap. The formula suggests that the price of a given year (P_t^B) cannot be higher than the price applied the previous year (P_{t-1}^B) adjusted by three increasing factors and one decreasing factor. The initial formula provided only two adjusting factors, namely the RPI factor and the X factor. The former compensates the effect of inflation and allows the utility to pass through the associated increase in the general level of prices on the fees charged on final users. The latter is responsible for a decrease in the price levied due to the alleged improvement of the firm efficiency over the chosen period. The co-existence of these two factors is supposed to transfer on the price cap the interaction between the increase of inputs cost and the increase of their productivity for the firm.[36] About the last two factors, the K factor takes into account the increase of the size of the network while the Q factor is an incentivizing factor that remunerates the utility for enhancements in the quality of services provided. It is expected to prevent the company from increasing its profits by cutting on quality rather than by increasing efficiency.

Rate-of return regulation sets the maximum price a company can charge according to a cost-plus scheme. The economic cost sustained by the utility to provide a service is increased by a factor that represents, in the intentions of the regulator, a rate of return that is fair enough to compensate the utility for the risk borne in performing its activity. This scheme reduces risks for utilities but is hard and costly to apply, as the regulator will need to gain insights about the cost structure of the operator. Moreover, given that the rate of return is equal to the ratio between earnings and the invested capital, rate of return regulation may cause overinvestment patterns, as an increase in invested capital causes a direct increase in the absolute value of allowed earnings. This is called Averch-Johnson effect. Another drawback of the rate of return regulation is that it eliminates the incentive to operate efficiently, as all incurred costs will be possibly passed through to consumers by increasing prices.

Revenue cap regulation is not so different from price cap regulation, with the exception that the constraint is put directly on revenues earned year by year by the utility on a given basket of services and only indirectly on the price set. The revenue cap formula is the same of the price cap and the company is still free to change prices within the basket, subordinately to the fulfilment of the regulatory constraints imposed. The main difference is that, in this case, final users face the demand risk, as the company will increase prices to achieve the maximum allowed revenues if demand falls.

[36]Tosato, Domenico – *Economia dell'organizzazione industriale - "La regolamentazione del monopolio"* - 2009

Revenue cap regulation is more appropriate that price cap regulation when variable costs are relatively low. [37] [38]

1.4 The infrastructure gap: where we are and where we need to go

Around the World, sizeable demand for both economic and social infrastructure exists, as infrastructure represents a key location factor and growth driver for all economies. Demand for infrastructure investments to face the great challenges that the XXI century is bringing about, including the call for sustainable development, is expected to grow as sizeable as never in the history of humanity. The new challenges that will drive it upward are growing demographic trends, migration from rural to urban areas as well as international migration, and the rise of the middle class of consumers. *I*nfrastructure needs are gigantic if compared with the projected increase in the World population from now to one century to come. Starting from the October 2017 World population count of 7.5 billion people, the number of men and women on the Earth is expected to achieve 8,6 billion units in 2030, 9,8 billion units in 2050 and 11,2 billion units in 2100. This remarkable increase is expected to arise mainly from emerging and underdeveloped countries, especially India, China and Nigeria, whereas the lengthened average life expectancy in developed countries is coupled with fading nativity rates.[39] Further the rural-urban migratory flows of estimated 1,5 million people per week, interesting especially catching up countries like China and India, will induce an increase of the World urban population of 1,5 billion people by 2030. By that time, the World is expected to have almost 50 cities counting more than 10 million people and up to 200 cities inhabited by 5 to 10 million people. There will be not just an increase in population, but people are rather expected to be better educated and increasingly mobile, hence to need more and better infrastructure to accommodate their new multifaceted needs. [40] In addition, in the closest future, infrastructure should be implemented in poorest countries to face the necessity to raise 800 million people from extreme poverty conditions. [41]

[37] Body of Knowledge on Infrastructure Regulation – "*Basic forms of regulation*"
[38] Unipi – "*Il nuovo metodo tariffario idrico (modelli di regolazione per un monopolio naturale)*"
[39] ASVIS – Persichetti, Lucilla - "*L'ONU aumenta le sue stime per la popolazione mondiale: 9.8 miliardi nel 2050*" – June 2017
[40] Forbes – Refoy, Jonathan – "*What's Driving Demand for Infrastructure and Innovation?*" – September 2013
[41] Global TrendLab 2015 – "*Overcoming the infrastructure gap*" – 2015

Nonetheless, in last decades, insufficient investment patterns, economic downturns and poor maintenance of existing assets have progressively dug a gap between infrastructure demand and supply, with the former growing at a faster rate than the latter. The share of countries' GDP devoted to infrastructure investing has shrunk in almost all World countries, during last decades, as both industrialized and emerging countries' governments have neglected the fundamental exigence of ensuring a quantitatively and qualitatively adequate endowment of infrastructure and of letting resource flow toward related sectors.

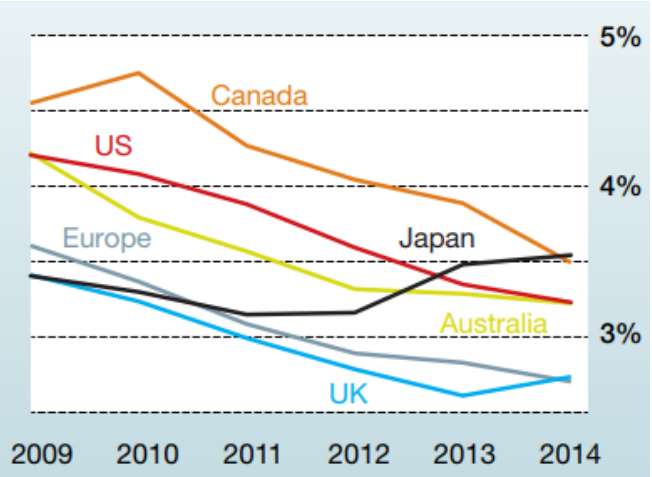


Figure 1.9 – Evolution of the public commitment toward infrastructure investments (% of the gross capital formation)
Source: McKinsey Global Institute 2016
2009-2014 data

Epic traffic jams, bottlenecked ports, blackouts, deteriorating dams, and tainted water supplies are clear signs that the World's infrastructure-related needs cannot be deferred indefinitely and that most countries need to take serious actions to avoid the creation of significant shortages and the worsening of existing ones.

The global demand for economic infrastructure and utilities is expected to average $3,3 trillion a year until 2030, corresponding to 3.8% of World GDP and summing up to around $49 trillion. Demand for power infrastructure has the lion's share, followed by demand for roads, water systems and telecom infrastructure. Transport infrastructure, including roads, rail, ports and airports, make up almost 40% of global demand. The exact composition of expected demand is summarized in the table below. The estimations here proposed are based on the assumption that demand for infrastructures needs grow along with the growth of the global GDP. [42]

Sector	Average annual demand (trillion $)	2016-2030 demand (trillion $)	%*
Power	1,0	14,7	30
Roads	0,8	11,4	23
Water	0,5	8,3	17
Telecom	0,5	7,5	17
Rail	0,3	5,1	10
Ports	0,1	1,3	3
Airports	0,1	0,9	2
World	**3,3**	**49,1**	**100**

Figure 1.10 – Composition of the World demand for infrastructure investments
Source: McKinsey Global Institute 2016

[42] McKinsey Global Institute in collaboration with McKinsey's Capital Projects and Infrastructure Practice– Woetzel, Jonathan; Garemo, Nicklas; Mischke, Jan; Hjerpe, Martin; Palter, Robert - "*Bridging Global Infrastructure Gap*" – June 2016

From 1992 to 2013, World countries have spent each year, on average, the equivalent of 3,5% of the World GDP in infrastructures. Transport infrastructure has received the biggest share of investments, followed by power, telecom and water infrastructure, consistently with the structure of the global demand. The following figure provides a graphical representation of the data about the World regions' infrastructure investment pattern.

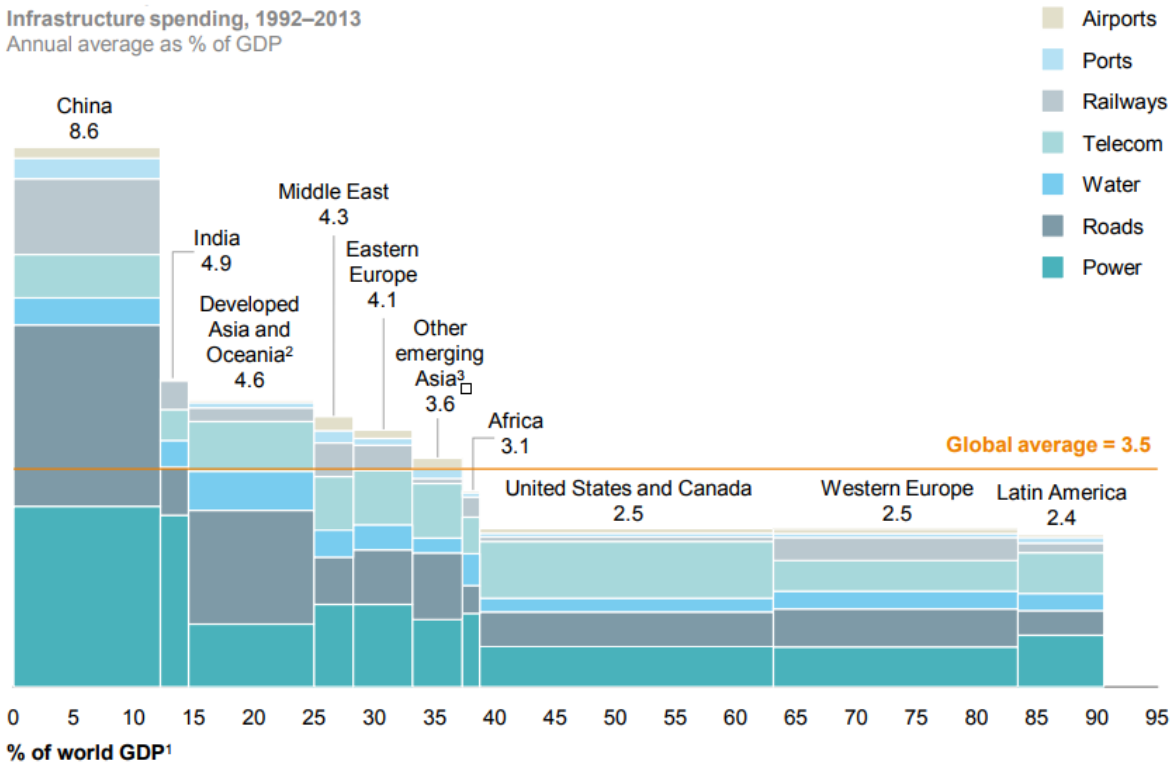


Figure 1.11 – Average infrastructure spending as a percentage of each region GDP
Source: McKinsey Global Institute 2016
1992-2013 data

In 2013, for example. World countries have spent $2.5 trillion in economic infrastructure assets, subdivided among transport infrastructures ($ 1.150 billion – 46%), power infrastructures ($ 750 billion – 30%), water infrastructure ($ 200 billion – 8%), telecom infrastructure ($ 400 billion – 16%). This value corresponds to around 3,6% of 2013 World GDP, consistent with the annual average of last two decades. China, alone, has invested $829 billion: more than Europe and United States together ($ 335 billion and $ 448 billion, respectively).

Therefore, on average, the World falls short of infrastructure investments for almost $1 trillion a year. The sole global baseline needs, whose computation does not consider the demand for already existing infrastructure works' maintenance and upgrading, exceeds investments actually carried out by around $350 billion annually, equaling to $5.200 billion across the entire 2016-2030 period. On the other hand, if top results are pursued, including the provision of all infrastructure works that are necessary to the achievement of the UN 2030 Sustainable Development, the requirement soars until equaling three times what initially estimated. [42]

1.5 The infrastructure gap in Europe

In order for the European single market to perform at an optimum level, the region requires integrated infrastructure networks for transport, energy and telecommunications that link all its member States. The development of the so-called "Trans-European Network" (TEN) has been indicated as a priority already in the Maastricht Treaty of 1992. This initiative includes an integrated network for transports (TEN-T), energy (TEN-E) and telecommunications (eTEN). TEN-T networks consist of nine European corridors that, by 2030, should unite 94 European ports with railway and road connections, 38 key airports with train connections to the major cities, 15.000 kilometers of high-speed trains and 35 cross-border projects to reduce bottlenecks. In the case of energy, the TEN-E network is expected to improve the cross-border interoperability of the electricity and gas networks and also boost renewables. Finally, the aim of the eTEN telecommunications network includes modernizing broadband networks and launching trans-European electronic services of common interest in the areas of health and public administration.

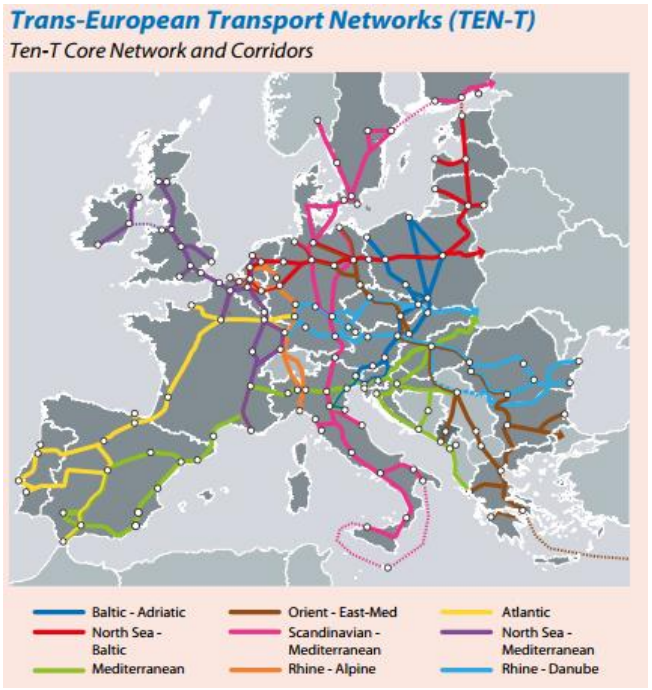


Figure 1.12 – The Trans-European Transport Network
Source: Caixa Bank - 2017

While the TEN project has had the merit to bring about relevant improvements in the situation of European infrastructure, much has to be done in order to fill the European infrastructure gaps estimated by the European Investment Bank. According to its projections, indeed, the European infrastructure shortfall equals to as much as €335 billion a year in next five years (2017-2022), namely roughly one third of the global infrastructure gap estimated by McKinsey Global Institute, assuming that the two sets of data (McKinsey Global Institute and EIB data sets) are comparable to a sufficient extent. More than 30% of this gap relates to energy infrastructure works needed to guarantee an adequate supply of energy to the European Union, modernize distribution networks and improve energy efficiency in building and industry, Telecom infrastructure, instead, accounts for 19% of the gap, as improved data capacity and cyber-security is needed. The lasting portion of the gap is made up by transport and logistics (24%) and water and waste management (27%). [43] The following table provides an overview of the European infrastructure gap. [43]

[43] CaixaBank – Mestres Domènech, Josep – "*Infrastructure in the European Union and the Junker Plan*" – March 2017

	Annual investment			
	Required	*Current*	*Gap*	*(% of total)*
Investment needs in transport and logistic infrastructure	160 bn	80 bn	80 bn	**24%**
Modernising urban transport to meet global benchmarks	80 bn	40 bn	40 bn	
Ensuring sufficient capacity in interurban traffic (including Trans-European Transport Networks)	80 bn	40 bn	40 bn	
Investment needs in the energy sector	229 bn	130 bn	99 bn	**30%**
Upgrading energy networks (gas and electricity)	64 bn	47 bn	17 bn	
Energy efficiency savings in buildings and industry	112 bn	42 bn	70 bn	
Power generation, including renewables	53 bn	41 bn	12 bn	
Investment needs in the telecommunications sector	160 bn	95 bn	65 bn	**19%**
Reaching global benchmark for broadband services	75 bn	45 bn	30 bn	
Matching US data centre capacity	50 bn	25 bn	25 bn	
Matching US investments in cyber-security	35 bn	25 bn	10 bn	
Investment needs in water and waste sectors	138 bn	48 bn	90 bn	**27%**
Water security, including flood risk management	15 bn	2 bn	13 bn	
Compliance and rehabilitation of Europe's water infrastructure	75 bn	30 bn	45 bn	
Enhancing waste management/materials recovery	8 bn	3 bn	5 bn	
Additional needs for resilient and efficient urban infrastructure	40 bn	13 bn	27 bn	
Total	687 bn	353 bn	334 bn	**100%**

Figure 1.13 – The infrastructure gap in Europe
Source: Caixa bank and EIB
2016 data

Trends in infrastructure investment in the European Union have closely mirrored the business cycle over last decades, falling on the onset of the global financial crisis and after the sovereign debt crisis. The first contraction was mainly caused by a dwindling private commitment toward infrastructure investment, while public funding continued to grow. The 2011-2012 crisis, instead, has caused a reduction in public infrastructure financing, associated to imposed fiscal consolidation patterns which have acted pro-cyclically and contributed to worsen the already existent reduction of infrastructure investments.

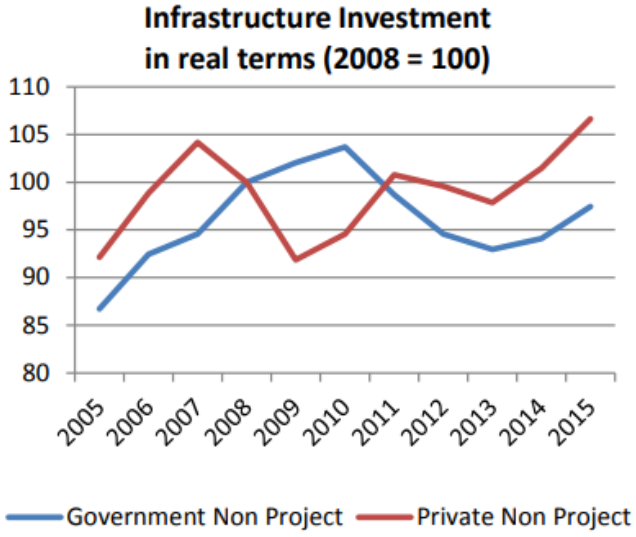


Figure 1.14 – Dynamics of the public and private commitment toward infrastructure investments in Europe
Source: EIB - 2016

The infrastructure sector that has suffered the most from the reduction of the financing flow has been the transport sector, whose share over the total flow of infrastructure investments fell from a 2007 value of 31% to a 2015 value of 26%, corresponding to a shift from 1,6 to 1,3% of the European GDP. [44]

[44] European Investment Bank – Revoltella, Debora; Brutscher, Philipp-Bastian; Tsiotras, Alexandra; Weiss, C. – "*Infrastructure Investment in Europe and International Competitiveness*" - 2016

1.5.1 Infrastructure can raise back the European economy

While major investments in infrastructure are needed to allow the European Union to fill its infrastructure gap, it is important to notice that it takes part of a larger long-term investment gap that has been gripping Europe for decades. Low levels of investment have represented a structural problem since the mid-1960s, when investments-to-GDP ratios have started sinking in many major European countries at a higher rate than how they were doing in United States. The 2008-2013 crisis, which has actually wounded the European economy more (and for a longer time) than how it has done with other comparable economic systems, has caused a magnification and embitterment of the structural weaknesses and unsatisfying economic performance in most European countries, which have found further difficulties in reverting to pre-crisis levels of output because of the constraints imposed by the monetary union in terms of deficit-spending and public debt making.

In addition, a gap has emerged and progressively widened between northern and southern European countries, as the latter have relied more on capital accumulation rather than R&D and technological enhancement, showing evident signals of weak growth, as a consequence. The following graph represents the different investment strategies of European countries, reporting the average 2000-2009 percentage of their GDP's share devoted to either ICT or non-ICT investments.

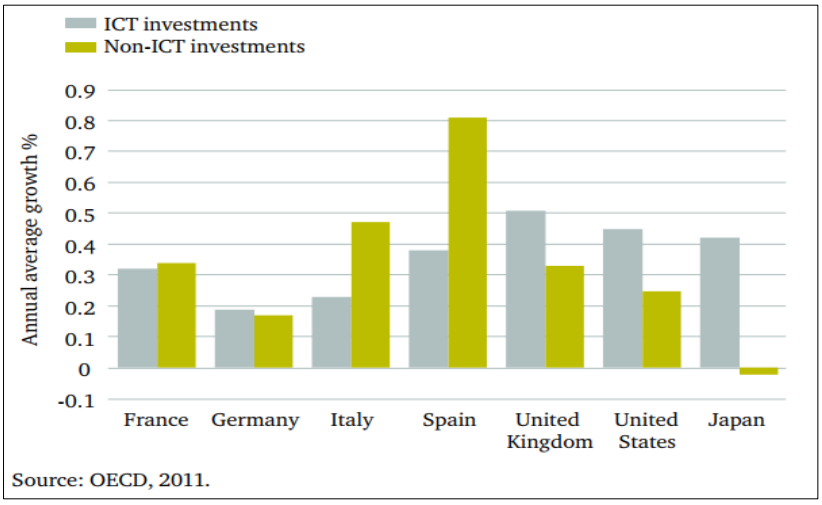


Figure 1.15 – ICT and non-ICT investments in Europe
Source: Chatham House 2014
2000-2009 data

It is evident how countries having devoted a poor share of their GDPs to ICT investments are now facing the worst challenges. During the five years of crisis, European economies lost an overall 1.3% of their real GDP, whereas the subset of euro area countries left on the ground as much as 2.3%. Southern Europe countries, including Greece, Italy, Spain and Portugal, showed the poorest performance, losing from 7% to 22% of the value of their gross production. Currently, output has not reverted yet to pre-crisis levels, although the European Union is at its fifth year of recovery.

Excluding United Kingdom, whose projected growth is expected to match that of United States (around 2.5% a year for the 2014-2019 period), European countries are foreseen to be struggling in pursuing the goal to come back to pre-crisis levels. European Union's expected growth is at 1.7% in 2017 and 1.8% in 2018.[45]

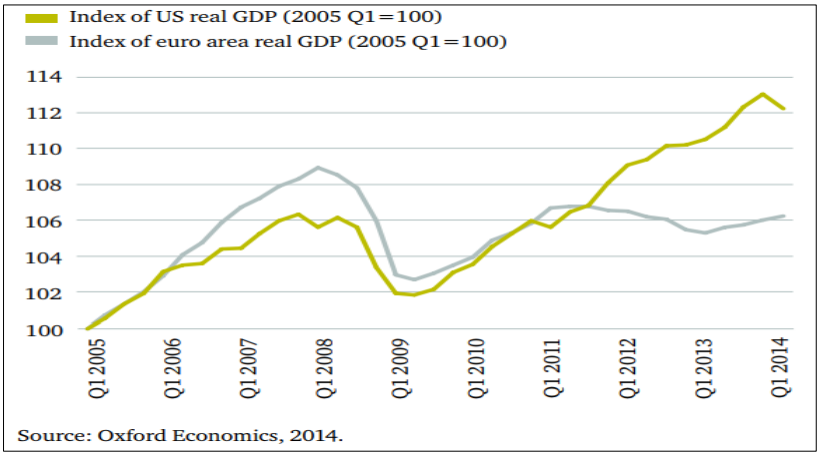


Figure 1.16 – A comparison between Europe and United States growth patterns
Source: Chatham House

Unemployment represents one of the heaviest burdens constraining demand, and hence economic growth, in Europe. The 2007-2008 crisis has revealed and worsened deep discrepancies among European economies and caused an overall 10% absolute increase of the unemployment rate in the 2009-2013 period, bringing it to a 17% level. This value decreased to 11% in 2014 and to 9.3% after the first half of 2017, without having reverted pre-crisis levels yet. Despite the decrease in the general unemployment rate, overall data may conceal worrying facts like the chronic unemployment in Greece (22%), Spain (17.7%) and Italy (11.3%), where the problem appears now all but transitory, despite the recent encouraging signals of recovery.[46] Youth unemployment has not proven better. The overall unemployment rate for under-25 aged workers in the euro area was 21% in 2016: approximately the same of 2008 and 5 percentage point above the 2007 level. [47]

On the supply-side, fading productivity and delays in catching up with United States in the adoption of Information and Communication Technologies have reduced productivity and output-to-capital ratios, depressing investments and causing productive capacity underutilization, despite an environment characterized by extremely low interest rates and favorable conditions for creditworthy borrowers.

[45] European Commission – "*Spring 2017 economic forecast*"
[46] Statista.com – "*Unemployment rate in member states of the European Union in May 2017*"
[47] Statista.com – "*Youth unemployment rate in the European Union and the euro area from 2006 to 2016*"

To fix this situation characterized by low growth, high unemployment and falling living standards, policies need to focus on strong and sustainable growth, with the view of allowing the European economies to revert the trend and get out from the slump it has experienced since the global financial crisis. Stimulating both publicly and privately sponsored large infrastructures is likely to represent a real answer to the problems affecting Europe. Infrastructure investments can exhibit large multiplier effects due to the positive externalities they bring about and improve both demand and supply-side performance.

Of course, the history of infrastructures in Europe is full of cases of bad planning and implementation and many projects have found partial, out-of-time or over-budget completion. Examples of grave inefficiencies or even corruption have not been rare and have left an inglorious record of unsatisfied investors. Misallocation of resources has indeed been one of the forces determining the sovereign debt crisis, both in the South, where cheap financing has led to infrastructure overinvestment, and in the North, where economies have often seemed reluctant to embark on major infrastructure initiatives and infrastructure deficits emerged.

Anyway the present is not to withstand the past, at least under a moral point of view, but rather to learn lessons from it. Well selected projects are likely to show a more than satisfying economic and social return, given the important challenges that the current global environment imposes, including climate change, ageing demographics, growing inequality, rapid technological advances and greater labor mobility. Moreover, returns from infrastructures' equity and debt can help companies and people to find an alternative way to earn sizeable returns in a very low interest rate environment.

The best investments need to get the right flow of capital to realize adequate infrastructures in the context of good projects, as this appears as a concrete possibility in breaking the impasse. If either public or private economic actors are encouraged to take advantage of the current environment, characterized by cheaper financial resources and plentiful real resources, they can activate a virtuous circle kick-starting growth, boosting demand and improving supply. For this to happen, the right incentives must be in place and this is a real challenge for European governments, regulators and institutions.[48]

[48] Chatham House Report – Subacchi, Paola; Pickford, Stephen; Tentori, Davide; Huang, Helena – "*Building Growth in Europe: Innovative Financing for Infrastructure*" – September 2014

ANNEX A: The infrastructure gap: the case of United States

United States are currently facing a remarkable lack of infrastructures despite their traditional leading position in development and innovation. A $1.000 billion capital needs to be injected in country's roads, waterways and broadband networks. Wastewater infrastructure alone would need additional $271 billion.[49] According to the American Society of Civil Engineers, US infrastructure gap costs $9 a day per American family, unintentionally paid in terms of delays, property damages and increased utilities' and goods' costs, while only $3 a day per family would be enough to close the American infrastructure gap. [49]

Traditionally United States have built infrastructures in a timely and cost-effective fashion but currently projects often go over budget and struggle to find completion. Probably investors would be more incentivized to invest in infrastructures if they deemed costs to be reasonable but United States are suffering from a competitive disadvantage with respect to countries like France and Japan, under this point of view. Several reasons have been pointed out as possible explanations for this phenomenon, including the high wages of unionized construction workers, environmental laws and high land cost, but none of them has shown really suitable to be taken as the main culprit. Instead, the most plausible explanation for the growth of United States infrastructure capital expenditure is the presence of important inefficiencies. The availability of capital is just a small part of the problem if its marginal productivity keeps decreasing because of inefficient project management, inefficient government contracting process and inefficient regulation.[50]

With a focus on transportation infrastructure, commenters have argued that too much has been built while already existing infrastructures are not being kept under adequate maintenance. Between 2009 and 2011, $20.4 billion were devoted to new infrastructure works while just $16.5 billion were used to update the whole existing system. This means an average of $5.5 billion a year, covering just 8.4% of the yearly need of $65.3 billion estimated by the US Department of Transportation. Building new infrastructure obviously raises political consensus more than modernizing existing ones, but it often emerges as a suboptimal solution. Half of heavy rail cars, a third of commuter rail cars and a fifth of transit buses should be replaced as transit ridership is growing faster than the American population itself, because of the emerging habits of new generations. Updating would ideally mean including newest technologies in infrastructural systems, so that congestion, delays and accident may be avoided more often and more easily. The US Accountability Office estimates that spending $1,3 billion in transport infrastructures would allow to cover the whole country with real-time traffic management systems. This would, in turn, enable traffic, travel times, emissions and crashes reduction

[49] American Society of Civil Engineers – "*2017 Infrastructure Report Card*"
[50] BloombergView – Smith, Noah – "*The US Has Forgotten How To Do Infrastructure*" – May 2017

while providing useful data to do even better in the future. In economic terms, it equals saving more than $30 billion in less than 10 years.

To fix problems clogging U.S. under this point of view, a radical change at system-wide level is needed. A top-down approach led by the federal government, like the current one, is likely to produce inefficient choices, as it is harder for federal actors to achieve a sufficient degree of information to act in the best interest of local communities without biases. For this reason, some authors claim that infrastructure planning activities are delegated to governments of each State. Notwithstanding, the process is going to be all but straightforward, because of all the vested interests and institutional inertia involved.[50] [51]

ANNEX B: Infrastructures and the WEF Global Competitiveness Index

In the course of Chapter 1, while introducing the reality of infrastructure and its benefits for societies and economies, the Global Competitiveness Index has been defined as a frequently employed measure of the status of health of countries' infrastructure systems (see Paragraph 1.1.2).

The World Economic Forum's Global Competitiveness Index is a composite index designed to rank all the World countries according to their degree of competitiveness, defined as the set of institutions, policies, and factors that determine the level of productivity of an economy, which in turn sets the level of prosperity that the country can achieve.

The index is composed by three sub-indexes, weighted differently according to the stage of development a country is going through, as it is measured by per capita GDP and the share of exports represented by raw materials. Basic requirements are more important for factor-driven economies (least developed), innovation and sophistication factors are more important for innovation-driven economies (most developed), while efficiency enhancing factors are more important for efficiency-driven economies, namely emerging ones. Sub-indexes are in turn composed by 12 pillars. As much as 114 indicators, capturing concepts that matter for productivity and long-term prosperity, are distributed among them. Each indicator is assessed by using a 1 to 7 scale and then indicators belonging to a given pillar are weighted to get the overall assessment of a country for what concerns that pillar. The scheme just described is summarized in the following table.

[51] Wired.com – Marshall, Aarian – "*How not to screw up spending $1 trillion in US infrastructures*" – January 2017

GCI	Basic requirements	Institution	21 indicators
		Infrastructure	9 indicators
		Macroeconomic environment	5 indicators
		Health and primary education	10 indicators
	Efficiency enhancers	Higher education and training	8 indicators
		Goods market efficiency	16 indicators
		Labor market efficiency	10 indicators
		Financial market development	8 indicators
		Technological readiness	9 indicators
		Market size	2 indicators
	Innovation and sophistication factors	Business sophistication	9 indicators
		Innovation	7 indicators

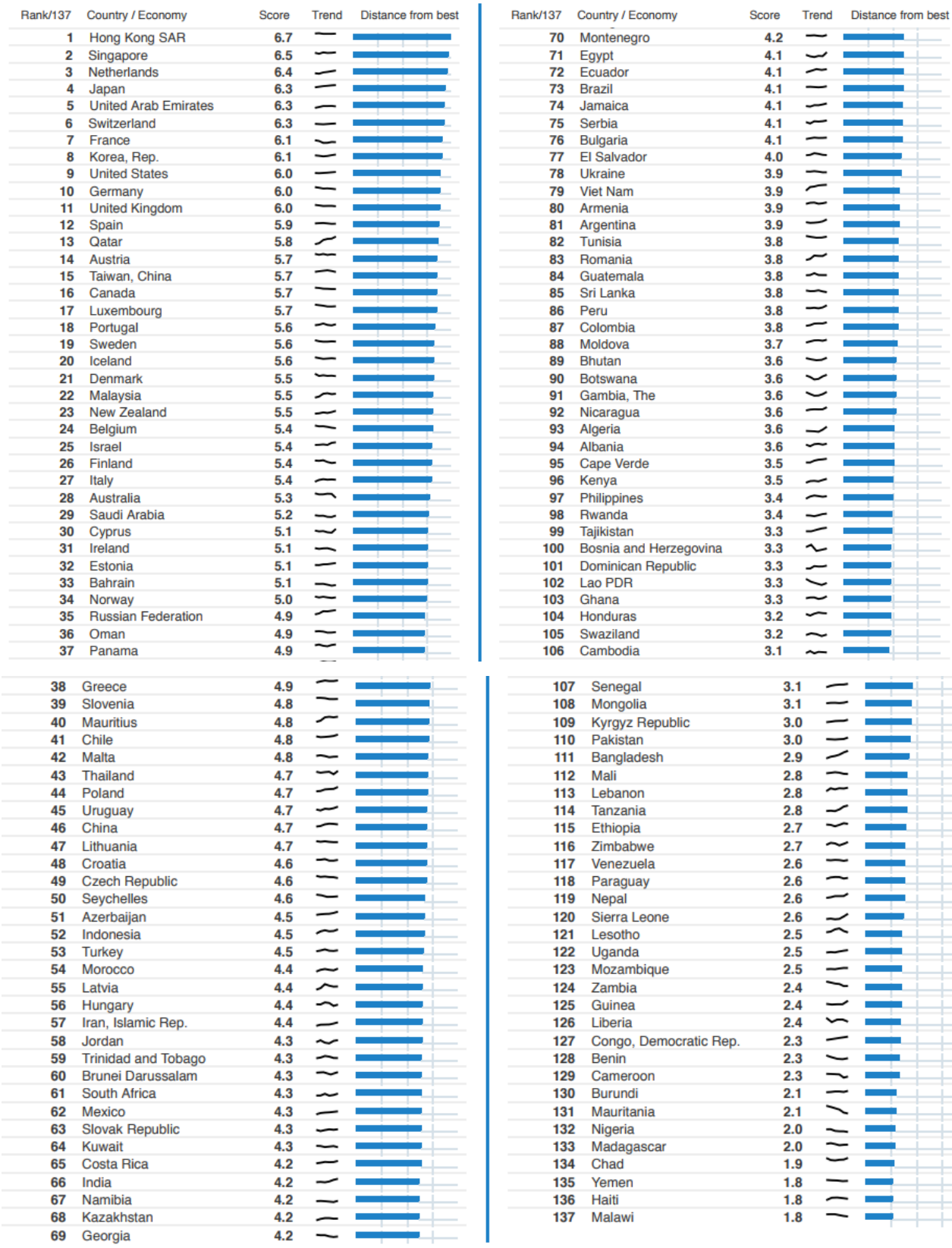
Infrastructures are one of the pillars of competitiveness, namely Pillar II, as "extensive and efficient infrastructure is critical for ensuring the effective functioning of the economy". They account for 25% of the score attributed to the first pillar and encompass 9 indicators, divided into two categories, as shown below.

Sub-index I	Pillar II		
Basic Requirements 35-50% of GCI	Infrastructure 25% of Sub-index I	*Transport infrastructure* 50% of Pillar II	Quality of overall infrastructure
			Quality of roads
			Quality of railroad infrastructure
			Quality of port infrastructure
			Quality of air transport infrastructure
			Available airline seat kilometers
		Electricity and telephony infrastructure 50% of Pillar II	Quality of electricity supply
			Mobile telephone subscriptions
			Fixed telephone lines

The World Economic Forum puts infrastructural adequacy in the basic requirements, whose weight is heavier for underdeveloped countries, keeping a particular emphasis on transports, electricity and basic telecommunications. This is arguably a sound logic: no country can develop without streets, ports, functioning railways, electricity and telephones. Nevertheless, the WEF has recognized that the radical changes observed in the context of the so-called digital revolution (also known as fourth industrial revolution) clearly generate the necessity to reconsider sources of competitiveness, growth and prosperity. Business models are increasingly based on ICT and countries neglecting the importance of developing in this direction go to suffer from competitive disadvantage and innovation slowdowns. For this reason, ICT infrastructures and connectivity measures have been added to the second Pillar of the GCI.

The score attributed to each country for infrastructure adequacy (pillar II of the GCI) in 2017 is shown in the figure below, provided by the World Economic Forum in its 2016-2017 Global Competitiveness Report. [52]

[52] World Economic Forum – Baller, Silja; Di Battista, Attilio; Browne, Ciara; Crotti, Roberto; Drzeniec Hanouz, Margareta; Gomez Gaviria, Daniel; Geiger, Tierry; Marti, Gaelle; Sala-i-Martin, Xavier; Verin, Stephanie - "*The Global Competitiveness Report 2016-2017*"



Rank/137	Country / Economy	Score
1	Hong Kong SAR	6.7
2	Singapore	6.5
3	Netherlands	6.4
4	Japan	6.3
5	United Arab Emirates	6.3
6	Switzerland	6.3
7	France	6.1
8	Korea, Rep.	6.1
9	United States	6.0
10	Germany	6.0
11	United Kingdom	6.0
12	Spain	5.9
13	Qatar	5.8
14	Austria	5.7
15	Taiwan, China	5.7
16	Canada	5.7
17	Luxembourg	5.7
18	Portugal	5.6
19	Sweden	5.6
20	Iceland	5.6
21	Denmark	5.5
22	Malaysia	5.5
23	New Zealand	5.5
24	Belgium	5.4
25	Israel	5.4
26	Finland	5.4
27	Italy	5.4
28	Australia	5.3
29	Saudi Arabia	5.2
30	Cyprus	5.1
31	Ireland	5.1
32	Estonia	5.1
33	Bahrain	5.1
34	Norway	5.0
35	Russian Federation	4.9
36	Oman	4.9
37	Panama	4.9
38	Greece	4.9
39	Slovenia	4.8
40	Mauritius	4.8
41	Chile	4.8
42	Malta	4.8
43	Thailand	4.7
44	Poland	4.7
45	Uruguay	4.7
46	China	4.7
47	Lithuania	4.7
48	Croatia	4.6
49	Czech Republic	4.6
50	Seychelles	4.6
51	Azerbaijan	4.5
52	Indonesia	4.5
53	Turkey	4.5
54	Morocco	4.4
55	Latvia	4.4
56	Hungary	4.4
57	Iran, Islamic Rep.	4.4
58	Jordan	4.3
59	Trinidad and Tobago	4.3
60	Brunei Darussalam	4.3
61	South Africa	4.3
62	Mexico	4.3
63	Slovak Republic	4.3
64	Kuwait	4.3
65	Costa Rica	4.2
66	India	4.2
67	Namibia	4.2
68	Kazakhstan	4.2
69	Georgia	4.2
70	Montenegro	4.2
71	Egypt	4.1
72	Ecuador	4.1
73	Brazil	4.1
74	Jamaica	4.1
75	Serbia	4.1
76	Bulgaria	4.1
77	El Salvador	4.0
78	Ukraine	3.9
79	Viet Nam	3.9
80	Armenia	3.9
81	Argentina	3.9
82	Tunisia	3.8
83	Romania	3.8
84	Guatemala	3.8
85	Sri Lanka	3.8
86	Peru	3.8
87	Colombia	3.8
88	Moldova	3.7
89	Bhutan	3.6
90	Botswana	3.6
91	Gambia, The	3.6
92	Nicaragua	3.6
93	Algeria	3.6
94	Albania	3.6
95	Cape Verde	3.5
96	Kenya	3.5
97	Philippines	3.4
98	Rwanda	3.4
99	Tajikistan	3.3
100	Bosnia and Herzegovina	3.3
101	Dominican Republic	3.3
102	Lao PDR	3.3
103	Ghana	3.3
104	Honduras	3.2
105	Swaziland	3.2
106	Cambodia	3.1
107	Senegal	3.1
108	Mongolia	3.1
109	Kyrgyz Republic	3.0
110	Pakistan	3.0
111	Bangladesh	2.9
112	Mali	2.8
113	Lebanon	2.8
114	Tanzania	2.8
115	Ethiopia	2.7
116	Zimbabwe	2.7
117	Venezuela	2.6
118	Paraguay	2.6
119	Nepal	2.6
120	Sierra Leone	2.6
121	Lesotho	2.5
122	Uganda	2.5
123	Mozambique	2.5
124	Zambia	2.4
125	Guinea	2.4
126	Liberia	2.4
127	Congo, Democratic Rep.	2.3
128	Benin	2.3
129	Cameroon	2.3
130	Burundi	2.1
131	Mauritania	2.1
132	Nigeria	2.0
133	Madagascar	2.0
134	Chad	1.9
135	Yemen	1.8
136	Haiti	1.8
137	Malawi	1.8

Figure 1.17 – WEF ranking of World countries' infrastructure quality
Source: World Economic Forum 2016-2017 Global Competitiveness Index report

Chapter 2

2.Characteristics of infrastructure assets, vehicles and investors

2.1 Infrastructure as an asset class

2.2 Public and private investors in infrastructure assets 2.2.1 Private investors in infrastructure: a focus on institutional investors

2.3 Financing infrastructure 2.3.1 Infrastructure project finance 2.3.2 Infrastructure corporate finance 2.3.3 Market vehicles for infrastructure financing

2.4 Determinants of infrastructure assets' risk-return profile 2.4.1 Sub-sector 2.4.2 Stage of development 2.4.2.1 Main risks borne by investors in infrastructure 2.4.2.2 Pre-completion risks 2.4.2.3 Post-completion risks 2.4.2.4 Risks borne all along a project 2.4.3 Geography 2.4.4 Financial structure 2.4.5 Contractual arrangement

2.5 Benefits of investing in infrastructure assets 2.5.1 Provision of essential services 2.5.2 Market power and protection from competition 2.5.3 Protection from inflation 2.5.4 Diversification benefits 2.5.4.1 How infrastructure investments behave when included in traditional portfolios 2.5.5 Attractive risk-adjusted returns 2.5.5.1 The Dow Jones Brookfield Global Infrastructure Index 2.5.5.2 Performance of infrastructure debt

2.1 Infrastructure as an asset class

Most investors find it convenient to consider investments in infrastructure assets as a separate asset class.[53] As of 2014, 68 of the top 100 institutional investors in infrastructure were explicitly allocating capital to infrastructure assets, while the others used to encompass infrastructure exposures among alternative, private-equity or real estate investments.[54] Indeed, given its features, the asset class of infrastructure can be seen as a hybrid class mixing together characteristics of real estate assets, equities and fixed-income, as summarized in the table below.

	Similarities	Differences
Private equity	• Management control over investments • Converging investment techniques	• Different risk-return objective; lower exposure to economic cycle • Longer investment horizon; return less driven by exit strategy • Strong cash yield/lower capital growth
Real estate	• Cash yield is significant part of return • Absolute return objective focus • Importance of location	• Control over operating companies • Barriers to entry; less exposure to valuation cycles • Longer cash flow predictability, higher gearing • Normally larger individual asset size
Equities	• Equity ownership • Upside return potential	• Lower level of securitization/liquidity • Lower correlation with business cycle • Relatively predictable and high cash yield
Fixed income	• Long-term, predictable cash yield • Long duration asset • Low market risk	• Asset ownership • Growth/upside potential • Inflation hedge features • Indirect exposure to interest risk

Figure 2.18 – How the infrastructure asset class compares to other asset classes
Source: UBS Global Asset Management 2011

The asset class of infrastructure finds its place in the context of the so-called "alternative" asset classes, representing both an alternative and a complement to traditional investment tools like bonds and shares, in the pursuance of a portfolio strategy supported by an optimal degree of diversification. A recent study from LUISS Business School and ASTRID has revealed that allocating a share of a portfolio composed only by traditional assets to alternative investment opportunities can improve its risk-return characteristics in each point of the Markovitz efficient frontier.[55] Alternative financing tools are less accessible for non-qualified investors and are often characterized by a low degree of liquidity and by returns weakly or inversely correlated with respect to other more traditional asset classes and markets. Several categories of alternative investments are available, each with its own features. Among them, it is possible to list financial instruments negotiated on regulated markets like currencies and commodities; real assets like artworks or selected wines; investment strategies based on direct negotiation among involved parties, like private equities and private debt; alternative investment vehicles like alternative investment funds.

[53] Weber, Barbara; Staub-Bisang, Miriam; Alfen, Hans Wilhelm – "*Infrastructure as an Asset Class - Investment Strategy, Sustainability, Project Finance and PPP*" – II edition – Wiley – 2016

[54] J.P. Morgan Asset Management – Pease, Bob – "*Infrastructure Investment Opportunities for Public Safety Plans*" – October 2014

[55] LUISS Business School & ASTRID - Merola, Federico; Caroli, Matteo; Iaione, Christian; Fersini, Paola - "*Le casse di previdenza tra autonomia e responsabilità. I professionisti, il risparmio, l'economia reale*" - 2017

During last years, the overall value of the industry of alternative investments has soared. Indeed, the value of alternative assets under management has shifted from $1 trillion to $7 trillion in fifteen years (1999-2014) and according to a PWC estimation, its total amount is going to reach $13 trillion by 2020. The set of investors allocating capital to alternative investments is broad and includes both institutional and retail investors. Pension funds, in particular, are becoming increasingly relevant global players in the market for alternatives. In most legislations, the access to alternatives is allowed only to actors showing a certain level of wealth and to institutional investors, as they are deemed to be better able to understand the structure of the investment and the associated risks, with respect to traditional retail investors. Usually, alternative investments are carried out through the typical structures of closed-end funds, characterized by a holding period ranging from 10 to 15 years, or through hedge funds. Alternative funds enjoy a greater degree of flexibility with respect to traditional funds, either for what concerns leveraging or for that concerns the asset allocation strategy. They are also likely to differ under the point of view of the structure and size of commissions, duration, liquidity, performance measurement and investors' constraints. [56]

Stylized economic characteristics of infrastructure assets include high barriers to entry, high fixed and low variable costs, whose combination is likely to generate economies of scale, inelastic demand for services and consequent pricing power, low operating costs with high target operating margins and long duration. As a consequence, the value proposition for infrastructure as an asset class is about capturing certain advantageous financial characteristics including attractive risk-adjusted returns, low correlation with the short-term swings of the economic cycle, low correlation of returns with respect to other asset classes, long-term stable and predictable cash flows, good inflation hedge, low default rates and a natural fit with long lasting inflation-linked pension liabilities. In addition, the investment in infrastructure is usually deemed to be socially and environmentally responsive.

In contraposition with expected benefits, infrastructure projects also carry some elements that deserve investors' attention and awareness. Capital intensity, high upfront costs, poor liquidity and a long investment horizon, in combination, translate into significant requirements in terms of both financial and managerial resources. Infrastructure facilities tend to show significant elements of heterogeneity and uniqueness and infrastructure projects are backed by complex legal arrangements meant to allocate risk and benefits with the goal of aligning the incentives of all involved parties. The uniqueness of infrastructure projects in terms of the services they provide and the opaqueness and diversity of their structures make infrastructure investments less liquid, especially if investments are carried out in the form of private equities or direct loans. Actually, among alternative investments, the

[56] LUISS Business School & ASTRID - Merola, Federico; Caroli, Matteo; Iaione, Christian; Fersini, Paola - "*Le casse di previdenza tra autonomia e responsabilità. I professionisti, il risparmio, l'economia reale*" - 2017

asset class of infrastructure is considered the least liquid, for what concerns both financing vehicles and the underlying assets, as shown in the graph below. Often, the information required by investors to assess single infrastructure projects and the infrastructure market in general is lacking or highly scattered, creating uncertainty.[57]

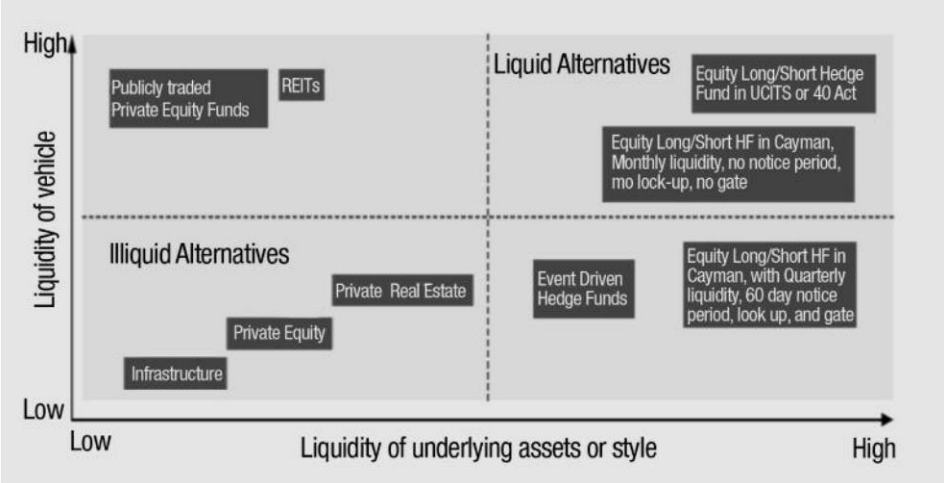


Figure 2.19 – Degree of liquidity of altenrative assets and vehicles
Source: LUISS Business School & ASTRID - Merola, Federico; Caroli, Matteo; Iaione, Christian; Fersini, Paola - "Le casse di previdenza tra autonomia e responsabilità. I professionisti, il risparmio, l'economia reale" - 2017

In addition, many of the expected qualities of infrastructure investments are not to be taken for granted, as many variables are involved and infrastructure assets substantially differ among each other. Understanding the investment in infrastructure is essential for investors to take the best out of it in terms of consistency with their risk-return targets and asset allocation strategies. For example, while some distribution networks actually behave like natural monopolies, some infrastructure sub-sectors, including energy production and provision of telecom services, are more likely to be characterized by competitive dynamics. In addition, monopolistic positions depending on political decisions are vulnerable to changes in the political will. Also the insensitivity to the economic cycle arising from demand inelasticity and low volatility, which appears evident for most utilities networks, is not always a reality when it comes to riskier economic assets like transport or telecom infrastructure. The existence of diversification benefits has been widely demonstrated for all infrastructure industries but correlation factors are dynamic, as it has emerged during the recent financial crisis, and contingencies may cause asset classes' performance to unfavorably converge. [58]

The characteristics of individual infrastructure assets can be influenced by at least three sets of factors: country-specific, sector-specific, asset-specific. Indeed, each country represents a particular political, legal, economic, social, institutional, entrepreneurial background for infrastructure investments and is likely to influence the quantity and the quality of infrastructure projects, impacting,

[57] OECD – "*Infrastructure Financing Instrument and Incentives*" - 2015
[58] Inderst, George – "*Infrastructure as an asset class*" – 2010

among others, the financing mix and the length of the pre-approval stage. Each industry, on its behalf, is designed to represent an answer to specific necessities and to provide unique products and/or services. The assets there employed will tend to be designed in accordance with the structural elements the industry has inherited from the environment where it operates. The figure below represents the hierarchical relationship existing among country-specific, industry-specific and asset-specific determinants of infrastructure assets' features. Also the risks that relate to infrastructure investing can be subdivided in general risks arising from the surrounding environment, sector-specific risks and asset/project risks. General risks include market risk, interest rate risk, exchange rate risk, ESG risk, political, legal and regulatory risk, *force majeure*. Asset specific risks, instead, include planning, construction and completion risk, technical risk, financing risk, syndication risk, operational risk, counterparty risk, realization risk. They will be defined and analyzed along this chapter. Industry-specific risks may include the risk of *impasse* due to urgent maintenance, the risk of congestion, the risk of changes in the relevant regulation.[53] In the figure below, the hierarchical structure of the determinants of infrastructure assets' features is shown. Country-specific, industry-specific and asset-specific elements are represented in the external, middle and internal circle, respectively.

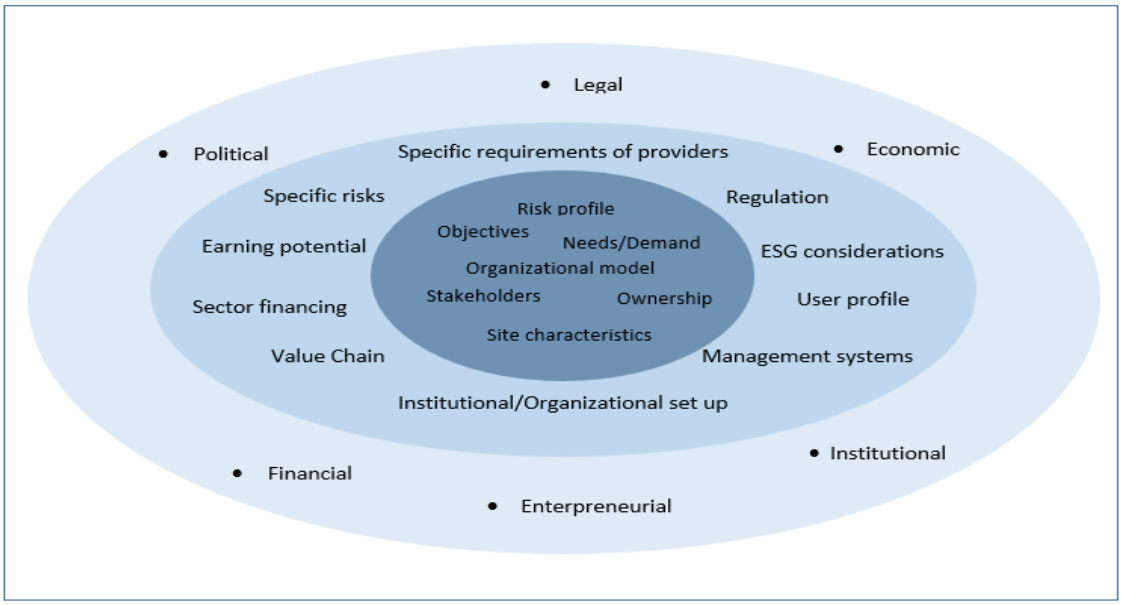


Figure 2.20 – The hierarchy of country-specific, sector-specific and asset-specific determinants of infrastructure assets' features
Source: Weber, Barbara; Staub-Bisang, Miriam; Alfen, Hans Wilhelm – "Infrastructure as an Asset Class - Investment Strategy, Sustainability, Project Finance and PPP" – II edition – Wiley – 2016

2.2. Public and private investors in infrastructure assets

Infrastructure assets can be beneficial for governments, citizens and investors but related benefits are delayed in time and capital shortages often arise, impeding infrastructure projects to take off. Traditionally, in industrialized countries, the public sector has been the main actor in the field of infrastructure financing and ownership, and related investments have been mainly funded through public budgets, given the infrastructure works' nature of public assets and the massive positive

externalities they are likely to bring about. Nonetheless, high development, maintenance and operation costs for infrastructure have come to represent a huge burden on welfare state budgets, already overwhelmed by reduced tax revenues and by the increasing costs of pensions and healthcare, associated to ageing population. Often, budgetary constraints have been further compounded by the need to repair the balance sheets of banks and rebuild capital and liquidity buffers, partly due to strengthened prudential regulation in the banking sector.

The recent financial crisis has further complicated the situation and, since then, European governments have started facing austerity policies reducing their ability to deficit spending and raising debt, hence to commit large amounts of capital to infrastructure investing. Under a purely political perspective, at times of shortage, cuts on capital expenditures are easier to make and less visible than cuts on existing resources or services, which are more likely to create immediate public dissatisfaction. Governments have been forced to defer investments in infrastructure construction, maintenance and upgrading until national balances had appeared healthier. All of these contingencies, coupled with the frequent inability of governments to provide efficient investments, driven by politically-induced misallocations of resources, have caused the public sector to progressively retrieve from the field of infrastructure financing and have stressed the need of a new financing model. [59] In response to this, governments have sought new ways to finance necessary investments in infrastructure, demonstrating a change in attitude and turning their attention to the private sector. The participation of private actors in the infrastructure finance market has therefore remarkably increased from 1980s onward. Most countries have implemented extensive legislations to open infrastructure sectors to private financers and currently a significant proportion of World economic infrastructure is under private ownership, above all in the telecommunication sector, followed by the power sector. Social infrastructure works only are still mainly under public ownership and control. Also emerging countries like China and India have gained awareness about the importance of involving private actors in funding infrastructures to be able to deal with huge related investment costs.[53]

Anyway, different countries are likely to show different degrees of reliance on public financing for infrastructures. Intuitively, the higher a country's public debt and the lower the quality of its infrastructure system, the more it will depend on the private sector to complement its endeavors. The following graph, realized by BCG on the basis of data from the World Economic Forum and the International Monetary Fund, shows how the World countries behave under this point of view.

[59] OECD - "*Private Financing and Government Support to Promote Long-Term Investments in Infrastructure*" – September 2014

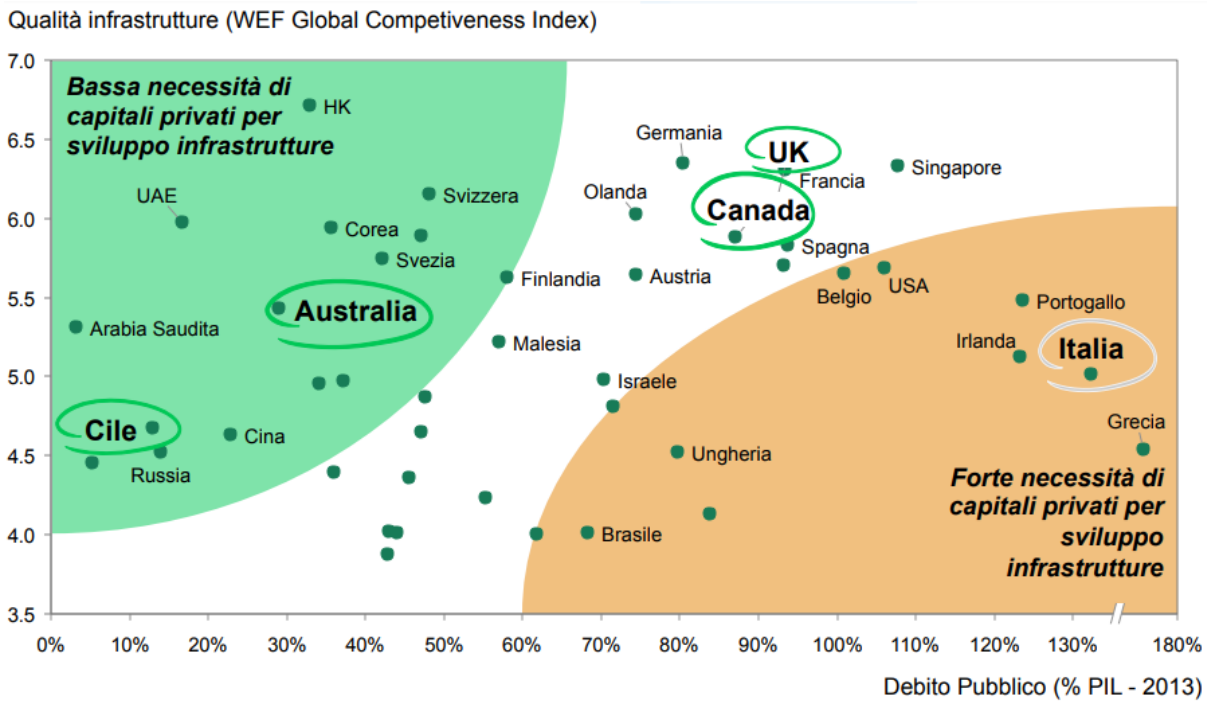


Figure 2.21 – Public debt, infrastructure quality and countries' reliance on private infrastructure financing
Source: SDA Bocconi 2013

On the left side of the chart, countries showing low indebtedness in relation to the quality of their infrastructure are shown. These include Hong Kong, United Arab Emirates, Saudi Arabia, Switzerland, China, Australia, among others, and show the lowest reliance on private support for infrastructure financing. On the right side, instead, there are countries with high public debt, in comparison with the quality of their infrastructure, including Italy, Greece, Hungary, Portugal, Ireland. For these countries, the need to embark in Public-Private Partnerships to fulfill their infrastructure investment needs is higher. Interestingly, most continental European countries lie in either the right or the middle-right section of the figure, showing moderate-to-high public debt in relation to the quality of their infrastructure. While they often embark in Public-Private Partnerships for non-financial reasons, it cannot be denied that a significant contribution from the public sector is essential to most of them, in order to provide themselves with an adequate supply of infrastructure assets.[60]

[60] SDA Bocconi – Vecchi, Veronica – "*La bancabilità del PPP*" - 2014

2.2.1 Private investors in infrastructure: a focus on institutional investors

Private investors in infrastructure assets are not a homogeneous group and perform their investments based on different financial goals and interests. They make precise choices about country, sector, stage and modality of entry, consistently with their risk-return profile, and have also specific preferences about the cash profile of their investments.

Return from an equity holding comes from both dividends and capital gains. The former are periodic cash flows issued to equity-holders after a firm has covered costs and satisfied all other creditors' claims. The latter can be earned in consequence of an increase of a firm's equity value on the market, depending on the overall assessment of the market itself about the success of its business and its perspective ability to generate cash flows. If the value of a firm increases, previous investors will be able to divest their stake earning more than what they have spent to invest in it. Investors that are mainly interested in dividends are called yield-driven investors while investors mainly interested in capital gains are called IRR-driven investors. Allegedly, anyway, many investors are interested in a mix of the two.

Yield-driven investors are long-term investors interested in revenue-generating "brownfield" assets. They typically adopt a buy-and-hold approach excluding short-to-medium term divestments of their assets and expect to earn steady annuities to match their long-term liabilities. Given their long-term approach, they are likely not to be affected by liquidity risk and realization risk, as they both arise when investors are selling their assets before maturity. Institutional investors are typical yield-driven players. These are financial players pooling large amounts of money to invest in securities, properties and other investments. Institutional investors include insurance companies, pension funds, investment advisors and mutual funds. They represent an increasingly important group of investors in infrastructure, because of their growing interest for alternative investments in the real economy, characterized by high productivity and hence able to generate long-term stable and predictable cash flows. Institutional investors are gaining increasing importance in global financial markets and their stock of capital under management has soared. In OECD countries, by the end of 2010, they were managing assets for a value of as much as $75.000 billion, subdivided among pension funds ($20.400 billion), insurance companies ($24.300 billion) and other investment companies ($28.800 billion). By 2012, this value had already achieved $97.000 billion, equivalent to three quarters of the global banking sector's assets under management.[61]

[61] Chatham House Report – Subacchi, Paola; Pickford, Stephen; Tentori, Davide; Huang, Helena – "*Building Growth in Europe: Innovative Financing for Infrastructure*" – September 2014

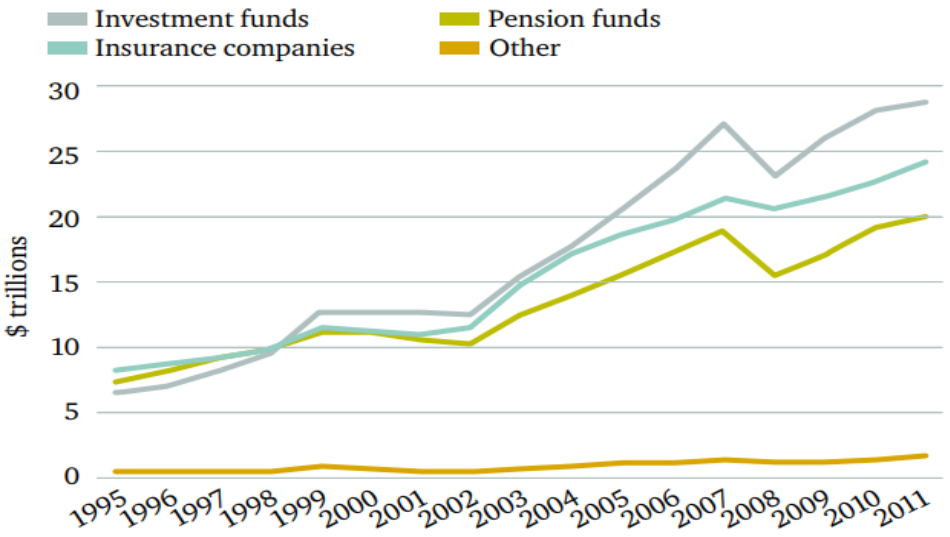


Figure 2.22 – Value of institutional investors' assets under management in OECD countries (trillion $)
Source: OECD 2013

Institutional investors massively allocate capital to government long-term bonds and real estate assets. Besides being expression of their preference for conservatively structured investments providing foreseeable streams of periodical cash flows, these choices represent a consequence of several environmental factors, including regulatory provisions somehow limiting their convenience to largely invest in risky assets, like the European Solvency II regulation for insurance companies. Investments in conservatively structured long-term infrastructure equity and infrastructure bonds can add much to this strategy, given that government bonds and real estate assets are not likely to offer satisfying returns in a low interest rates, flat yield-curve period like the current one. As of June 2014, the top 100 institutional investors in infrastructures were committing $272 billion to the infrastructure asset class through unlisted, listed and direct investments. In the same year, 44% of interviewed institutional investors declared to be willing to increase the share of their assets under management represented by infrastructure, while only 11% wanted to reduce it.[54]

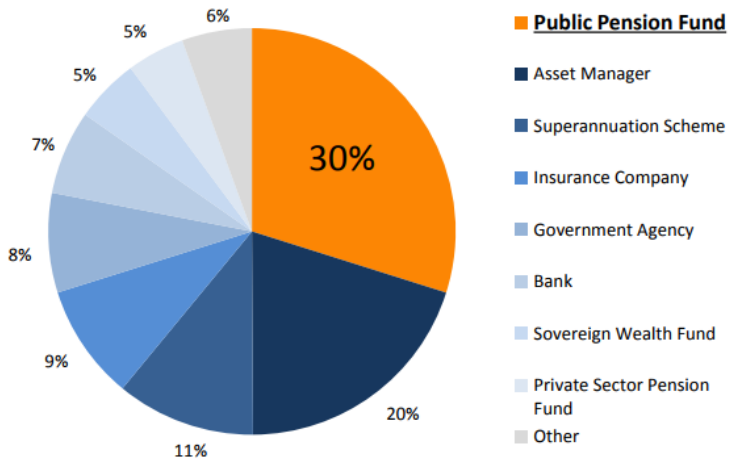


Figure 2.23 – Subdivision of top 100 institutional investor in infrastructure for type of business
Source: J. P. Morgan Asset Management 2014

As opposite to Yield driven investors, IRR-driven investors are interested in fast entry and exit strategies covering investment periods ranging from two to seven years, on average. They expect assets to appreciate fast and include estimations of the exit price in their investing decisions while putting in second place possible early cash flows issued by the assets. They target exit options allowing them to divest consistently with their strategy without impairing the likelihood of success of the project. Disinvestment can occur through an Initial Public Offering, a sale on the secondary market or a trade sale. IRR-driven investors are strategic investors like investment funds and are more likely to target assets under construction, with no revenue generation capacity and a low value, which is expected to soar as the asset comes closer to its completion and the probability of success increases. IRR-driven investors face realization risk, namely the risk that the price at which they get to sell the asset on the market is lower than expected and fails in satisfying their IRR expectations.[62]

2.3 Financing infrastructure

Infrastructure are usually financed by a mix of equity and debt capital. Equity instruments are all the financing tools that embody an ownership interest in a firm or a project asset. Equity capital is essential risk capital to start or refinance a business. Investments in equity can be carried out by purchasing both listed and unlisted shares. Listed shares are indirect participation rights in corporates, projects and other entities. They usually represent minority interests and provide investors with limited influence on the entity's management. Unlisted shares instead confer direct ownership, control and operation of the entity, as they usually entail concentrated ownership structure and closer ties among owners and managers (who sometimes coincide). Equity-holders' benefits include both economic and administrative rights. On the administrative side, they have the right to vote in the meetings of the shareholder board, which is entitled by law to take some decision interesting the firm/project and the underlying business. Intuitively, the bigger the stake, the more an investor will be able to influence the board with its vote. Economic benefits can derive from the cash flows possibly issued in the form of periodic dividends as well as from possible capital gains. Dividends represent a portion of a company's yearly net income, proportional to the size of the ownership interest and to a payout ratio, defined at managerial level. Capital gains are unrealized gains arising as a consequence of the appreciation of a company or project asset value, as it is represented by its projected ability to generate cash flows in the future. Investors can monetize capital gains by selling their stake on the market, if an open market does exist, or earn a share of the resulting proceeds when the company/asset is sold. Capital gains are the main source of return for equity investors in businesses showing important investment

[62] Weber, Barbara; Staub-Bisang, Miriam; Alfen, Hans Wilhelm – "*Infrastructure as an Asset Class - Investment Strategy, Sustainability, Project Finance and PPP*" – II edition – Wiley – 2016

opportunities that justify the retention and reinvestment of produced income. On the contrary, dividends, above all if sizeable, are generally issued by mature “cash cow” businesses with limited need or possibility to profitably reinvest earnings. Investors in equity expect the highest return with respect to providers of all other types of capital, as their claims on the company or project are satisfied on a residual basis, after all other investors have received what they are meant to. Therefore, in case of company of a project default or liquidation of a company, equity capital investors face a higher likelihood of losing the whole investment or a significant portion of it. As a compensation for high risk, equity investors’ return has no upper limit: as long as the business is successful, their earning potential is infinite. Equity investors are interested in maximizing the return on equity, namely the ratio between net income and the equity capital invested, over a given period of time. Obviously, institutional investors targeting core brownfield infrastructure will look for high dividend yields to increase their return on equity, given that core infrastructure assets are unlikely to provide relevant capital gains.

On the other side, debt-holders inject money in a company, project or other entity in order to earn a stable stream of periodical cash flows in the form of interests, computed as a direct function of an either fixed or variable interest rate and of the amount lent, net of partial reimbursements. At the end of the investment horizon, they also expect to have received back the invested capital, either one-shot or through a series of partial principal repayments over the life of their investment. In the best case scenario, they earn what has been established in advance, while in case of default they can lose invested capital. Notwithstanding, they have a higher priority in capital reimbursement and are therefore less likely to suffer from grave losses of capital. Loans and bonds represent the main form of infrastructure financing, consistently with the role and depth of debt markets in the World. Debt financing can be provided through multiple instruments. They include loans granted by companies as a form of direct investment, as well as structured instruments to be resold to investors or distributed on the market. Debt can be sold on both the private and the public market. Debt sold on the private market takes the form of private-placement debt while debt for the public market is embodied in bonds, be they corporate or government bonds. Some debt instruments are customized to meet the exigencies of specific categories of investors, such as insurance companies and pension funds, exploiting clientele effects on price and increasing the appeal of infrastructure financing.

Hybrid financing instrument represent a bridge between equity and debt capital instruments. They include mezzanine equity and debt capital instruments with equity-like features.

Institutional investors have a number of ways to invest in infrastructure equity, including:

- Direct investments in an infrastructure asset, either alone or according to a co-investment scheme involving other institutional investors, industrial and financial partners, professionally managed investment funds;
- Investments in unlisted infrastructure companies or private infrastructure investment funds;
- Investments in listed infrastructure companies owning a portfolio of assets
- Purchase of listed infrastructure companies' shares, either directly or through pooled investment funds [63]

Infrastructure exposures, similarly to traditional ones, can be subdivided in listed and unlisted investment opportunities. Unlisted infrastructure investments are gained through the private market and involve a close relationship between investors and companies, as the formers directly own a portion of an infrastructure company and of its assets. The most important benefits of this kind of investment is that investors get the direct exposures they are looking for and all of the benefits that come with owning the infrastructure facility. On the other side, the lack of liquid secondary markets and the customized nature of unlisted infrastructure investments determine a significant degree of illiquidity, strengthened by a frequent lack of information about the investment.

As an alternative, investors can finance listed companies whose business is based to a significant extent on infrastructure-related activities. Listed companies' equity has the advantage to be traded on liquid public markets and hence it represents an easily divestible investment. Public market regulation imposes certain disclosure standards and hence listed opportunities are more transparent and comparable. In addition, public markets grant investors the possibility to access investment opportunities that would not be otherwise available. The primary drawback of this type of investment is that listed companies are often conglomerates whose share of business represented by infrastructure-related activities is significantly lower than 100%.[64]

[63] J. P. Morgan Asset Management & Milliman– Bornens, Francois; Coatesworth, William - "*Infrastructure investments for insurance companies under Solvency II*" – September 2013

[64] McGraw Hill Financial – S&P Dow Jones Indices – Cheng, Tianyin; Srivastava, Vinit – "*Approaches to benchmarking listed infrastructure*" – October 2015

The table below summarizes the characteristics of listed and unlisted infrastructure investment opportunities, in comparison.

Considerations	Public	Private
Control	Lower	Variable
Volatility	Higher (but less so than often assumed)	Lower (but higher so than often assumed)
Frequency of Valuations	Daily	Quarterly or Annually
Liquidity	Daily	Lower
Diversification	Greater	Lower
Fees	Lower	Higher
Investor Commitment Level	Lower	Higher
Financial Transparency	Higher	Lower

Figure 2.24 – Characteristics of listed and unlisted infrastructure opportunities in comparison
Source: Goldman Sachs Asset Management 2016

The following table hosts a complete taxonomy of financial instruments through which it is possible to finance infrastructure.[65]

Modes		Infrastructure Finance Instruments		Market Vehicles
Asset Category	**Instrument**	**Infrastructure Project**	**Corporate Balance Sheet / Other Entities**	**Capital Pool**
Fixed Income	**Bonds**	Project Bonds	Corporate Bonds, Green Bonds	Bond Indices, Bond Funds, ETFs
		Municipal, Sub-sovereign bonds		
		Green Bonds, Sukuk	Subordinated Bonds	
	Loans	Direct/Co-Investment lending to Infrastructure project, Syndicated Project Loans	Direct/Co-investment lending to infrastructure corporate	Debt Funds (GPs)
			Syndicated Loans, Securitized Loans (ABS), CLOs	Loan Indices, Loan Funds
Mixed	**Hybrid**	Subordinated Loans/Bonds, Mezzanine Finance	Subordinated Bonds, Convertible Bonds, Preferred Stock	Mezzanine Debt Funds (GPs), Hybrid Debt Funds
Equity	**Listed**	YieldCos	Listed infrastructure & utilities stocks, Closed-end Funds, REITs, IITs, MLPs	Listed Infrastructure Equity Funds, Indices, trusts, ETFs
	Unlisted	Direct/Co-Investment in infrastructure project equity, PPP	Direct/Co-Investment in infrastructure corporate equity	Unlisted Infrastructure Funds

Figure 2.25 – Taxonomy of instruments and vehicles for infrastructure financing
Source: OECD 2015

[65] OECD – "*Infrastructure Financing Instruments and Incentives*" - 2015

2.3.1 Infrastructure project finance

There are basically two ways to invest in infrastructure equity and debt: project and corporate finance. Traditionally, corporate finance has represented the predominant financing method. Most regulated entities, waste managers and energy businesses have a long track record of in-balance-sheet private financing. More or less diversified listed companies constitute sizeable investors in infrastructure assets and projects, as well as infrastructure operating companies. Recently, though, both private and public investors have paid increasing attention to alternative financing schemes, above all project finance initiatives.

Project finance is a type of structured financing based on the existence of a legally and financially independent stand-alone entity called Special Purpose Vehicle or Special Purpose Entity, which is entitled to perform all and only the activities related to the project for which it is created, in the context of a non-recourse or limited-recourse financing scheme, which ring-fences its sponsors from the liabilities that arise from the entity's activities. The SPV is created by one or (usually) more sponsors, which inject equity capital in it at the start and whenever it is needed, and receives debt capital from stand-alone borrowers or (usually) syndications of borrowers. The project entity is the core of the contractual network backing the project in question, representing one of the ends of each of the contractual links that are essential for the pursuance of the project goals. Through said links, the project company exchanges resources, benefits, risks and information with its counterparties. [66]

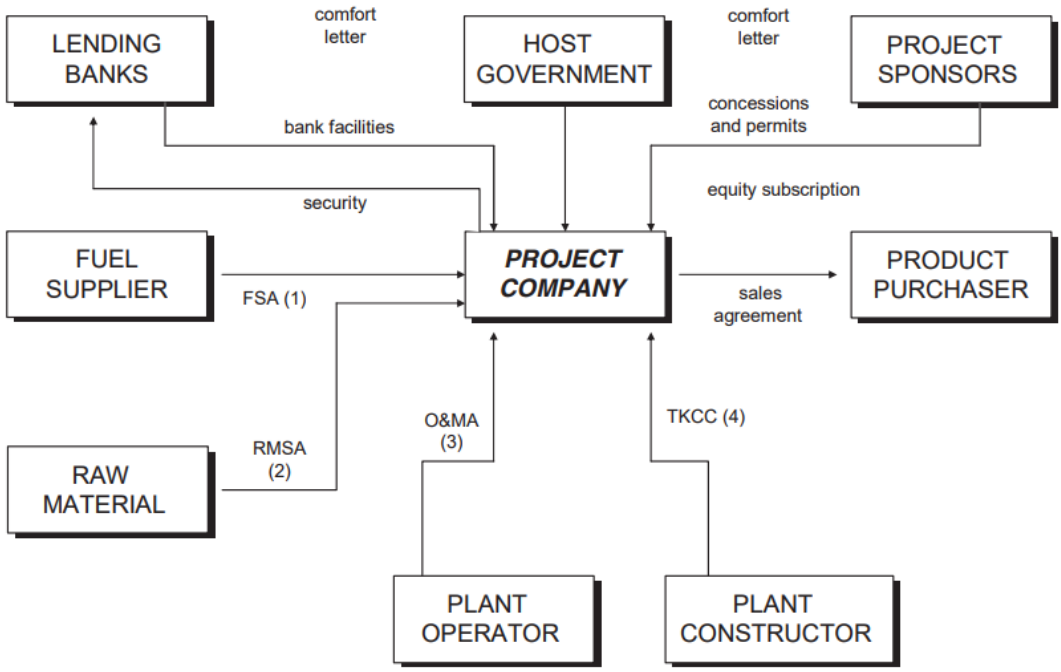


Figure 2.26 – Contractual structure of a project finance deal
Source: Academic Press Advanced Finance Series – Gatti, Stefano – "Project finance in theory and practice – Designing, Structuring and Financing Public Projects" - 2008

[66] Academic Press Advanced Finance Series – Gatti, Stefano – "*Project finance in theory and practice – Designing, Structuring and Financing Public Projects*" - 2008

Project equity and project debt investors can only rely on the project cash flows to earn the return they expect from their investment and, in case of default, creditors have recourse on project assets only. In some cases, other assets are purposely identified in advance to back investors' claims up. Therefore, the projects' creditors neglect sponsors' creditworthiness and carefully asses the financial feasibility of the project and the expected streams of cash flows it is expected to generate, which have to cover debt servicing and costs, before ultimately issuing satisfactory dividends to sponsors. Possible guarantees and covenants that may be provided by the project sponsors make up the security package. The essence of project finance is risk allocation. By means of project finance, the multiple sources of risk affecting a complex large project like the construction of an infrastructure work are split among all involved parties, with the aim to allocate each risk to the party that is better equipped to deal with it. Project finance techniques are usually employed only for projects enough sizeable to make related benefits offset the typically important transaction costs of project financing. Generally, project finance techniques are adopted in mature industries where a monopolistic position can be built. Products or services supplied are standardized and show high demand inelasticity. For project finance to be convenient, sponsors have to be reliable and experienced, risk has to be efficiently allocated among parties and sales and purchase agreements have to be in place to reduce demand and supply risk. [67] Project finance techniques have emerged as particularly suitable for projects characterized by high specificity, low re-deployable value and high capital intensity, where the public sector acts as either regulator or counterparty. Recently, co-investment platforms for the leveraging of institutional investors' capital in project finance have been developed and spread. These platforms allow institutional investors to pool their resources without relying on intermediaries and reduce the cost of project finance. The main factor triggering this new trend is the acquired awareness that several institutional investors miss resources and expertise to make direct investments in infrastructure assets but may have built significant scale and market presence, together with the expertise to perform due diligence on infrastructure.

Among main project finance instruments, it is possible to list project bonds and sub-sovereign issues in bond markets, loans and direct lending in non-public markets, listed entities and direct/co-investments in project equity. Contracts like concessions, long-term leases and Public-Private Partnerships usually determine risk sharing and control arrangements in project finance. Public-Private-Partnerships, which have emerged as broadly used legal frameworks for project finance investments, are hardly standardized and are shaped according to the specificities of single projects.

[67] Merola, Federico – "*How to analyze, structure and finance direct investments in real assets abroad with a project finance approach*" – International finance course teaching material - 2017

In most cases, project equity-holders bear asset-specific risks, and the return on their investments depends on the success of the project. Sponsors initiate a project by injecting equity into a Special Purpose Vehicle or by participating as bidders for projects tendered by the public sector. Sponsor confer equity, that usually represents from 10% to 30% of a project financing mix. They are closely bound with managers of the project but are not usually involved in operations. While equity providers aim at reducing the portion of equity capital in the financing mix, so to minimize their commitment and enjoy a stronger leverage effect, in times of crisis borrowers may require that the equity financing is increased.

Generally, project finance deals exhibit high levels of leverage. For infrastructure projects the leverage is even higher, given that infrastructure assets are deemed to produce more stable cash flows and infrastructure projects sponsors are prone to accept higher levels of debt. In addition, infrastructures are capital intensive assets and tend to exhibit lower technical and operational risks, therefore sustaining a higher share of debt than other equally rated projects. Traditionally, debt ranges from 80% to 90% of the financing mix of infrastructure projects and there are some examples of 100% debt financed projects. In these cases, lenders are also the operators of the asset.

Project debt is not unique. Each project is characterized by a different security package made up by sponsors for credit enhancement, including covenants, collaterals and other credit enhancement tools. This, coupled with the tranching of issues, creates different credit instruments with different profiles, able to meet different investors' exigencies.

Infrastructure debt is usually considered as fixed income for investors and can be divided in several different types of asset. Infrastructure project debt instruments include project loans and, to a lesser extent, project bonds. Mezzanine debt and other subordinated issues can be added and come to represent from 0% to around 20% of the debt financing mix. Mezzanine debt is riskier than senior debt but less risky than equity capital. Riskiness is here represented by a lower priority in interest payment and principal repayments, especially relevant in case of financial distress or project default. The lower the seniority of a tranche of debt capital, the higher the risk and hence the higher its expected yield, that is viewed as a financing cost from the point of view of the project. Different tranches of debt can offer different risk-return profiles, hence attracting investors with heterogeneous preferences. Development banks, commercial banks and Special Purpose Vehicles can issue listed or private mezzanine financing, representing quasi-equity instruments, namely fixed income financial products with equity rights, particularly appealing for investors like pension funds. Mezzanine capital represents an important source of support and protection for senior debt and increases its quality, as it buffers it against losses.

Most project debt instruments are denominated in local currencies to avoid currency mismatch between revenues and financing flows. Nonetheless, markets where the use of derivative contracts for currency risk hedging is spread, multi-currency financing structure can arise. Within underdeveloped and emerging markets having small sized debt markets still need to be supported by a series of sound legal, fiscal and monetary policies. [65]

2.3.2 Infrastructure corporate finance

Corporate finance is the traditional form of non-public infrastructure finance. Corporates can be considered as portfolios of projects with differing performance and operational risks. Already existing companies may issue new shares or take more debt to finance the planning and construction of new infrastructure assets. Retail and institutional investors can invest in the equity of companies by directly purchasing their shares or by investing in funds including said companies in their portfolios.

An infrastructure company can be defined as a company having consistently earned most of its revenues (e.g. 70%) from infrastructure-related economic activities, over a significant or at least not negligible period of time (e.g. over the previous three years).

The market of debt is a large source of corporate financing. Traditional, subordinated and convertible bonds, as well as preferred stocks, are all sources of corporate debt that can be found on the market. In addition, companies can borrow money from banks through the syndicated loan market. Syndicated loans are hybrid instruments combining elements of the direct private lending with elements of debts negotiated on the market. These are packaged credit solutions by a group of banks and allow for a better risk allocation among the financial institutions involved, besides allowing them not to withstand some of the typical obligations regarding obligations' issuers.[68] In addition, banks can increase their liquidity by packaging and selling some of their outstanding loans through a securitization. Structured debt products include Collateralized Loan Obligations and Asset Backed Securities. Private market channels are also in place for companies to raise additional capital. Institutional investors can fund them by contributing sizeable amounts of equity and debt capital, either directly or in the context of co-investment schemes.

Legal provisions have played an important role in determining the interest of investors for debt finance. Debt interests paid by companies are considered as before-tax expenses and therefore reduce companies' taxable income. This phenomenon is known as the tax shield of debt and causes a reduction in the real cost of debt with respect to the contractually defined one. In addition, the current international economic environment, characterized by low interest rates, has observed a decrease in the nominal cost of debt, therefore reducing companies Weighted Average Cost of Capital and

[68] Gadancez, Blaise; "*Il mercato dei prestiti sindacati: struttura, sviluppo e implicazioni*" – December 2004

enhancing equity-holders' return. This makes debt an important part of an efficient capital structure for infrastructure corporate financing.

Equity for corporates can be provided through private and public financing. Private equity is directly contributed to unlisted companies, to which equity providers tend to be strongly bound. Indeed, private equity providers usually have large stakes in the companies they fund and are often directly involved in its development and management. Instead, public equity is provided to companies, funds or assets that are traded in some forms of listed vehicle on a stock exchange. Traditionally, public equity providers hold just minority interests in the companies they buy shares of and do not participate in the business. Closed-ended funds, multilateral partnerships, and Real Estate Investment Trustees are examples of investment pools for infrastructure but, at the same time, they issue shares (and sometimes debt) on the market as traditional corporations do. [65]

2.3.3 Market vehicles for infrastructure financing

Market vehicles are diversified portfolios of securities, loans or private investments allowing to pool capital from different sources and are the most commonplace means for infrastructure investing. Direct investing is indeed a rarely used form of investment for infrastructure, as it entails the deployment of significant financial and managerial resources. Single direct investments in infrastructure assets can indeed require upfront capital injections of hundreds of millions. As a consequence, also biggest investors may find it difficult to couple such a huge commitment with a fair degree of portfolio diversification. In carrying out direct infrastructure investments, investors also need to carefully assess the specificities of the target opportunity and so they have to rely on an internal team of professionals in charge of conduct due diligence, assess potential risks and expected return of the asset, negotiate the acquisition, possibly participate in the construction of the asset, engage in ongoing asset management activities. For these reasons, large investors are likely to opt for co-investments schemes in a single asset, together with a professionally managed investment fund.[63] Funds are appealing to several categories of investors and are usually characterized by high liquidity and transparency and low transaction costs. Most funds are open-ended, meaning that they have no set number of shares. New shares are issued when investors demand for them while old shares are redeemed when former investors are willing to sell their investment in the fund. When new shares are issued, their value is determined by the real net asset value of the fund. Therefore, open-ended funds always reflect the value of the underlying assets. Funds can also be closed-ended, meaning that a fixed number of shares is spread into the public market at the beginning, through an Initial Public Offering and then transferred among investors in the secondary market at the current market price. The following table provides a synthetic comparison between open- and closed-ended funds.

Open ended	Closed ended
Indefinite fund life	Finite fund life
Suited for mature assets with long-term steady cash flows	Well-suited for greenfield assets with unproven revenue streams, which have a high likelihood of being sold in the near term
Fees paid on value of fund assets	Fees paid on committed capital
Investor has limited ability to redeem investment	Little or no liquidity for investors
Independent third party asset valuations, typically conducted six monthly	Valuations performed yearly by manager; asset values may not be accurately reflected until divestment of the asset
Stable returns with high yield component	Majority of returns consist of capital growth
Typically pay stable cash yields throughout fund life	Capital tends to be returned to investors in last few years of fund life

Figure 2.27 – Characteristics of open-ended and closed-ended funds in comparison
Source: AMP Capital 2013

Publicly listed funds include both mutual funds and exchange traded funds. Mutual funds are pools of money provided by individual or corporate investors and managed by a fund manager according to an agreed-upon objective. The presence of a full-time manager in charge of monitoring the course of assets the fund has invested in is a prominent advantage of investing in mutual funds.[69] Exchange traded funds, instead, are not actively managed but replicate a market index like the S&P 500 or the Dow Jones Industrial Average.[70] Private infrastructure funds are in the form of general partnerships and act similarly to private equity funds. The pooled money is used to perform selected investments and to pay management and operating fees. Private funds show low liquidity and average duration ranging from 5 to 15 years. Private funds' managers seek to enhance the value of the underlying assets by improving operations and/or management of related businesses. General partnerships involve active management of the investment and of the associated risks. Infrastructure unlisted funds are the main investment vehicle connecting investors to infrastructure assets. The average size of each of them is around one billion dollars, with a significant variance. Along 2017, 69 private infrastructure funds had achieved their final close, securing as much as $65 billion. Half of this amount has been secured by the five biggest funds.[71]

Funds of funds show several commonalities with individual funds. Capital is pooled and then drawn at need. Usually a fund of funds invests in eight-to-twelve funds at a time and its management lies primarily in the investment management rather than in the management of underlying businesses. Indeed, funds of funds are often specialized in due diligence and diversification. It is important to stress that the management style and chosen criteria differing among funds are an important determinant of the characteristics of investments that need not to be neglected by investors willing to find investment

[69] Thebalance.com – Kennon, Joshua – "*The Basics of Mutual Funds*" – April 2017
[70] Assogestioni – "*Exchange traded funds*"
[71] Prequin – "*2018 Global Infrastructure Report (Sample pages)*" – January 2018

opportunities that keep consistent with their preferences and risk-return targets. [72] The average size of infrastructure funds of funds is of around $400 million and their average duration is slightly less than two years and half. Since 2008, infrastructure funds of funds achieved, on average, 101% of their initial target. [73]

Other market-based infrastructure finance instruments are indices that track infrastructure shares. The formation of such indices facilitates product creation and allows for both active and passive management in infrastructure companies. General Partnerships are private market funds focused on the market of institutional investments. These market instruments allow participants (limited partners) to access diversified exposures to private infrastructure equity and debt. [65]

2.4 Determinants of infrastructure assets risk-return profile

Infrastructure investments offer a broad variety of risk-return profiles and cash flow types, ranging from highly conservative fixed income-like investments to riskier assets showing private equity-like features.[74] Each asset can be positioned at one point of the spectrum according to several elements, including its size, its sector, its expected life span, its service area demographics, regulatory and political considerations. The following figure provides a schematic representation of the main factors impacting the risk-return profile of infrastructure assets.[75]

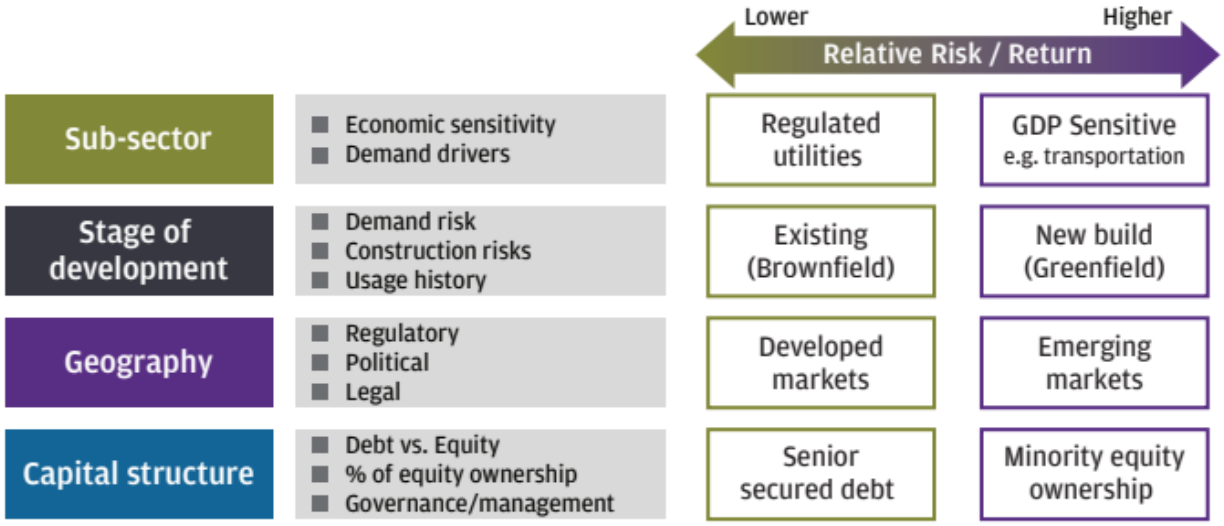


Figure 2.28 – Determinants of the risk-return profile of infrastructural assets
Source: J. P. Morgan Asset Management 2015

[72] Credit Suisse Asset Management – Russ, David; Thambiah, Yogi; Foscari, Nicolo – "*Can Infrastructure Investing Enhance Portfolio Efficiency?*" – May 2010
[73] Prequin – "*Infrastructure Funds of Funds*" – December 2017
[74] Weber, Barbara; Staub-Bisang, Miriam; Alfen, Hans Wilhelm – "*Infrastructure as an Asset Class - Investment Strategy, Sustainability, Project Finance and PPP*" – II edition – Wiley – 2016
[75] J. P. Morgan Asset Management – "*Infrastructure Investing. Key benefits and risk*" - 2015

2.4.1 Sub-sector

Infrastructure can be divided in social availability-based assets, utilities and economic infrastructures (see Paragraph 1.2). Social infrastructures are schools, jails, public parks, cemeteries, firefighters' and police stations, administrative buildings and other publicly financed works enabling the provision of social services. Utilities are energy, gas and water providers, waste and wastewater managers. Economic infrastructures are found in the transportation and communication sectors. Most research paper suggest that the risk-return profile of infrastructure assets and the related yields are primarily determined by the sector they belong to. Nonetheless, considering the sector alone substantially neglects the inner complexity of assessing the characteristic of infrastructure assets and may induce inexperienced investors in severe mistakes. The industrial sector is nothing but one of the elements determining an infrastructure asset risk-return profile and cannot be taken as the bulk of an investment analysis.[76] Still, it can represent a good hint, given that each sector tends to behave according to some recurrent schemes which consolidate over time. One of the most important sector-driven factors determining the risk-return profile of an infrastructure investment is the extent to which the public sector contributes to face the cost of the underlying service. The larger the share of an infrastructure operator's revenues that is issued by a public entity, the lower the degree of demand risk borne. Demand risk is a subcomponent of (non-financial) market risk and is the risk of falling revenues associated to a reduction in the number of purchases, which can be in turn determined by several causes, including competition or sudden changes in consumers' preference.

The operator of an infrastructures can be remunerated for the service he supplies according to one of the following schemes:

- *Availability-based payment scheme:* the public sector pays a fixed periodic amount to the private entity for the availability of a given service to final users (performance-based payments) or for the availability of related premises, facilities and equipment, independently from the actual level of usage. In this case, demand risk is completely borne by the governmental body, that may be paying for a service for which demand is lower than expected, either from the begin or from a certain point in time. The operator bears some performance risk instead, as payments are no more issued if he fails to guarantee the due continuity of the service. Some thresholds may be set in terms of scope and/or quality of services provided, in order to determine the amount of the periodic payment issued. Availability fees are usually issued to operators of financially non-sustainable social infrastructure assets under Public-Private Partnerships agreements.

[76] B Capital Partners – Weber, Barbara – "*'What you don't see is what you get': The real risks and reasonable terms of infrastructure investment*"

- *Patronage-based payment scheme:* the operator is a player of a competitive market or is awarded a concession to levy fees on final customers. The amount of the fees is determined so that he can cover both its operating and investment costs and depends on the degree of choice that final users have, ranging from compulsory usage (monopolistic environment) to free choice in a competitive environment. Anyway, the business is economically sustainable and does not need any public support. When a business is awarded patronage fees, it faces both demand and performance risks completely, like a "traditional" business: if demand falls, revenues fall and if the business loses continuity, the operator faces all the related negative consequences. Anyway some parachute mechanisms may be guaranteed by the government in case of difficulties, given the strategic importance of concerned assets.
- *User-based payment scheme:* this is a hybrid payment scheme that may take two forms. In the first form, the economic cost of the service is still completely covered by the public sector but proportionally to the frequency and/or intensity of actual usage. This case is closer to availability-based schemes. In the second form, the public payment is complementary to the fees levied on customers. This scheme may be employed when the full coverage of the economic cost of the service would mean an excessive price for final consumers or when it comes to provide potentially profitable services in unprofitable time or place conditions While the former version completely charges demand risk on the operator, the latter splits it between the private and the public sectors and is deemed to align their incentives and to optimize the trade-off between quality and financial viability.[74]

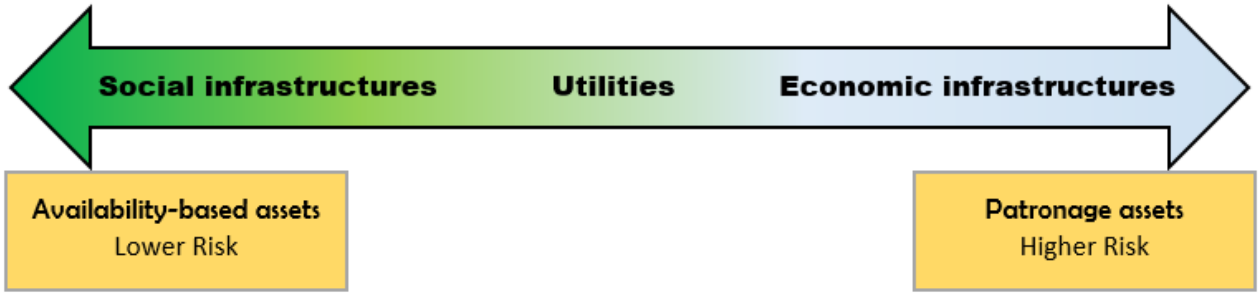


Figure 2.29 – Payment schemes and risk in infrastructure industries

Moving from the left to the right of the spectrum, the participation of the public sector in infrastructure operators' revenues decreases and there is more room for competition among them. This means that they increasingly have to rely on revenues coming from final users willing to pay for the specific service provided. Even in context of limited competition and demand inelasticity, this means increased demand risk and increased sensitivity to the short-term economic upturns and downturns.

As a rule of thumb, social infrastructure is the least affected by short-term economic fluctuations while economic infrastructures are likely to suffer from reduced revenues during economic downturns. Utilities, lying in the middle, face a predictable cyclicality associated to human behaviors and habits rather than to economic conjunctures.[77]

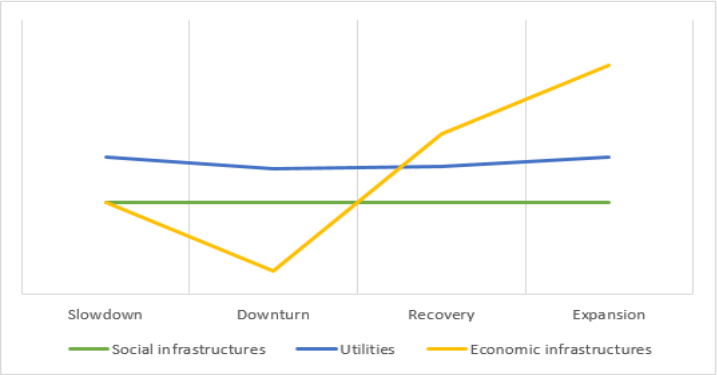


Figure 2.30 – Sensitivity of infrastructure sectors' performance to economic upturns and downturns
Source: AMP Capital 2014 (adapted)

The following table gives an overview of the composition and size of expected return from infrastructure assets in different industrial sectors, together with a qualitative assessment of their overall riskiness.

Sector	Relative risk assessment	Avg. cash yield %	Avg. expected return (%)[1]	Capital appreciation potential
Social infrastructure/PPPs and PFIs[2]	Low	4-5	5-8	Low
Contracted power generation[3]	Low	5-8	6-10	Low
Regulated utilities	Low-medium	4-7	8-10	Low-medium
Toll roads	Low-medium	4-6	8-12	Low-medium
Airports	Medium	5-7	10-15	Medium
Seaports	Medium	5-7	11-16	Medium
Freight rail	Medium-high	6-8	12-16	Medium-high
Telecommunication infrastructure	High	5-9	12-18	High
Merchant power generation	High	0-4	14-20	High

Figure 2.31 – Infrastructure sectors return (size and composition) and risk
Source: J.P. Morgan Chase & Co – "Infrastructure investing: key benefits and risks" – 2015
[1]Loan-to-value ratios are assumed to range between 50% and 85%
[2]PPP and PFI refer to Public-Private-Partnerships and Project-Finance-Initiatives respectively
[3]Contrcts are assumed to have minimum term of ten years

The chart below, instead, shows the distribution of new infrastructure deals among infrastructure industries, comparing the results related to each year of the 2014-2017 period. [78]

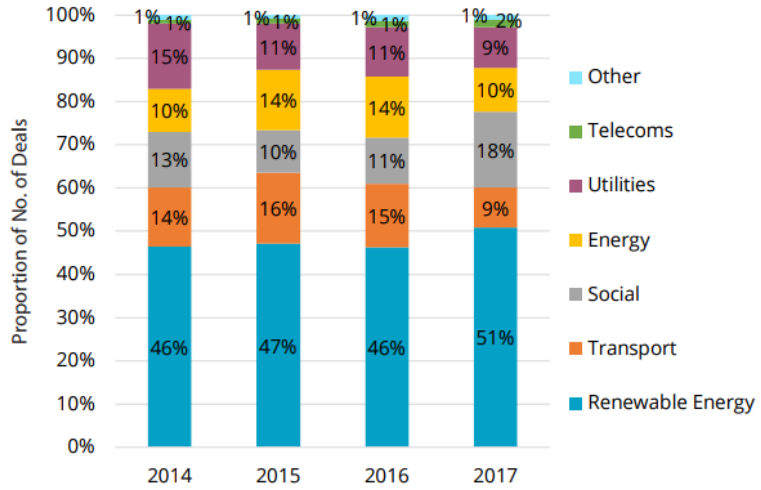


Figure 2.32 – Infrastructure deals by primary industry over 2017
Source: Prequin 2018

[77] AMP Capital – "*Understanding infrastructure*" – 201
[78] Prequin – "*2017 Infrastructure Deals*" – January 2018

2.4.2 Stage of development

The same asset or project can show significantly different risk-return characteristics, depending on the moment of its life when it is analyzed. Three phases of each project's life can be identified, namely a greenfield, a development and a maturity phase. During the greenfield phase, the infrastructure asset is said to be a greenfield asset, while during the other two phases it is said to be a brownfield asset in its primary/construction phase or a brownfield asset in its secondary/operational phase. [79]

Greenfield assets are new works to be designed and built from scratch in a place where no similar works have ever arisen before and no past performance record is available. In this moment the infrastructure is not revenues-generating yet and the expected return is exclusively composed by deferred capital gains to be realized if the value of the work actually increases as a consequence of successful completion and subsequent performance. Greenfield assets are generally deemed to be much riskier than already existing assets. The risks of greenfield projects on the cost side are primarily planning, development, receipt of permits, approval of the public, structuring, financing, technologic, as well as construction and operation risks. On the revenue side, the main risk is the uncertainty about the validity of conjectures formulated about future volumes and applicable prices.[80] Investors in greenfield infrastructures are also implicitly taking on the perspective risks regarding actual usage and performance of the asset. As a consequence, greenfield assets are highly remunerative and are targeted by investors willing to include in their portfolios private equity-like investments expected to generate J-curved profits. The relative frequency of greenfield infrastructure deals in a region is inversely correlated with its stage of development. Indeed, more than half of infrastructure deals, in Africa, are greenfield deals, while in OECD countries the share is significantly lower.[81]

Brownfield assets in their secondary phase are fully operational and revenue-generating infrastructure works. They are expected to provide high cash yields but GDP-level potential capital gains. This is the least risky phase in the life of an infrastructure asset, as many unknowns have disappeared and only general operational risks are still in place, including demand risk, performance risk, regulatory risk, political risk. Consistently, brownfield assets' overall return is lower. Financers of brownfield infrastructures are interested in fixed-income-like assets that provide them with a reliable stream of long-term steady inflation-linked cash flows.

[79] EY – Allison, Ryan; Tufts, Sam – "*Infrastructure investments. An attractive option to help deliver a prosperous and sustainable economy.*" - 2015

[80] B Capital partners – Weber, Barbara - "*<What you don't see is what you get>: the real risks and reasonable terms of infrastructure investments*" -

[81] Prequin – "*Greenfield Infrastructure Deals*" – May 2017

Analogously to what said for the sub-sector, the stage of development of an infrastructure asset is not the only element to be considered in assessing its potential for return and related risk. While it is true that greenfield assets are riskier than brownfield infrastructure in most cases, some well selected greenfield investments may present risk-return characteristics resembling brownfield-like conditions.

The following chart shows the value-creation process of an infrastructure asset (specifically, a wind farm) from its pre-planning greenfield phase to the mature phase of its operational stage, including the appreciation of the invested capital, associated costs and risks taken.

	Greenfield		Brownfield	
	Pre-planning development	Post-planning development	Construction	Operations Ramp-up | Growth | Maturity
Duration	12–24 months	3–6 months	12–24 months	20+ years
Description	• Before permits • High risk • 1 in 3 gets approved • €0.5–1 million invest	• Permits received • Negotiation of all relevant contracts • Pre-financial close	• Post-financial close • Post all contracts • Construction risk relatively low • Pre operations	• Once constructed and connected to the grid, priority of dispatch given with guaranteed take-off agreements for energy generated • Ramp-up and growth phase not applicable
Equity*	€0–5k per MW	€150–200k per MW	€300–400k per MW	€600–800k per MW
Costs	€1–2 million per project		€15–50 million per project	

Figure 2.33 – Value creation: from greenfield to brownfield - Example of an onshore wind development
Source: B Capital partners

The development phase is a hybrid optional phase where an existing (brownfield) asset is renovated, enhanced, upgraded or expanded. It may carry most of the same risks borne during the greenfield phase (e.g. permission risk, financing risk, construction risk) but to a lesser extent, as they are likely to regard only the incremental aspects of the project. Risk and return of assets under development lie in the middle between greenfield and mature assets' risk and return. Ideally, given the length of infrastructural works' lives, they should undergo a development phase several times. [77]

The following figure graphically describes the behavior of an infrastructure asset going through its life stages, stressing both the progressive increase in its value and the contemporary decrease in the number of sources of risk affecting the project in each moment.

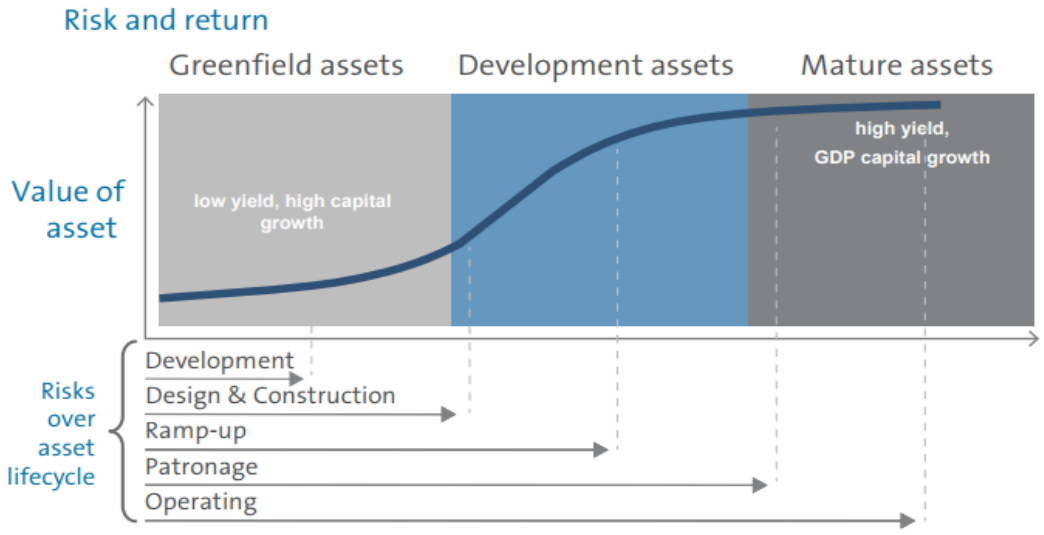


Figure 2.34 – Stages of an infrastructure asset's life: value and risk dynamics
Source: AMP Capital

Over 2017, 72% of infrastructure deals have interested fully operational infrastructure assets. Deals regarding greenfield and brownfield assets in their primary phase, instead, have represented 24% and 4% of all the deals, respectively.[78]

2.4.2.1 Main risks borne by infrastructure investors

Risk is an inner characteristic of business. Whatever economic activity is influenced by several different sources of risk. Financial risk is whatever factor potentially causing the reality to positively or negatively diverge from the expected outcome. While this definition finds applicability in a broad set of situations, the risk here considered is the "insurable risk", namely the risk of "negative events" (missed revenues or arising losses). Risks faced by investors in infrastructure assets can be subdivided, with respect to the life-stage of the project when they are borne, in pre-completion risks, post-completion risks and risks faced all along the project. The immediately following paragraphs give an overview about most important sources of risk affecting infrastructure investments. Some other are discussed in the continuation of this Chapter.

2.4.2.2 Pre-completion risks

- *Planning, construction and completion risk*

Planning, construction and completion risks are central for any project whose positive outcome relies on a work-in-progress construction. Possible related events include, from the worst to the least bad, non-completion of the work, completion with structural or performance deficiencies, delayed completion, off-budget completion. Planning the construction of infrastructure assets requires significant organizational and engineering work in order to ensure logistic and technical feasibility and having the works done is the outcome of complex projects characterized by several interrelated and interdependent activities and constrained by limited time and budget. Each activity is meant to provide

one or more qualitatively and quantitatively satisfying deliverables in the context of a time frame defined in advance and is attributed some more or less specific resources. In order for the project to be successfully completed, requirements arising from the vital logical links existing among several activities need to be met. If one or more activities find partial or delayed completion, this may have more or less heavy consequences for the other activities of the project, including remarkable increases in costs, penalty charging and negative impacts on the contractual structure linking the actors involved among each other. Planning risk can be mitigated by requiring independent *ex ante* appraisals from engineering experts. Construction risk is borne by the general contractor in charge of building the infrastructure, who passes it through to its subcontractors but keeps responsible toward the project entity, who expects it to guarantee completion at a certain moment. Accordingly, the reputation, experience and creditworthiness of the general contractor can make the difference for the success of a project and need to be carefully assessed. [82]

- *Technological risk*

Technological risk is the risk that a specific technology, theoretically applicable to a given facility, proves inapplicable, unsuitable, ineffective. It is borne especially in the pre-completion phase by the investors having funded the project, either directly or through a project vehicle. In theory, infrastructure assets should work on well-known tested technologies provided by reliable suppliers but they may be conceived to work upon technologies that are not fully understood or tested yet. This is often the case of infrastructures for renewable energy. Problems are more likely to arise when the technology is chosen by different subjects than the building company. While it is clear that completely unknown technologies will be hardly employed, it is also true that most projects, especially if ambitious, involve technologies showing at least some elements of novelty. Technological risk management requires a good degree of flexibility, that is not easy to couple with the careful planning activity naturally required by infrastructure construction projects. [82]

2.4.2.3 Post-completion risks

Post-completion risks concern the basic economic mechanisms inherent to the businesses supported by the constructed facility, namely input supply, input transformation, product sales. Although the post-completion phase is commonly deemed as less risky, post-completion risks may still cause delayed revenues and squeeze margins, impairing the project's ability to adequately remunerate investors for their commitment.

[82] Academic Press Advanced Finance Series – Gatti, Stefano – "Project finance in theory and practice – Designing, Structuring and Financing Public Projects" - 2008

- *Demand and supply risk*

Demand and supply risks are submodules of the non-financial market risk. Market risk can be considered as a general risk (as opposed to a project/asset-specific risk), given that it is determined by exogenous elements belonging to the environment where the business operates and does not directly depend on the features of the business itself. Nonetheless, the business operator can put in place some mitigation or hedging measures to properly face it. Demand risk is the risk that a business operator faces falling revenues because of unanticipated demand-side negative events or overoptimistic estimations of the drivers of demand. Basic economics suggest that the aggregate demand for a product is given by the demanded quantity multiplied for the price paid. If one or both of these elements are wrongly estimated *ex ante* or decrease during the operational phase, the business operator faces a revenues shortfall. This may be the case of a sudden massive change in consumers' preferences toward substitute or competing products. Clearly, no business can survive if it is not able to generate enough revenues to cover costs and guarantee a fair return on investors' capital. Demand risk can be mitigated by performing a careful preventive assessment of the target market, including an evaluation of its size, elasticity of demand, degree of competition, existence of substitute goods/services. Supply risk is the risk that the operator of an infrastructures has to face an unforeseen lack of possibly essential inputs. In extreme cases, inputs' flow may be completely and suddenly interrupted, while more likely events entail input shortfalls or the supply of impaired quality/poorly compatible goods, either from previous suppliers or from new "emergency" suppliers. Supply-side negative events are likely to cause under-exploitation of the productive capacity, increased costs and shrinking margins. Commodity risk is a specific example of supply risk (price risk sub-module), representing the risk of adverse price changes for floating price inputs like crude oil, steel or gold. Increases in input prices cause a contraction of profits, *ceteris paribus*, and may even translate into operating losses if the price of raw materials supersede the price at which produced goods or services are sold. The market risk associated to goods and services demanded and supplied by the operator can be reduced by using long term supply or offtake agreements with input providers or customers. Said agreements determine a minimum volume of goods exchanged over a given period and establish related economic conditions, punctually or within a range. They are mostly utilized for the purchase of commodities and raw materials. Derivative instruments, like futures or options, can be used to hedge or insure against commodity risk. [74] [82]

- *Performance risk*

Performance risk is a project-specific risk including the possibility that a completed facility underperforms with respect to expectations or standards. This may occur either in the initial testing phase or along the life of the asset. Underperformance may be caused by virtually infinite events or sets of events and have several consequences, usually borne by the operator itself. It may translate in reduced quantity and/or quality of the output, increased waste from the productive process, compromised safety, reputational losses, law breaking and so on. The most obvious consequences of performance breakdowns are efficiency losses and cost overruns but other consequences are not ruled out. To gain an insight about how grave lacks of performance can be, it is possible to recall that poor management and uneducated choices have been the main cause of the 1986 Chernobyl nuclear disaster. Performance risk mitigation occurs both before and during the operational phase. It starts with the choice of a suitable operator, having good knowledge of the products and processes and the technical and procedural skills to properly manage the business and the underlying technology. Ongoing maintenance is indispensable as well, in order to prevent negative events related to assets decay and obsolescence. When the likelihood of performance-related negative events and their expected loss are estimated to be overwhelmingly high, performance risk can be insured. [82]

2.4.2.4 Risks borne all along a project

Some risks are borne to different extents during both the pre-completion and the post-completion phases of infrastructure projects. Most of them are general risks, as they depend on the macroeconomic dynamics of the region where the asset is physically placed.

- *Interest rate risk*

The interest rate risk is the risk of unfavorable fluctuations of interest rates, with a negative impact on the firm's cash flows. Unlike exchange rate risk, it affects both domestic and foreign investments as well as international multi-currency projects. Basically, increases in interest rates cause an increase of debtors' interests burden and translates in increased costs of borrowed money. At extreme consequences, the magnified financing cost may consume an intolerable portion of a project's value. Interest risk assumes a greater importance when the investment horizon is longer, as long investments usually entail floating interest rates and their present value is much more sensitive to interest rate fluctuations. In addition, given the high leverage characterizing infrastructure projects, interest payables end up in representing one of main voices of cost for the owners of the asset. This happens both in the construction and in the operation phases, but to different extents. In the former case, interest payables represent the most sizeable and unpredictable source of expenses and revenues are not collected yet. In the post-completion phase, instead, the issue becomes less trenchant. In this

phase revenues are generated and they are expected to somehow change as interest rates move. Therefore, the following dynamics need to be considered at the same time: the increase/decrease of interest payables' value due to increase/decrease of the benchmark interest rate, the decrease of interest payables' value due to the decrease of the debt-equity ratio and the progressive reduction of the outstanding debt, the effect of interest rates' movements on the value of the revenue streams. Ideally, a case-by-case assessment should lead to the so-called "self-protection of revenues". The more changes in interest payables and revenues due to interest rates' fluctuations are correlated, the more the operating firm will be screened from interest rate risk. Importantly, this does not represent a form of insurance from the risk, as it rules out also possible positive consequences of favorable interest rates' changes. [82]

- *Exchange rate risk*

Exchange rate risk is the set of possible consequences of adverse fluctuations of relative currencies' value. In other words, if a portion of a company's revenues is denominated in a given foreign currency and that currency depreciates with respect to the company's home currency, this will cause the firm to have gained less of its own currency. Conversely, if a company has payables denominated in another currency, it will suffer from possible appreciation of the foreign currency with respect to its own, as this would impose it to deploy more of home monetary units to pay its debts. Clearly, this applies to multi-currency business only, including international and multinational businesses. Fixing an exchanged amount in a given currency means allocating exchange rate risk on the party having that currency as foreign currency. Allocation does not reduce the risk but shifts it from a party of the transaction to another. Exchange rate risk can also be allocated to third parties by using derivative instruments. [82]

- *Environmental, Social, Governance risk*

Environmental, Social and Governance risks are frequently interrelated risks arising from externalized non-financial factors that can impact a company or project profitability and reputation. They are especially important in projects' pre-completion phase but they do not disappear successively and so have to be continuously managed. What ESG risks have to be managed time by time depends on the specificities of projects/assets, including their sector and their physical location. The investing approach (see below) also does much in determining how and how much ESG risks are considered, given that neglecting them may have severe repercussions on the continuity of businesses. While a considerable share of people in the World are rising their awareness about environmental, social and governance issues and are shifting their habits toward more sustainable lifestyles, they expect businesses to do the same and this is like to impact their consumption schemes more than ever. In

addition, the digital revolution has improved the means through which information can flow and peer pressure can act, hence increasing the possibility of moral hazard-related negative consequences on businesses.

According to the degree of EGS integration in the decision-making process, it is possible to identify several investment approaches. At the extremes of the spectrum it is possible to find financially-oriented strategies with poor or no interest for ESG issues and philanthropy-based strategies with poor or no interest for financial profits. Intuitively, most real cases lie between these ends.

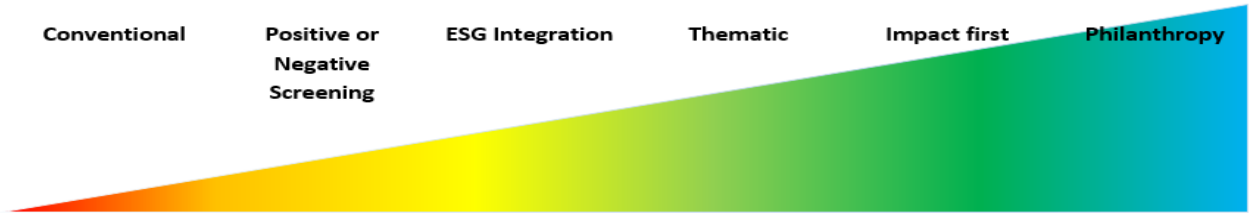


Figure 2.35 – Investments strategies according to the degree of consideration for ESG issues
Source: Weber, Barbara; Staub-Bisang, Miriam; Alfen, Hans Wilhelm – "Infrastructure as an Asset Class - Investment Strategy, Sustainability, Project Finance and PPP" – II edition – Wiley – 2016

From the left of the spectrum to its right, the focus shifts from financial to social profit. Screening strategies involve the preventive elimination of undesired investments or classes of investments (negative screening) or the creation of an eligible set of investments based on suitable criteria (positive screening). Negative screening is performed by individual investors and funds refraining from investing in businesses like tobacco or weapons. ESG integration strategy arise when quantitative and qualitative ESG factors are taken into account in the investing decision-making process at portfolio, stock, issuer or investee level. Screening and ESG integration strategies are considered as sustainable and responsible investing strategies where the financial profit is still the most important goal. Thematic investment strategies lie half-way between responsible/sustainable investment strategies and impact-based strategies and borrows features from both, as it equally pursues financial and social profits. For example, investing in a wind farm is likely to be beneficial for both investors and the society as a whole. "Impact first" strategies are applied when investors accept to earn lower-than-fair rate of returns on their investments, given that they actually have a positive impact on the society, like it could be the case of a consortium of farmers foregoing profits deriving from intensive livestock to produce higher quality meat granting animals with better life conditions.

The environmental risk encompasses all environment-related matters that can delay or prevent the completion of a project or cause cost overruns, before and after its completion. It is receiving an increasing attention in recent years because of the concerning path of humanly-induced natural resource fast depletion and perspective insufficiency of natural services to fulfill future generations' needs, also in the light of the projected demographic growth and increasing concentration of people in urban centers. Environmental risk is about both the effects of infrastructure works on the environment and the effects of the environment on infrastructure works. Infrastructure-induced impacts on the environment may include water and land pollution and excessive greenhouse gases emissions, undiscriminating use and waste of natural resources, deforestation, hindered biodiversity, alterations of ecosystems, damages to ecosystem services. Environmental-related effects on infrastructure works can either be direct, as it is the case of extreme climatic events damaging a bridge or a pipeline, or indirect, like in the case of changing environmental regulations or standards, causing a failure of the infrastructure operator to receive an authorization or avoid adverse legal actions and reputational losses. Climate risks have important repercussions on other pre- and post-completion risks, including planning, construction, completion, technology, financing, syndication, operational and residual value risks. An infrastructure asset that is built according to an environmentally-careful approach is more likely to be future-proof and to face reduced risks all along its life.

Social risks have predominantly to do with human and labor conditions, as well as health and safety matters for workers and local communities. Social risks are often linked to environmental and governance risks. They arise as a consequence of general lacks of safety associated to the construction of big infrastructures, possible exposure of workers and communities to hazardous substances, poor workers' living conditions, child and forced labor, damages at cultural sites or negative effects on indigenous populations. Social risks emerge in the form of public resistance to a project, allegedly in the form of street protests, negative ad campaigns and political adverse actions.

Governance is the set of processes and procedures aimed at managing a business. Governance risk is often associated to poor management practices, including corruption, improper payments to contractors and subcontractors, misalignment between managers' and shareholders' interests, poorly designed incentive mechanisms and governance structures. Typically, governance risk management is way more important in developing countries where the rule of law is still weak. [83]

[83] Weber, Barbara; Staub-Bisang, Miriam; Alfen, Hans Wilhelm – "*Infrastructure as an Asset Class - Investment Strategy, Sustainability, Project Finance and PPP*" – II edition – Wiley - 2016

2.4.3 Geography

Each country has several features that directly and indirectly affect the characteristics of its infrastructural systems. Infrastructure projects' risk-return profile strongly depends on the political, regulatory, legal and economic environment where they are located and investors have to carefully chose where to let their money flow according to their risk attitude and return expectations. Country-based risks affect infrastructures during their whole life.

- *Political risk:*

Political risk is a broad category of risks, including all possible negative consequences associated to politic dynamics that could directly or indirectly influence a country's business environment and companies there located. Political risk has to do with governmental stability, popular agitations, changes in law and adverse lobbying. A broadly adopted definition of political risk subdivides it in four sub-categories, namely investment risk, *force-majeure* risk, change-in-law risk and quasi-political risk. Investment political risks arises from any possible governmental choice directly hitting the normal functioning of a business, including nationalization, expropriation, seizure, limitations of business freedom (e.g. obligation to purchase raw materials from national producers), limited currency convertibility. *Force majeure* political risk arises from episodes of violence, including armed conflicts, rebellions or intense violent protests. Change-in-law risk encompasses all variations in the laws directly or indirectly affecting businesses in a country, hence including changes in tax laws, employment laws, safety standards and so on. Quasi-political risk includes risks depending on local governmental bodies and breach of contracts. Developing countries are particularly prone to suffer from a higher degree of political risk, given that their legal structure is not well-defined, their governments are often unstable and there is a lack of experience of private capital investment in strategic sectors. Political risk can be hedged through agreements with influent authorities in the country or by means of insurance coverage.

- *Regulatory risk:*

Regulatory risk is the risk that a project faces negative collateral effects of regulatory provisions in place where it is carried out. Business activities have to withstand several obligations, including those referring to environmental, consumers' and workers' protection. While most of these regulations are necessary and their importance is commonly felt, some aspects are complicated to regulate and several obstacles may jeopardize the design of sound regulations able to sustain reasonable balances among the interests involved. In addition, if rules are designed without carefully assessing all the possible related consequences, they are likely to cause inefficiency and excessive bureaucratization of procedures. Too many times, also in developed countries, getting the authorization to start a project

takes more than the construction itself, with obvious negative consequences on the investment performance.

- *Legal risk:*

Legal risk is the risk that once contracts and agreements backing a certain project are in place, they are not effectively enforced. Contracts enforceability depends on the characteristics of a country's judicial system and is an essential element for doing business. While the amount of political risk tends to be a negative function of a country's development status, legal risk may be high in advanced countries as well. This depends also on administrative and institutional issues like corruption, impairing the judicial system capacity to determine contracts' enforceability.[84]

The following chart provides a representation of the degree of country risk in each of the World countries. Country risk is here defined as the risk arising from the coexistence and interaction of political, legal and regulatory risks. Data encompass indicators of both short-term and long-term sources of politic and economic stability/instability. Countries in green (Scandinavian countries) are the best performers, followed by countries in pale green and countries in pale orange.[85]

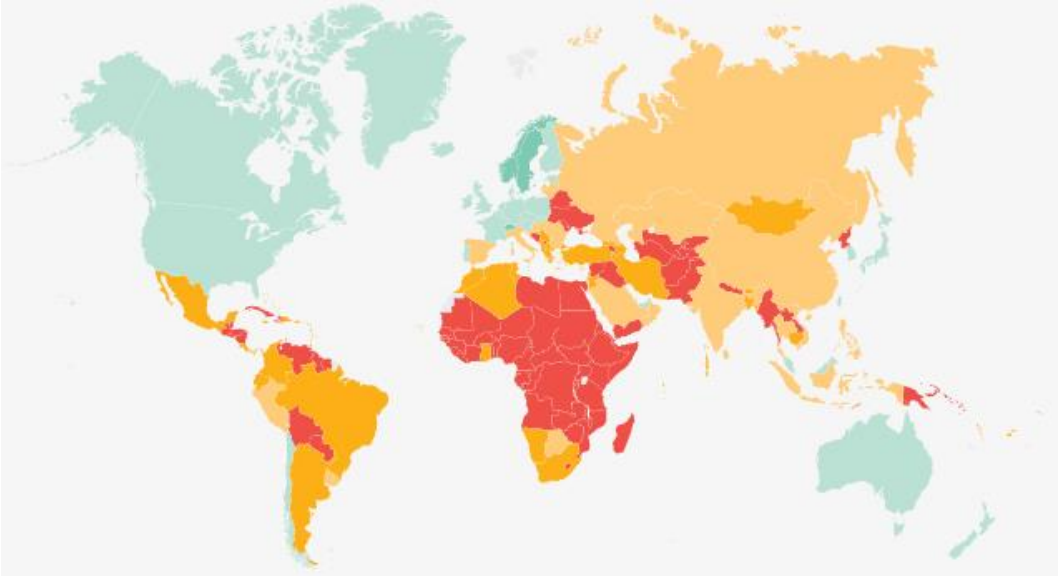


Figure 2.36 – Country risk in World countries
Source: Marsh and BMI 2017 Political Risk Map

Ideal markets for investors in infrastructures show strong growth potential, secure business environment, well-established legislative and regulatory systems and a firm political environment. Clearly, this is not generally expected to translate in investors preventing themselves from investing in riskier markets like emerging countries (as well as they are not expected to target low-risk brownfield

[84] Academic Press Advanced Finance Series – Gatti, Stefano – "*Project finance in theory and practice – Designing, Structuring and Financing Public Projects*" - 2008
[85] Marsh and BMI – "*Political risk map 2017*"

assets only). A sound asset allocation strategy may well entail intra-class diversification among geographies, life stages and sectors.

Emerging markets are characterized by information asymmetries and less certainty about future revenue streams. Governmental support is essential there, given that often user payments are not sufficient to cover the infrastructure investment cost. Investors are interested in making sure that targetable emerging markets fulfill certain conditions, and are willing to analyze them on a case-by-case basis before investing. Ascertained this, some emerging countries may well be worth the commitment. Emerging markets show the greatest demand for infrastructures and investors are unlikely to completely bear the risks associated. Sovereign risk can be covered by ad hoc sovereign insurance policies, either purchased on the market or provided by International Financial Institutions like the World Bank. Also local governments may put in place risk-sharing agreements, warranties and financial support for private investors willing to fund local infrastructures, as well as making considerable efforts to provide them with a supportive fiscal environment. This may translate into very attractive risk-adjusted returns. The net return on a properly hedged investment may reach as much as a 20% level: a very good result for an asset-based uncorrelated investment, very appealing for yield-driven investors escaping from the low-yield environment of OECD countries, where increased competition drives infrastructure assets' returns down.[86] [87] [88]

The Third ARCADIS' Global Infrastructure Investment Index of 2016 (GII2016) confirms these findings. It is the result of a composite analysis aimed at ranking countries according to their long-term potential to attract investments in infrastructures. The study is based on national statistics and publicly available data focused on forecasts about demand for infrastructure, ease of doing business and benchmarking of investment risk. Indicators of economies' dynamism are given a higher weight. Long-term indicators include:

1. Economic environment indicators impacting the relative strength of demand for infrastructure investments
2. Business environment indicators determining a country's attractiveness for investments in general
3. Quantity and quality of risks affecting the likelihood of earning expected returns on investments
4. Infrastructures (relative scale of infrastructure opportunity and capacity to deliver)
5. Degree of financial support to infrastructures investment provided through the financial system

[86] McKinsey&Company – Duvall, Tyler; Green, Alastair; Kerlin, Mike – "*New horizons for infrastructure investing*" – August 2015

[87] Forbes – Moser, Joel – "*Emerging market infrastructure*" – March 2015

[88] Economic Research Institute for ASEAN and East Asia – Zen, Fauziah – "*Bridging the Gap: Financing Infrastructure Development in Emerging Economies*" – August 2016

In the 2016 version of the ARCADIS' GII, short-term barriers to infrastructure investors have been considered too, in order to gain a better insight on the real attractiveness of countries for investors in infrastructures. These include currency devaluations, exposure to weak commodity prices, loss of credit worthiness and increased insecurity, as well as the global slowdown driven by China's deceleration in growth. Singapore has been and still is by large the most attractive country for infrastructure investors, followed by Qatar, United Arab Emirates, Canada and Malaysia.

North America and Canada – Well-performing and improving – United States rank 8th in the GII2016, thanks to the country's strong economic position, low risk environment and developed financial sector, coupled with the presence of plentiful investment opportunities. For a long time, the country has suffered from the absence of long-term planning about infrastructure interventions, causing underinvestment and limiting interventions to reactive maintenance. Nonetheless, the recent governmental approval of the Fixing America's Surface Transportation Bill, providing the injection of $305 billion in the transportation sector and mapping investments for a five-year period, has importantly contributed to end previous stagnation. In addition, states are increasingly supporting private financing by setting adequate legislations and providing more appealing financing instruments. The attractiveness of projects currently under development has increased competition among contractors bidding for them. Multi-billion dollar projects are particularly sought after, reaching up to ten bidders at a time. Criticalities detected regard the need for cross-state consistency about investment-friendly legislation and the need for federal government intervention in order to raise acceptance for private investments. Canada ranks 4th in the GII2016, consistent with the result of GII2014. As for US, it can rely on a mature financial market, a strong economy and a low risk environment but has long suffered for poor infrastructure planning and underinvestment. This has been partially fixed by the ten-year-horizon $53 billion-worth 2014 New-Building-Canada Plan. The 2016 federal budget devoted further resources to public transit, clean technologies and housing. Overall, Canada is seen as an attractive and welcoming market for infrastructures private financing, with private investors already involved in highways', railways', hospitals' and airports' funding. For major schemes, private funding of at least 25% is required to trigger public investments.

Latin America – Troubling but long-term potential for growth – Latin American countries' performance is pushed downward by concerning economic conditions, low commodity prices and currency devaluation. Brazil, the major Latin American economy, ranks 33rd and is struggling with a scandal involving several big companies and government members. Even in Chile, the best ranking country of Latin America (16th), opportunities remain limited. Nonetheless, in the long run, a significant improvement in the current situation may be arising. Brazil offers interesting infrastructure gaps and a

large economy potentially able to accommodate investments thanks to a suitable institutional and regulatory environment. In addition, the ongoing investigation is hopefully triggering a change in the *modus operandi* of Brazil's government. The same positive expectations can hold for Chile, which has long struggled to earn a good reputation of low-risk reliable market. Argentina, whose economy has been torn apart by high inflation and limited trade, is also on the path of rising again. In December 2015, a new government was elected and immediately started to work on the creation of a suitable environment for investments. Confidence is expected to grow, as well as international interest toward the country, and investment opportunities are not missing, given the paralysis of infrastructural interventions under the previous government.

Asia Pacific – Mixed performance with opportunities and challenges on the horizon – The Asia Pacific area hosts countries remarkably differing among each other for their economic performance, as reflected by their ranking in the GII2016. Most of them are characterized by strong economic environments but their environment is getting riskier because of currency devaluation and falling commodity prices. Singapore ranks 1st in the World and has consistently held the title of most attractive country for infrastructure investments from the 2012 GII. This achievement is due, among other things, to a consistent and rational deployment of a significant portion of its GDP (from 5% to 6%) to infrastructural interventions. Its government has prioritized infrastructure investments as a mean for growth, especially in the healthcare and transport sectors, carrying on massive public investments with some support from banks. Remarkable efforts are in place to stimulate private investments as well, above all by performing analyses and studies aimed at reducing uncertainty for investors. Australia ranked 11th in 2016, losing two positions from 2014, because of increased risk and relatively low quality infrastructures for a developed country. Currently, it is interested by an important process of asset recycling. After the success of the late 1990s airport privatization campaign, the Australian government is privatizing previously publicly held infrastructural assets in the energy and port sectors to direct revenues toward new infrastructure investments. Overall, Australia can be considered as a trustworthy market on its way to raise back. China (currently 17th in the GII) shows the best economic environment of the World, thanks to continuing growth, but its ranking is worsened by a high risk environment and less attractive business sectors. Moreover, its recent economic slowdown is likely to affect its future position, besides having an impact on the whole Asia Pacific area. In order to try to fix the situation, the Chinese government is considering a massive involvement of the private sector in the aviation sector financing. Potential for investment is huge and increased demand for raw materials would bring sizeable side effects. Nonetheless, plans are still stuck at their feasibility stage. Other important Asia Pacific countries ranked among the 41 World's most attracting countries for investments in

infrastructures are Malaysia (5th), Japan (12th), South Korea (20th), Indonesia (21st), India (23rd), Thailand (25th) and Philippines (28th).

Europe – Well performing and stable, sometimes stagnating – European countries are unsurprisingly among the most attractive, mature and stable markets, with eight of them ranking among the top twenty: Norway (6th), Sweden (7th), United Kingdom (9th), Netherlands (10th), Germany (13th), Austria (14th), Belgium (18th), France (19th). Europe boasts a good flow of deals and long experience in the field of Public-Private Partnerships granting investors with an excellent degree of certainty. On the other side, several countries of continental Europe (above all Greece, Spain and Italy) are facing significant economic challenges and structural deficiencies, hindering their ability to excellently host infrastructure investments. While it is true that all European countries, including low performing ones, have the potential to represent profitable low-risk locations and to host long-term revenue generating projects, there is a general lack of "bankable" opportunities. Moreover, returns are not as competitive as in emerging markets and incentives to invest are likely to reduce as competition drives prices down. This has led to the issuance of the Junker Plan, a €315 billion initiative aimed at stimulating private investments in European infrastructures (see Paragraph 3.2.1). The Plan is aimed also at enhancing information and transparency by creating the European Investment Project Portal: a platform for PPP deal flow across Europe. United Kingdom is the first European country in the GI2016. It devotes a reduced share of its GDP to infrastructure investing but has renewed its commitment toward transport and housing projects by setting up schemes to attract investors into multi-billion initiatives. It has also created an independent National Infrastructure Commission to develop and oversee a plan to direct infrastructure investments, aimed also at causing a de-politicization of decisions about infrastructures. The overall bright future of the United Kingdom is threatened by the consequences of Brexit. Germany is notoriously another of the most appealing and reliable European markets, where opportunities are there in virtually all infrastructural sectors. The same can be said for France, despite its political discontinuity about infrastructure investments and excessive public sector involvement, somehow causing a reduction in investors' confidence. Also Netherlands are well recognized as a stable, organized, legally and politically safe market, enjoying excellent flows of deals. Italy ranks 34th in the GII2016. Its low ranking is caused by concerns about government regulation, transparency of government policy making, prevalence of foreign ownership and poor legal environment. Despite some signals of trend reversion, its economic environment is the worst of the GII2016 (41st) because of poor economic and demographic prospected growth.

Middle East – Very high with different perspectives – Middle Eastern countries taking part of the GII2016 are Qatar (2nd), Emirate Arab United (3rd) and Saudi Arabia (15th). In 2015, Qatar showed the World third highest GDP per capita and has kept a consistently high commitment toward infrastructures over last years. The country's priority is in financing transportation systems and connectivity, also in the vision of huge investments for the FIFA 2022 World Cup. At the current date, infrastructure investments in Qatar have been completely carried out by the government and there is no appreciable sign of interest toward private sector financing. Opportunities may instead be found in operation and maintenance of existing assets, above all in social sectors like health and education. United Arab Emirates, instead, are expected to progressively encourage private investments in their infrastructural system and to incentivize private companies to approach governmental agencies in order to formulate proposals. Dubai government is also interested in proposals about alternative financing options for infrastructures and is enjoying an important contribution from Asia and the UK. Both Qatar and United Arab Emirates have successfully overcome the negative impact of falling oil price and are likely to respect their commitments for last years, like the Dubai metro system's 2020 Expo Expansion. On the contrary, when possible, they are capitalizing on low commodity prices to reduce their construction costs. Saudi Arabia has not been as lucky, as it is struggling with low oil prices and the financial burden of the war in Yemen. Its attractiveness for infrastructure investors has fallen of three positions with respect to the GII2014. Many important projects have been delayed or cancelled and investors are not enjoying expected results from their commitment. In addition, excessive public sector involvement in the financing of infrastructures increases the riskiness of the kingdom's environment. Anyway the huge scale of Saudi Arabia projects keeps the interest for the market very high and oil price recovery, together with restored political stability, will allow the country to improve its ranking in the future editions of GII. [89]

The geographical distribution of infrastructure deals and the associated aggregate value, with referral to the year 2017, are represented in the following chart. [78]

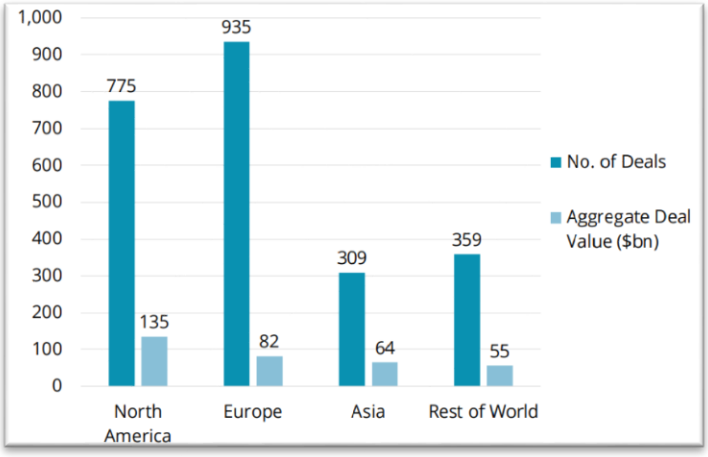


Figure 2.37 – Geographical distribution of infrastructure deals in 2017
Source: Prequin 2018

[89] ARCADIS – "*Third Global Infrastructure Investment Index – Bridging the investment gap*" - 2016

2.4.4 Financial structure

Each investor's perspective is influenced by the quantity of capital he provides to the infrastructure project/company. Companies act under dependency for financing and hence, the higher the commitment of a single investor into a company's capital, the higher its likelihood to exert a strong influence over the company itself, according to the relative size of his investment with respect to other investors. At the same time, committing large amounts of capital increases the absolute value of the expected loss in case of default and may represent a dangerous undiversified exposure. Also the type of capital committed implicates several differences in terms of risk-return expectations and degree of control. Project shareholders face higher risk but unlimited potential for profit. At the same time, they have an ownership interest in the project and can exert direct influence over the project management by voting in the meeting of shareholders. The bigger the share of the company's equity under the control of a single investor, the more he is able to determine the company's direction. Debtholders, instead, are external actors lending money to the company in exchange for interest payments. They face lower risk but capped potential for profit and do not enjoy direct influencing mechanisms. They can exert influence by requiring guarantees, collaterals and covenants to bake their loans and by aggregating in syndications and groups of lenders. The higher the number of lenders in a group and the share of the project debt represented, the higher the influence of that group for a company/project management.

2.4.5 Contractual arrangement

Investment opportunities need to be analyzed on a case by case basis through the assessment of all the listed criteria and keeping in consideration the specific contractual arrangement, including elements like the reliability of the involved counterparties, the degree of government support, the presence of guarantees and risk mitigation tools.[90] The same asset, under different contractual arrangements may show sensitively different risk/return characteristics, as shown in the following figure, which shows how the same asset's IRR can range between a conservative 5% and an opportunistic 15%+. The chart in question also offers a synthetic overview of the contents discussed until this point in the course of the paragraph.

[90] B Capital – Weber, Barbara – "*'What you don't see is what you get': The real risks and reasonable terms of infrastructure investment*"

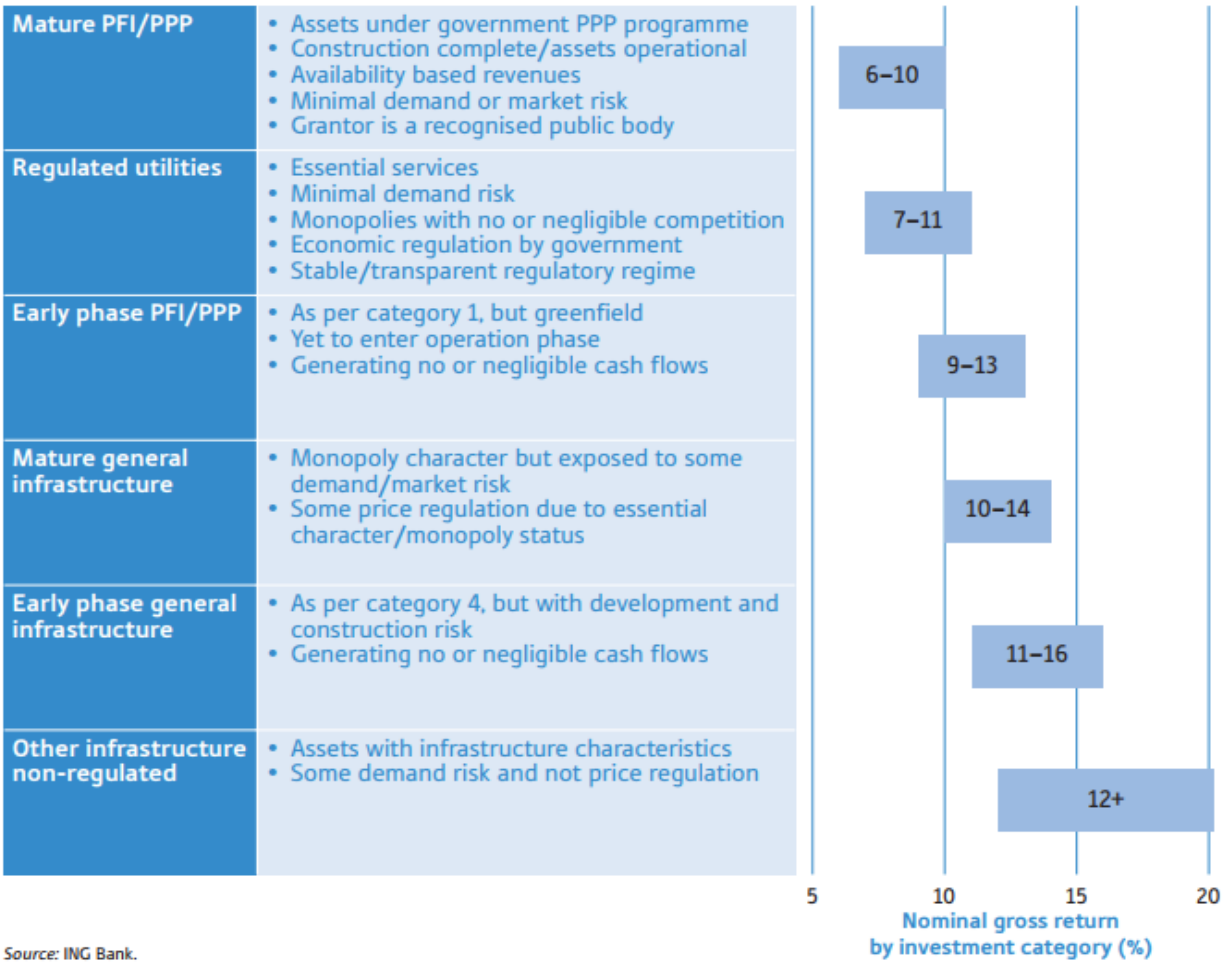


Figure 2.38 – Different risk-return profiles of an infrastructure asset under different contractual frameworks
Source: B Capital Partners

The degree of relative involvement of the private and public sectors in the ownership, financing and operation of infrastructure assets determines the contractual structure of the deal and hence the allocation of related benefits and risks among involved parties. In particular, the higher the public commitment, the lower the risk that the private party bears, especially if availability-based or regulated payment schemes are adopted (see Paragraph 2.4.1).

	Low → Extent of private sector participation → High → Increasing share of risk shouldered by private partner →				
Form of procurement	Traditional public procurement (TIP) & SOE provision		Private Participation in Infrastructure : Concessions & PPPs		Open competition by private operators
Type of contract	Work and service contract (often 1-3 years)	Management and maintenance contracts (3-8 years)	Concessions & PPPs (Operation and maintenance / Build operate transfer / others) where the main source of revenue for the private partners is government (10-30 years)	Concessions & PPPs (Operation and maintenance / Build operate transfer / others) where the main source of revenue for the private partners are user charges (10-30 years)	Full privatisation

Figure 2.39 – Allocation of infrastructure risks underlying different contractual structures
Source: OECD 2015

The way a contractual arrangement is designed also influences the extent to which each involved party has to bear contractual risk. Contractual risk refers to inadequately structured agreements leaving room for contract invalidation, diverging interpretations of the underlying agreement, opportunistic behaviors and *ex post* deviations from initial pacts. A failure in well-structuring a contractual agreement can virtually worsen the size and potential impact of all sources of risk, including credit, performance, political, financing risk. Contractual risk invariably affects the project company more than any other subject involved, as it is tied to all other counterparties at the same moment. [74]

Contractual arrangements can provide several risk mitigation mechanisms which are likely to significantly improve their structure and the cost-benefit tradeoff entailed. Risk mitigation instruments are financial tools intended to allocate certain sources of risk from private investors (owners or lenders) to creditworthy third parties (guarantors or insurers) showing a better capacity to withstand them. Private investors expect target projects to be soundly structured and are not willing to take excessive risk or to face sources of risk they do not have the capability to deal with. They focus on considerations about the return on invested capital, which has to be enough to remunerate them for the amount and quality of risks they accept to bear. Hence, risk mitigation instruments are likely to increase the flow of domestic and foreign private capital in developed countries to complement scarce public financing for infrastructure. In addition, they are likely to improve the credit rating of the borrower, be it a public or private entity, and so to reduce the cost of its financing. Guarantees and insurance policies are the main risk mitigation instruments. They differ in that guarantees are timely payments issued to claimers if the guaranteed entity fails in fulfilling its financial obligations toward them, independently from the reason of the bad performance, while payments from insurance companies are instead issued after a relatively long checking process to ascertain whether the insurance contract provides coverage against the specific cause of default. They provide payments for determined beneficiaries if certain events related to covered sources of risk materialize. Beneficiaries can either be equity investors or debtholders, as risk mitigation tools can offer protection against both investment and credit risks. Insurable sources of risk that can cause debt service default or investment losses can be subdivided in political and commercial. The related coverage can be either partial or total. In the former case, risk mitigation instruments allow to share risk between guarantors/insurers and investors/lenders, while in the latter the risk is completely transferred.

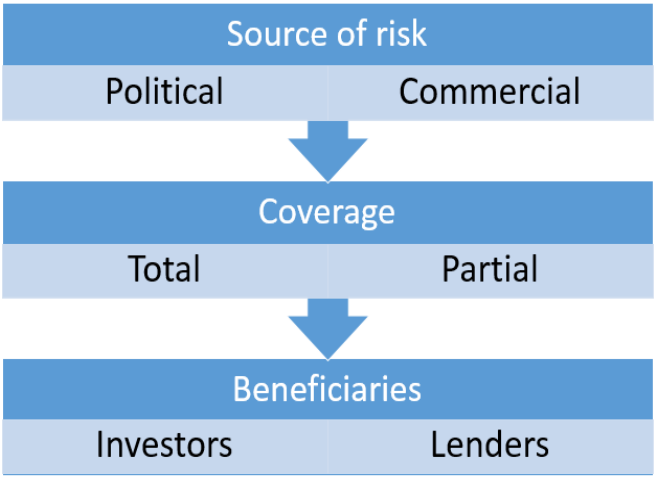


Figure 2.40 – Classification of risk mitigation instruments
Source: World Bank 2007

Risk mitigation providers are multilateral and bilateral agencies, together with private financial entities. Multilateral agencies supplying risk mitigation instruments include multilateral development banks and affiliated development insurance agencies. Eligible projects need to support the goals in view of which the multilateral institution provides the guarantee, besides meeting certain other criteria like the country of origin or investment. Bilateral or national agencies offering risk mitigation tools are bilateral development agencies and Export Credit Agencies. Bilateral development agencies share most features with multilateral development agencies: they provide guarantees to projects that support certain development goals and other criteria. As for multilateral development agencies, anyway, their focus lies primarily in granting loans to development projects rather than leveraging their balance sheets through guarantees. Export Credit Agencies include (but are not limited to) import-export banks, export credit guarantees agencies and investment credit insurance agencies. Some ECAs are part of their respective governments, some others represent governmental agencies, while in certain countries they are managed by private actors on behalf of the government. Independently from their structure, their goals usually mirror their countries' national interest. Indeed, ECAs usually offer comprehensive risk coverage to stimulate a country's export, to encourage outbound international investments and to stimulate the domestic debt market. The range of political and commercial risk coverage instruments offered by ECAs is usually fairly standardized. Some private actors as well are involved in the provision of commercial and political guarantees and insurance, including monoline insurers, offering complete coverage to structured debt transactions, and political risk insurers and reinsurers, providing political risk insurance. While public guarantors and insurers are likely to enjoy favorable public treatment, private guarantees and insurances may be more widely available as they are not tied to development goals.

Credit guarantees Credit guarantees protect lenders from debt service default of a company/project and can either provide for partial coverage or grant a total protection. The associated payment is issued regardless of the reason of the default, be it political or commercial.

Partial Credit Guarantees cover only a portion of the debt service of a financial instrument and aim at both facilitating the borrower's access to the market and improving the terms of its debt, including maturity and the interest rate, by splitting credit risk between potential lenders and guarantors. PCGs are flexible instrument and can be designed to meet certain market conditions and specificities of concerned debt instruments. They can be designed to improve the rating of a loan or portfolio of loans up to a certain point. Traditionally, PCGs have provided coverage for late maturity payments and have been employed by developing countries' public entities to borrow in the international bank market or to support a bond offering on the international market.

Full Credit Guarantees, instead, offer full coverage for the debit service default of a given debt instrument. These completely allocate risk to the guarantor and so it is usually a prerogative of borrowers and securities showing a standalone investment-grade rating on an internationally recognized scale. Still, FCGs are often used by bond issuers to improve their rating and fulfill investors' requirements. In some developing countries, monoline insurers have granted full coverage for bonds issued by infrastructure project companies.

Political risk insurance or guarantees Political risk insurances and guarantees cover losses arising in force of specified political risk events. Standard political risk events include (but are not limited to) currency inconvertibility, expropriations, war and civil disturbance, breach of contract and arbitration award default. Anyway, today the concept of the political risk investors demand protection from is broader than before and includes all losses associated to governments' and sub-sovereign entities' actions and omissions. Political risk insurances and guarantees differ for the kind of provider. Political Risk Guarantees are issued by multilateral development banks and some bilateral agencies and cover commercial lenders in private projects. These instruments usually offer full coverage for determined politically-induced negative events, which are specified in advance on a case-by-case basis. The spectrum of events that may be covered through these guarantees is very broad. Besides listed traditional political risks, they may provide coverage against risk associated to public termination payments, contractual performance of public counterparties, political actions and omissions determining adverse effects. Political Risk Insurances are provided by Export Credit Agencies, investment insurers, political risk private insurers and multilateral insurers to protect investors and lenders against the consequences of defaults arising from some standard political risk events. Coverage is usually close but not equal to 100%.

Export credit insurance and guarantees Export credit insurance and guarantees protect exporters from commercial losses or export-related project debt financers from their borrowers' default and are issued by Export Credit Agencies. Their goal is to increase the international flow of goods and services by reducing the risks borne by involved parties. These instruments are sometimes called "comprehensive risk insurance and guarantees", as they cover a portion of both political and commercial risk. Said portion is usually close but not equal to 100% for both sources of risk. Purely commercial risks covered include (but are not limited to) borrower/buyer bankruptcy or insolvency, missing payments from the buyer or buyer's failure/refusal to accept goods, termination of purchase contracts. Export credit insurance and guarantees are usually tied to the nationality of exporters or suppliers and sometimes of the project sponsors or lenders. [91]

[91] World Bank - Matsukawa, Tomoko; Habeck, Hodo – "*Review Of Risk Mitigation Instruments for Infrastructure Financing and Recent Trends and Developments*" – January 2007

2.5 Benefits of investing in infrastructure assets

The asset class of infrastructure encompasses a broad set of investment opportunities and cover the whole risk-return spectrum. Infrastructure assets hence range from "core" to "opportunistic" assets. Core infrastructure assets can include bridges, tunnels, toll roads, pipelines, facilities for the transportation and distribution of energy, waste and wastewater management systems. Value-added infrastructure may encompass airports and seaports, railways, contracted power generation. Finally, development projects, non-OECD exposures, satellite networks and merchant power generation can be considered as opportunistic investments, whose risk is significantly higher in exchange for the expectation of robust capital gains in case of success.[92] By December 2017, according to Prequin data, 35% of interviewed investors believed that investing in core infrastructure assets was among the most promising investment strategies, at the moment. The share of interviewed investors which have declared to rely on value-added and opportunistic infrastructure investment strategies, instead, has been of 28% and 17%, respectively. [93] [94] [95]

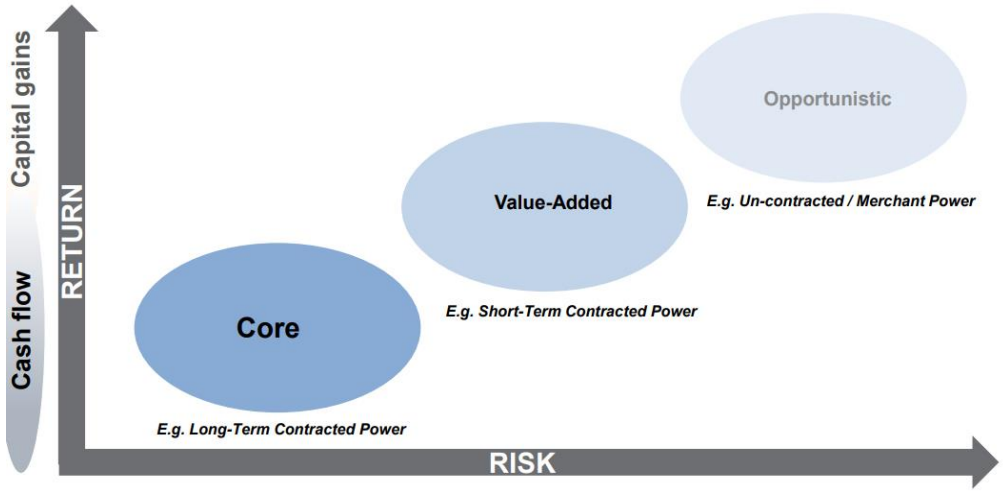


Figure 2.41 – Risk-return profile of core, value-added and opportunistic infrastructure assets
Source: J. P. Morgan Asset Management

Core infrastructures are located on the left end of the risk-return spectrum and show the following set of features:

1) Have gone beyond their rump-up phase;
2) Are located in established and transparent political and regulatory environments;
3) Work in economically and demographically advantageous markets
4) Are long-living with scarce technological and obsolescence risk

[92] J. P. Morgan Asset Management & Milliman– Bornens, Francois; Coatesworth, William - "*Infrastructure investments for insurance companies under Solvency II*" – September 2013
[93] Prequin – "*Core Infrastructure*" – December 2017
[94] Prequin – "*Value Added Infrastructure*" – December 2017
[95] Prequin – "*Opportunistic Infrastructure*" – December 2017

Hence, these infrastructure assets are revenue generating brownfield works and are mostly located in OECD countries (60% of the capital raised in 2017 for core infrastructure investment funds has come from United States and United Kingdom[96]). Related operations are based on reliable well-known technologies and, in exchange for low risk, their return is mostly composed by cash yields rather than capital gains and is lower than the one expected by investors in opportunistic assets. Core infrastructure assets are found in mature markets for essential services whose demand is inelastic and often enjoy a monopolistic position in those markets, screened by high entry barriers and consistent regulatory frameworks. Their return tends to be insensitive to periods of economic weakness. As a specific asset deviates from one or more of these characteristics, it moves toward the right end of the risk-return spectrum represented in the figure above.

Core investment strategies entail prudent leveraging and the establishment of long-term agreements with reliable counterparties. They target mature markets with a consistent and transparent regulatory framework and tend to geographically diversify, in order to mitigate asset-specific risks. Core infrastructure investors seek stable foreseeable risk-adjusted and inflation-indexed cash flows. [97] Core infrastructure equity investments are usually performed under the following contractual structures:[98]

- Regulated Assets with fixed criteria for the remuneration of investments (energy transmission and distribution)
- Public-Private Partnerships, where one or more public actors act as guarantors or contractors in the context of infrastructure projects
- Long-term concessions for the provision of public-interest activities under price-regulation (toll roads, public parking, railways)
- Long-term contracts with demand-side guarantees including take-or-pay or take-and-pay clauses

In the following paragraphs, some of most prominent advantages seek by investors in infrastructure assets are scrutinized, with a particular reference to core infrastructure assets.

[96] Prequin – "*2017 Infrastructure Deals"* – January 2018

[97] J.P. Morgan Asset Management – Bahçeci, Serkan; Leh, Stephen - "*The infrastructure moment. Core infrastructure's growing role in institutional portfolios*" – January 2017

[98] ANIA and ASTRID – "*Gli investimenti infrastrutturali nel contesto di Solvency II – Il ruolo delle compagnie di assicurazione*" – November 2017

2.5.1 Provision of essential services

Investing in infrastructures means allocating capital to physical assets enabling the provision of essential services to the society and playing a fundamental role for the functioning of an economy. Coupled with capital-intensity and long duration, this is probably the only real element of commonality to all infrastructure works. The essentiality of the service supplied represents a strong element of interest for investors, because provided services behave like non-discretionary consumer goods and the related demand reacts far less than proportionally to changes in prices. To make an example, demand for electricity in United States has historically shown a 5% reaction to changes in the electricity price, falling by 1% for each 20% price increase. Demand inelasticity is an important driver of cash flow stability. The following charts show how electricity and gas consumption in United States have been resilient to all economic events occurring from 1973 to 2013. The essentiality of services provided in infrastructure-based sectors also causes charged rates to be regulated. Broadly speaking, this means that said rates are kept high enough not to hamper private actors' incentives to invest in infrastructures while, on the other side, prices are regulated with the aim of ensuring that the whole population can afford underlying services. This further contributes to generate demand inelasticity.

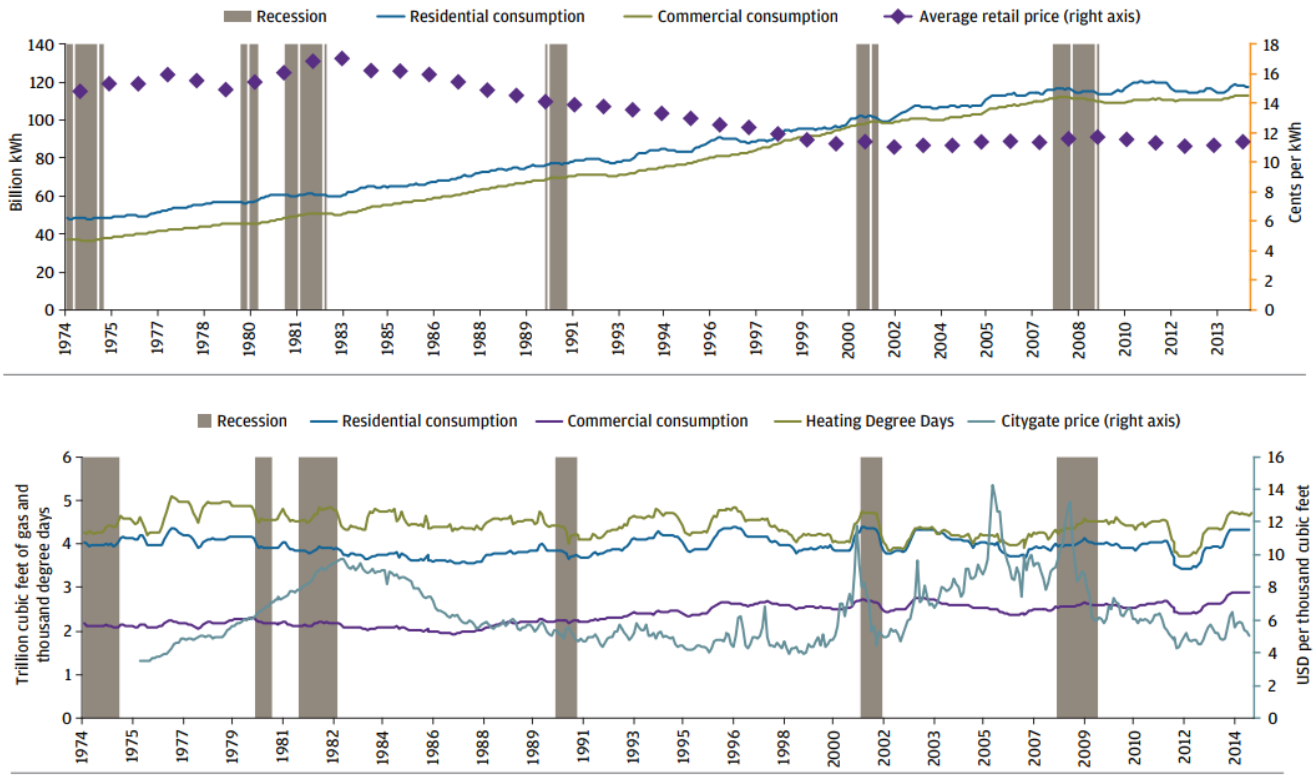


Figure 2.42 – Trends of electricity and gas consumption in United States from 1973 to 2013
Source: EIA and J. P. Morgan 2015

For institutional investors like pension funds and insurance companies, investing in infrastructures providing essential services also grants "indirect" benefits, as it improves people living conditions and has a positive impact on important welfare indicators that directly affect their core business, including mortality and morbidity rates. This allows them to partially internalize infrastructure-induced positive externalities.[99]

2.5.2 Market power and protection from competition

Apart from the virtually unaltered willingness of consumers to purchase services provided by means of infrastructural works, despite possible changes in prices, some further aspects contribute to stabilize infrastructure-related cash flows over time. One of this is a very low risk of unforeseen changes in market dynamics due to arisen competition. Network industries are naturally prone to behave like natural monopolies (see paragraph 1.3) and hence, related markets are better served by a single player rather than multiple businesses. Even more competitive infrastructure industries are usually relatively concentrated. Once an infrastructure is operational within a given area, it carries a high capacity and usually takes time to get congested. Before that moment, incumbents face virtually no threat for competition, as no room is there for other players in the market, except for cases of cross-sector competition (e.g. roads, railways and air transportation may compete for medium length routes). Moreover, infrastructure assets are characterized by very high investments and low variable costs, so incumbents will experience a significant first-mover advantage that will prevent would-be competitors to compete on prices. Sometimes, the monopolistic structure of the market is artificially created by a public entity through a concession awarded in force of a tendering process. Concessions tend to be long-term and to grant the infrastructure operator the possibility of indexing charged prices to inflation.

2.5.3 Protection from inflation

Cash flows produced by infrastructure assets are usually earned on a regular basis over very long periods of time, lasting up to 30 years or more. For the essentiality of services provided by means of infrastructure works, said cash flows are screened against changes in consumers' preferences and tend to be steadily earned over time in force of limited competition. In addition to this, investing in infrastructure can give a fundamental support in managing two important risks concerning especially long-term investors: inflation risk and asset/liability duration risk. Inflation risk is the risk that unforeseen changes in the inflation rate alter the real value of future cash flows. Inflation is traditionally subdivided in demand pull and cost push inflation. The former arises when demand for

[99] J.P. Morgan Chase and Co – "*Investing in infrastructure – Key Benefits and Risks*" - 2015

goods and services grows faster than the supply, which remains unaltered, hence causing increases in prices. Cost push inflation occurs when the aggregate output suffers from a reduction and, in combination with a constant demand, drives prices up.[100] Asset holders are concerned by possible abnormal increases in the inflation rate, as they can cause a significant downward pressure on the purchasing power of the cash flows earned. Over the long run, anyway, exposing infrastructure cash flows to inflation, even moderate, may severely impact their value and hinder the convenience of a whole project, as a consequence of the reduction of the real value of cash flows earned by investors. Therefore, infrastructure projects are usually put into a regulatory or contractual framework allowing for inflation-accommodating pricing schemes. Regulated utilities can adjust charged rates for inflation according to consistent regulatory approaches, like price-cap regulations (see paragraph 1.3). The same provision can be included in concession statements awarded by public entities to transport companies and in contractual agreements aimed at insuring long-term supply of essential goods like electricity and gas. This provides a long-term protection against negative effects of inflation and, in conjunction with low elasticity of demand, insulates infrastructure assets from economic cyclicality. The combination of these conditions and the long-term investing horizon of infrastructure assets allows long-tern investors to minimize duration gaps between their assets and liabilities. This is especially useful to long-term risk averse investors like pension funds, especially if they are liability-driven investors, hence striving to minimize inflation risk and the potentially huge effect that adverse changes in interest rates may cause to the net present value of a portfolio exhibiting mismatched assets and liabilities. [101]

The following figure shows the resilience of annual infrastructure cash-flows of 229 mature infrastructural assets in United States and Europe-15 to recorded inflation. Cash flows are measured in terms of EBITDA over the 2986-2013 period. Its correlation coefficient with respect to U.S. inflation, over the period, has equaled a value of 0,33. [99]

[100] Charmaine, Barbara; Cortis, Dominic; Perotti, Roberta; Sammut, Claudia; Vella, Antoine – "*The European Insurance Industry: a PEST analysis*" – November 2016

[101] Credit Suisse Asset Management – Russ, David; Thambiah, Yogi; Foscari, Nicolo – "*Can Infrastructure Investing Enhance Portfolio Efficiency?*" – May 2010

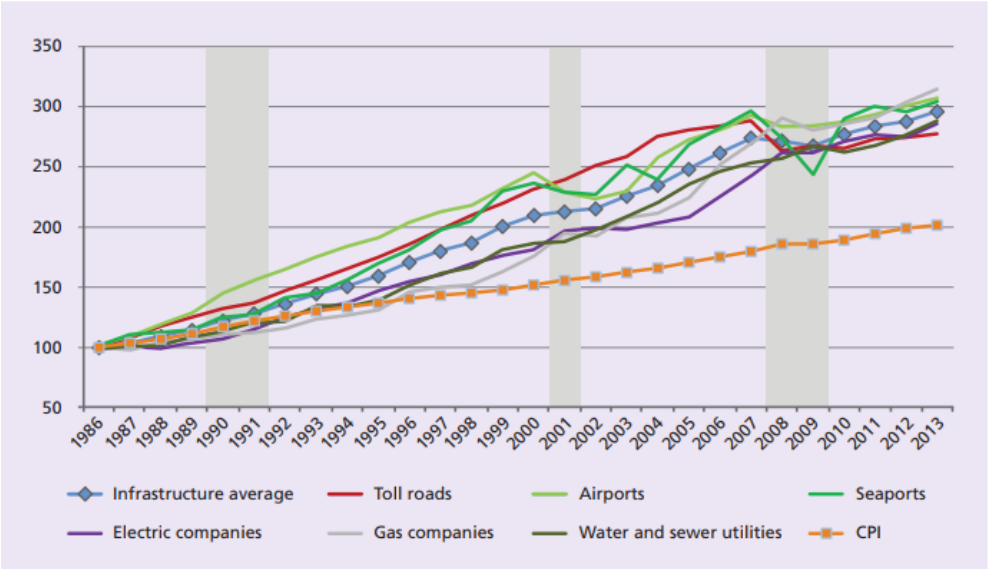


Figure 2.43 – Resilience of infrastructure assets' EBITDA to inflation in U.S. and Europe
Source: J. P. Morgan Asset Management

The market performance of listed infrastructure indexes seems to mirror the resilience of real measures of infrastructure income to different inflation rates. The Dow Jones Brookfield Global Infrastructure Index is a pure-play core infrastructure index with a market capitalization of more than $700 billion, of which almost 60% is invested in United States infrastructure assets. The S&P Global Infrastructure Index, instead, is an index composed by clustering stocks across the energy (15), transportation (30) and utilities (30) sectors, showing each a weight of up to 20%, 40%, 40%, respectively. [102] The following chart shows their performance in both high and low inflation circumstances, in comparison with the S&P Global Broad Market Index.[103]

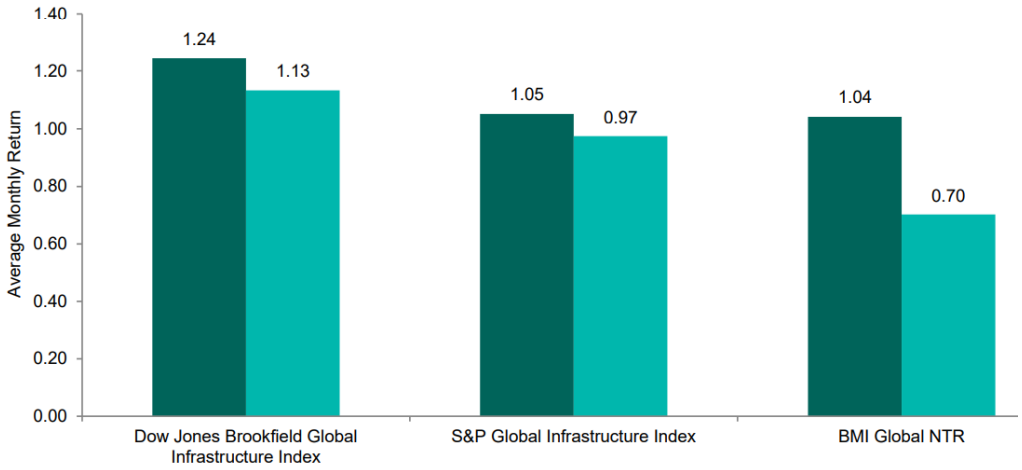


Figure 2.44 – Resilience of listed infrastructure indexes' performance to inflation
Source: Standard and Poor's 2015

[102] Morgan Stanley Investment Management – Bigman, Ted; King, Matt – "*The case for a Strategic Allocation to Global Listed Infrastructure Securities*" – January 2017
[103] McGraw Hill Financial – S&P Dow Jones Indices – Cheng, Tianyin; Srivastava, Vinit – "*Approaches to benchmarking listed infrastructure*" – October 2015

2.5.4 Diversification benefits

Diversification is an important element of winning asset allocation strategies, as no asset class shows consistent performance year after year. It is performed by investing in assets showing non-perfectly correlated returns (better if non-correlated or negatively correlated) and allows for the progressive elimination of the so-called non-systematic (or diversifiable) risk, namely risk whose possible negative effects impact single businesses and/or sectors only, rather than a whole region or economy. A diversified portfolio can offer more stable and less volatile performance over time. The underlying reasoning is that if assets are not perfectly correlated, their respective returns move differently and somehow balance each other stabilizing the portfolio return and reducing its volatility. The recent financial crisis has shown how correlations can change dynamically, especially if hit by exogenous shocks. As a take-home from this bad experience, investors have started seeking for more ways to diversify their portfolios and minimizing correlation among their assets. Thanks to low usage volatility, resilience to the economic downturns and protection from inflation, infrastructure assets have emerged to be good diversifiers when paired with a number of other more traditional asset classes. [104]

The following table reports historical estimates of the correlation between different asset classes, including listed infrastructure. The investment in infrastructures is here represented by the Macquarie Global Infrastructures Total Return Index. Data refer to the 2000-2010 period and have been produced by Credit Suisse Asset Management.

	US Equities	Non-US Equities	Global Bonds	Real Estate Investment Trusts	Commodities	Hedge Funds	Inflation-Linked Bonds	Private Equity	Global Infrastructure
US Equities	1,00								
Non-US Equities	0,63	1,00							
Global Bonds	0,23	0,17	1,00						
Real Estate Investment Trusts	0,56	0,45	0,22	1,00					
Commodities	0,15	0,45	0,14	0,18	1,00				
Hedge Funds	0,46	0,61	0,23	0,30	0,43	1,00			
Inflation-Linked Bonds	0,19	0,21	0,86	0,24	0,32	0,25	1,00		
Private Equity	0,84	0,63	0,01	0,61	0,11	0,52	0,01	1,00	
Global Infrastructure	0,44	**0,83**	0,32	0,44	0,40	**0,71**	0,42	0,56	**1,00**

Figure 2.45 – Correlation between listed infrastructural investments (Macquarie) and other asset classes 2000-2010 data
Source: Credit Suisse Asset Management

The Macquarie Global Infrastructures Total Return Index embodies a broad concept of infrastructure, including core assets as well as opportunistic investments, hence the table above shows a moderate, though existent, diversification effect. If the concept of infrastructure is restricted to core infrastructures only, thanks to a J. P. Morgan Asset Management 2014 study, we can observe a remarkable increase of the desired effect in question, as shown in the next table.

[104] LUISS Business School & ASTRID - Merola, Federico; Caroli, Matteo; Iaione, Christian; Fersini, Paola - "*Le casse di previdenza tra autonomia e responsabilità. I professionisti, il risparmio, l'economia reale*" - 2017

	Global Equities	Global Bonds	Hedge Funds	Private Equity	Commodities	Global Real Estate Investment Trusts	US Core Real Estate	Europe Core Real Estate	OECD Infrastructures
Global Equities	1,0								
Global Bonds	0,0	1,0							
Hedge Funds	0,7	-0,2	1,0						
Private Equity	0,8	-0,2	0,8	1,0					
Commodities	0,3	0,0	0,6	0,4	1,0				
Global Real Estate Investment Trusts	0,6	0,2	0,6	0,5	0,6	1,0			
US Core Real Estate	0,1	-0,1	0,2	0,4	0,1	0,0	1,0		
Europe Core Real Estate	0,4	-0,3	0,5	0,6	0,3	0,4	0,7	1,0	
OECD Infrastructures	0,1	0,6	0,1	0,0	0,0	0,2	0,2	0,1	1,0

Figure 2.46 – Correlation between core infrastructure investments and other asset classes
Source: J. P. Morgan Asset Management
1994-2013 data

Infrastructure also offers interesting intra-class inter-sectoral diversification benefits, as shown in the following table, based on 1986 to 2013 data from United States. Hence, core investment strategies are expected to diversify also across industrial sectors.

	Toll roads	Airports	Seaports	Electric companies	Gas companies	Water and sewer utilitiess
Toll roads	1,00					
Airports	0,50	1,00				
Seaports	0,31	0,39	1,00			
Electric companies	-0,18	-0,23	0,02	1,00		
Gas companies	-0,31	-0,16	0,08	0,28	1,00	
Water and sewer utilities	0,02	0,20	-0,05	-0,01	0,05	1,00

Figure 2.47 – Infrastructure intra-class sectoral diversification
Source: J. P. Morgan Asset Management
1982-2013 data

Importantly, also direct investments in unlisted infrastructure capital show some not negligible diversification benefits. Their performance has appeared as poorly correlated with respect to other listed and unlisted classes of assets and, above all, to move differently with respect to the performance of listed infrastructure investments. On a hand, this means that historical data about listed infrastructure returns cannot be used to fill the vacuum left by the scarcity of information about historical performance of unlisted infrastructure assets. On the other side, it may suggest that investors interested in gaining exposure to a well-diversified portfolio of infrastructure should consider both listed and unlisted issues.[105] The following values are based on monthly data collected from October 2007 to June 2013.

	Fixed income	Direct real estate	Global listed property	Global listed infrastructure	Australian equities
Unlisted infrastructure	-0,03	0,48	0,19	0,26	0,29

Figure 2.48 – Correlation between unlisted infrastructure assets and other asset classes
Source: AMP Capital
2007 to 2013 data

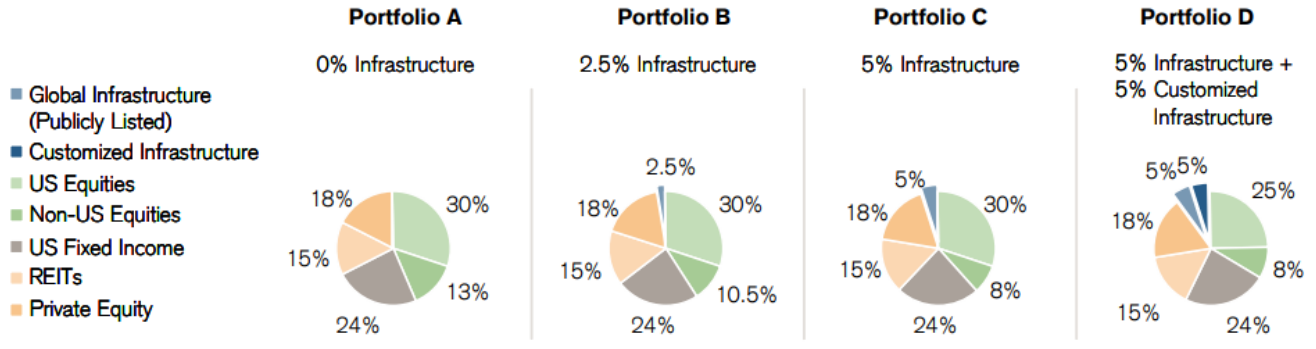
[105] AMP Capital – "*Understanding infrastructure*" – 2014

2.5.4.1 How infrastructure investments behave when included in traditional portfolios

To show the effect of including infrastructure investments within a portfolio, Credit Suisse Asset Management[106] has generated an hypothetical portfolio composed by:

- An exposure to the Macquarie Global Infrastructure Total Return Index, composed by approximately 250 infrastructures'/utilities' stocks in the FTSE Global All-Cap Index. The MGI Index is designed to reflect the stock performance of listed companies involved worldwide in the management, ownership and operation of infrastructure assets. It is chosen for its broad geographical and sectoral coverage and because it puts together brownfield and greenfield investments.
- An exposure to a customized set of infrastructure funds approximating the impact of an infrastructure investment performed with the view of growth. The index is composed by infrastructures from three equally weighted sectors, namely airports, ports and energy;
- Exposures to US-equities, non-US-equities, private equities, US fixed income and Real Estate Investment Trusts.

Four portfolios have been created by altering the share covered by infrastructure investments and results based on historical data show an improvement of the Sharpe Ratio of portfolios as long as more of infrastructures is included within it. The Sharpe Ratio represents a measure of risk-adjusted return, indicating the "return per unit of risk". In the context of this experiment, the increase in capital allocated to infrastructure assets, either listed or customized, is not transmitted equally on other classes but impacts the share dedicated to non-U.S. equities, first, and the share of U.S. equities, in the last portfolio. The allocation to private equities keeps unaltered, and so the commitment toward REITs and U.S. fixed income assets. Results of the experiment are represented in the following figure.



Target Return	8.80%	8.80%	8.80%	9.10%
Target Risk	11.70%	11.50%	11.40%	11.30%
Return per Unit of Risk (Sharpe Ratio)	0.75	0.76	0.77	0.8

Figure 2.49 – How including listed and "customized" infrastructure assets change a traditional investment portfolio Sharpe ratio
Source: Credit Suisse Asset Management 2010

[106] Credit Suisse Asset Management – Russ, David; Thambiah, Yogi; Foscari, Nicolo – "*Can Infrastructure Investing Enhance Portfolio Efficiency?*" – May 2010

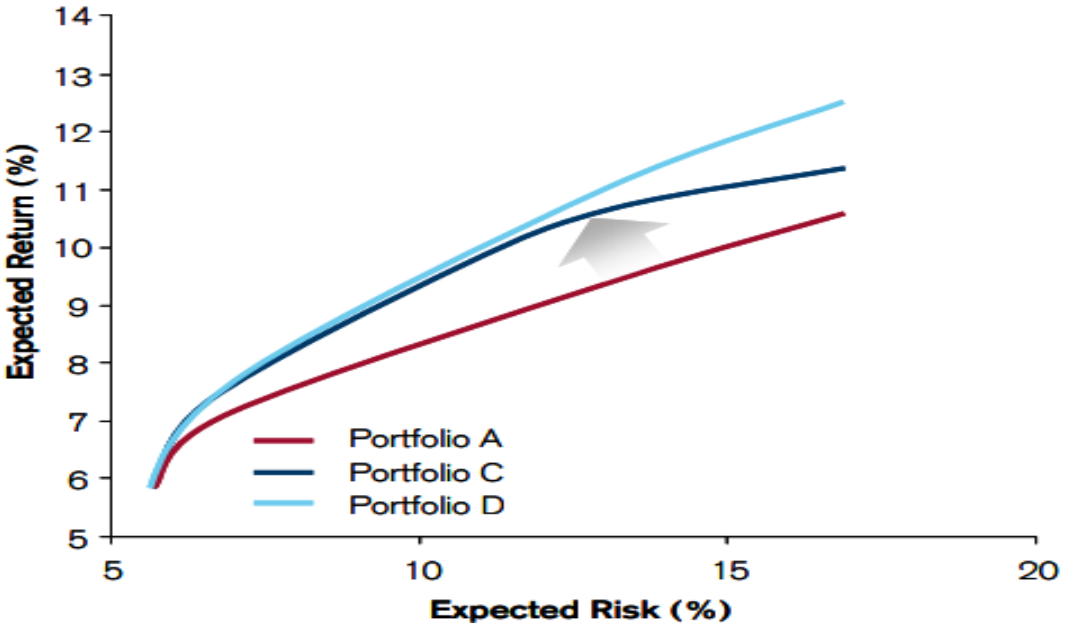


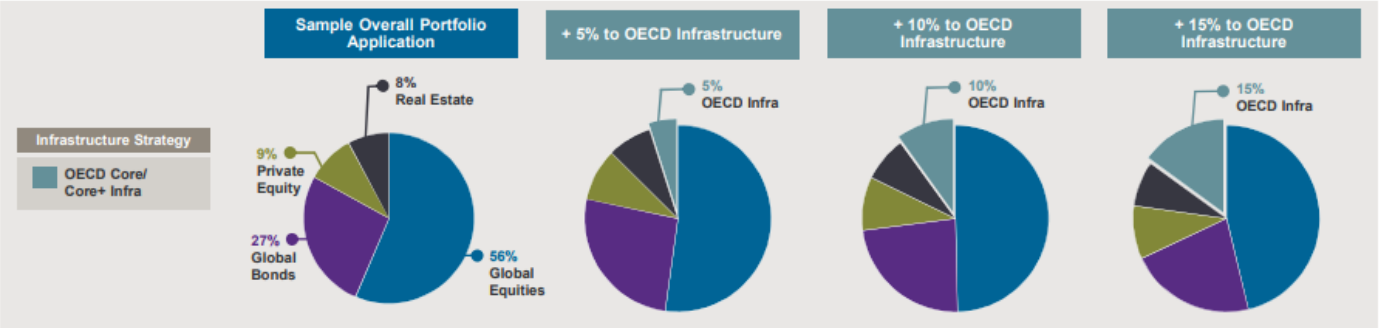
Figure 2.50 – How the efficient frontier reacts to increases of the share of infrastructure in a traditional portfolio
Source: Credit Suisse Asset Management 2010

From the experiment, a decreasing trend of the portfolio volatility has emerged, as long as larger exposures to global listed infrastructure assets have been included. This determines an improvement of the portfolio Sharpe Ratio. Adding a share of customized infrastructure with a tilt for greenfield growth infrastructure assets, in portfolio D, has also increased expected return, while still reducing volatility. The recorded straightforward decrease in volatility can be seen as a consequence of the positive effects of infrastructure investments on portfolio diversification.

Generally speaking, decreasing the allocation to listed equities is likely to push both volatility and expected return downward. In this case, thanks to increasing exposures to infrastructure assets, a portfolio showing the same return but minor volatility has been built, coming to an improvement of the position of the Markowitz efficient frontier, namely the set of portfolios showing the best risk-return trade-offs (see figure above).

A similar experiment has been carried out by J. P. Morgan Asset Management[107], with a stronger focus on core infrastructure. A theoretical portfolio composed by exposures in global equities (56%), global bonds (27%), real estate (8%) and private equity (9%) has been built and has subsequently been added with a growing exposure in core infrastructure assets. This time, the increase in asset allocation toward infrastructure has been distributed *pro rata* between fixed income and equities. The experiment is based on a twenty-year time horizon and on historical data taken from several sources.

[107] J. P. Morgan Asset Management – LeBlanc, Matt - "*OECD infrastructure – Outlook and Trends*" – November 2015



Risk/return characteristics				
Expected Return*	7.2%	7.3%	7.5%	7.7%
Expected Income	2.3%	2.4%	2.6%	2.7%
Historical Return	8.4%	8.5%	8.7%	8.8%
Historical Volatility	12.3%	11.8%	11.2%	10.7%
Estimated Sharpe	0.42	0.45	0.49	0.53
Max Annual Drawdown	-24.3%	-23.2%	-22.2%	-21.1%

Figure 2.51 – How an exposure to OECD core infrastructure assets can change an investment portfolio Sharpe ratio
Source: J. P. Morgan Asset Management

The results of the second experiment are consistent with what seen in the previous one and represent very positive findings. As the portion of core infrastructure increases, a general straightforward improvement of the risk-return characteristics of the portfolio is recorded. Said improvement is reflected in both the increase of expected yield/historical return and the decrease of the portfolio volatility. Also the worst case scenario, namely the lowest return recorded during the twenty-year period under analysis, gets better as core infrastructure is added.

Anyway, given that reported benefits arise from diversification, there will be a certain point from which larger exposures in infrastructure investments will come at no absolute benefit, meaning that it will no longer improve both the expected return and volatility at the same time.

2.5.5 Attractive risk-adjusted returns

Infrastructure assets are characterized by a significant lack of comparable data about past performance. This partly derives from the heterogeneity of the assets encompassed in the class and partly on the diverse conception that different experts have with regard to what is infrastructure and what is not. In addition, while listed infrastructure indexes can represent a valuable referring point for the assessment of listed infrastructure expected performance, unlisted illiquid infrastructure exposures, which have increasingly come to represent an element of interest for institutional investors, are particularly hard to track. According to most scholars and practitioners, listed infrastructure investments performance cannot be taken as a proxy for the performance of unlisted infrastructure investments. While there are several evidences supporting this view, Morgan Stanley Asset Management experts have proposed an alternative scenario, based on a significantly reliable listed infrastructure equity index.

In the following table, a thorough overview and description of main listed infrastructure equity indexes is provided. Data refer to the last day of 2015.

INDEX	DOW JONES BROOKFIELD GLOBAL INFRASTRUCTURE INDEX	S&P GLOBAL INFRASTRUCTURE INDEX	MSCI ACWI INFRASTRUCTURE INDEX	MACQUARIE GLOBAL INFRASTRUCTURE 100 INDEX	FTSE GLOBAL CORE INFRASTRUCTURE 50/50 INDEX
Components	95	75	260	100	218
Market Cap (Free-Float Adjusted)	$712B	$880B	$2,747B	$1,273B	$1,502B
Selection Criteria	Pure-play approach that evaluates cash flows of companies (Infrastructure operations must account for greater than 70%).	Stocks are clustered across three sectors (combination of GICS sectors). 15 stocks come from Energy with their weight capped at 20%. 30 each come from Transportation and Utilities, with their total weights capped at 40% each.	Infrastructure companies that fall into one of five groups (combination of GICS sectors): Telecommunications, Utilities, Energy, Transportation, and Social.	Based on revenue analysis by Macquarie (over 50% must come from infrastructure operations).	Stocks are grouped across three sectors (combination of ICB subsectors): 50% from Utilities, 30% from Transportation, and 20% from Other.
Focus	Pure-play core infrastructure	Broad-based infrastructure exposure	Broad-based infrastructure exposure and related businesses	100 largest constituents and heavily weighted towards Utilities	Broad-based, Utilities-centric exposure
Regional Exposure	Americas: 59.4% EMEA: 26.4% Asia: 8.6% Australia: 5.6%	Americas: 43.9% EMEA: 34.6% Asia: 10.8% Australia: 10.6%	Americas: 46.6% EMEA: 30.0% Asia: 20.2% Australia: 3.1%	Americas: 58.5% EMEA: 27.6% Asia: 10.7% Australia: 3.3%	Americas: 57.1% EMEA: 18.8% Asia: 17.1% Australia: 7.0%

Figure 2.52 – Listed infrastructure equity indexes
Source: Morgan Stanley Asset Management 2016
2015 data

The following table provides an overview of the performance of the indexes described above, in terms of risk and return. It also compares infrastructure equity indexes' performance with the performance of a general market index, namely the S&P Global Broad Market Index. Data refer to October 2015 and are provided by Standard & Poor's.

Time period	S&P Global BMI	Dow Jones Brookfield Global Infrastructure Index	S&P Global Infrastructure Index	MSCI ACWI Infrastructure Index	Macquarie Global Infrastructure 100 Index	FTSE Global Infrastructure 50/50 Index
Annualized returns (%)						
3 years	**7,23**	6,94	5,58	3,63	4,02	**7,43**
5 years	6,95	**10,38**	5,69	4,21	3,79	**8,65**
7 years	6,42	**9,78**	4,31	3,98	2,08	-
10 years	4,87	**8,93**	5,16	4,66	3,84	-
Annualized volatility (%)						
3 years	**9,99**	**10,27**	**10,43**	**10,28**	**10,87**	**10,06**
5 years	13,23	**10,15**	11,89	**10,70**	**10,94**	**9,86**
7 years	18,29	14,11	17,10	13,71	14,12	-
10 years	17,08	13,81	16,26	13,59	13,93	-
Return/Volatility						
3 years	**0,72**	**0,68**	0,53	0,35	0,37	**0,74**
5 years	0,53	**1,02**	0,48	0,39	0,35	**0,88**
7 years	0,35	**0,69**	**0,25**	**0,29**	**0,15**	-
10 years	**0,29**	**0,65**	0,32	0,34	**0,28**	-

Figure 2.53 – Performance of listed infrastructure equity indexes
Source: Standard & Poor's 2015

From the table above, it is possible to observe a mixed picture about the performance of listed infrastructure equity. Best performing indexes have been the Dow Jones Brookfield Global Infrastructure Index and the FTSE Global Infrastructure 50/50 Index. The S&P Global Infrastructure Index has also shown a discrete performance but has underperformed both mentioned infrastructure indexes and the general market index. Virtually all indices, including the Broad Market Index, show a remarkable worsening of their performances if the time horizon is lengthened to include the years of the financial crisis.

2.5.5.1 The Dow Jones Brookfield Global Infrastructure Index

Among reported indexes, the Dow Jones Brookfield Global Infrastructure Index has shown the best performance in the considered time horizon, having admirably withstood also the crisis periods and having overperformed the general market index. The DJBGII is a pure-play infrastructure index composed by companies getting more than 70% of their revenues from infrastructure operations. By the last day of 2015, the index was composed by 95 securities with a market cap amounting to $712 billion. As of June 30th 2016, instead, the DJBGI index market cap exhibited a $900 billion value.

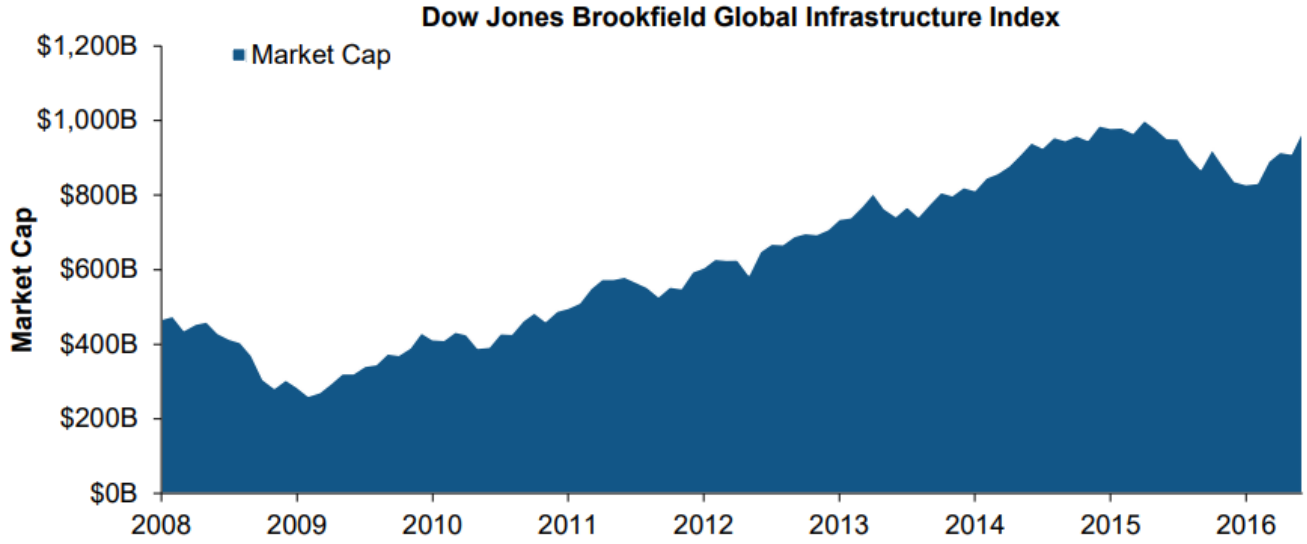


Figure 2.54 – The growth of the Dow Jones Brookfield Global Infrastructure Index market capitalization
Source: Goldman Sachs Asset Management 2016

The Dow Jones Brookfield Global Infrastructure Index is particularly representative of the universe of listed infrastructure, as it has a global geographical scope, encompasses data from different infrastructure sectors rather than adopting an aggregation approach and focuses on the transmission and distribution stages of the infrastructure industries supply chains neglecting the least "infrastructure-intensive" phases of infrastructure-related activities. Its good performance and its alleged capacity of providing a realistic representation of global listed infrastructure can be considered as an indicator of the convenience of listed infrastructure investments under the risk-return point of view, also withstanding the unsatisfying performance recorded by other listed infrastructure equity indexes.

The first figure shows the composition of the Dow Jones Brookfield Global Infrastructure Index The following two, instead, offer a graphical representation of its performance, in terms of absolute return, at first, and in terms of risk-return performance in comparison with non-infrastructure indexes, then.

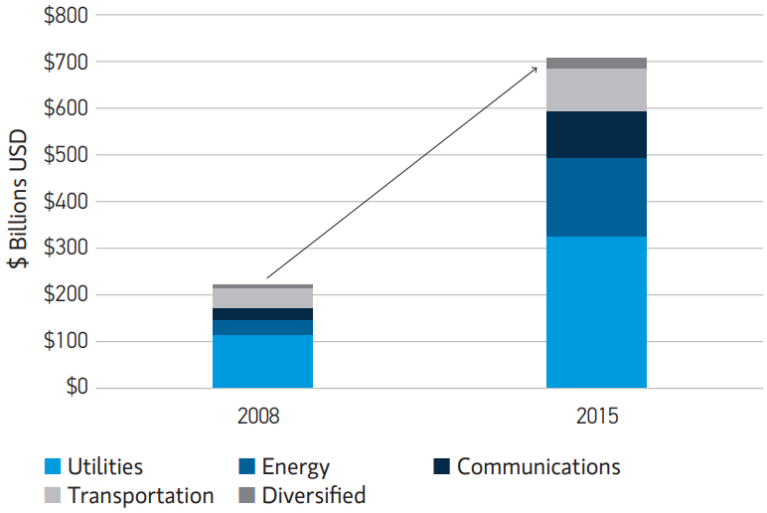


Figure 2.55 – Composition of the Down Jones Brookfield Global Infrastructure Index
Source: Morgan Stanley Asset Management 2016
2015 data

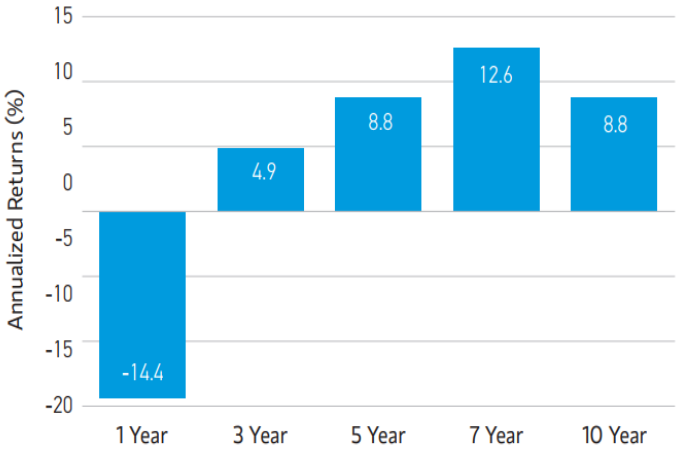


Figure 2.56 – Annualized return of the Dow Jones Brookfield Global Infrastructure Index
Source: Morgan Stanley Asset Management 2016
2015 data

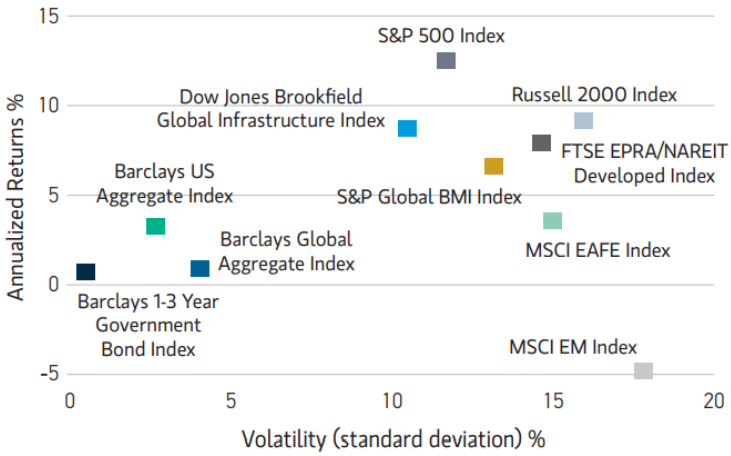


Figure 2.57 – Five-years risk-return comparison between DJBGI index and other non-infrastructure indexes
Source: Morgan Stanley Asset Management 2016
2015 data

By June 30th 2016, the Dow Jones Brookfield Global Infrastructure Index exhibited a yield of 3,4%, higher than both Barclays Global Aggregate Index for bonds (1,1%) and the MSCI World Index for global equities (2,6%). By that time, the DJBGI presented a volatility (annual standard deviation) of 10,8%: higher than the Barclays Global Aggregate Index (4,4%) but lower than the MSCI World Index (13,1%).[108]

The following table shows a comparison between the performance of listed infrastructure investments (DJBGI index) and the one of unlisted infrastructure investments (Prequin data), for vintage year. Historical evidence shows favorable results under the point of view of realized returns, with private and public market equity internal rates of return ranging between 5% and 19%, depending on geography, industry type, leverage within the capital structure, and the level of asset maturity. Most institutional investors are expected to target a range of 4% to 11% nominal annualized return, with the vast majority in the 8%-9% range. The DJBGI index has met this target, although other listed infrastructure equity indexes have shown mixed performance.

For its representativeness with respect to the infrastructure universe, the DJBGI has been recommended also as a proxy to assess the performance of core unlisted infrastructure investments. While several contrary evidences are there in the literature, the following table shows how the return profile for listed infrastructure has actually largely matched the one of the unlisted, on a vintage year basis. [109]

VINTAGE YEAR	PRIVATE INFRASTRUCTURE (PREQIN MEDIAN IRR)	LISTED INFRASTRUCTURE (DJBGI INDEX)
2006	7.9%	10.7%
2007	5.0%	8.0%
2008	9.0%	6.9%
2009	11.0%	15.8%
2010	9.2%	12.7%
2011	18.6%	12.7%
2012	11.0%	12.5%

Figure 2.58 – Comparison between listed (DJBGI index) and unlisted (Prequin) infrastructure performance
Source: Morgan Stanley Asset Management 2016
2015a

[108] Goldman Sachs Asset Management – "*Building a Case for Global Infrastructure*" – October 2016
[109] Morgan Stanley Asset Management – Bigman, Ted; King, Matt – "*The Case for a Strategic Allocation to Global Listed Infrastructure Securities*" – January 2016

2.5.5.2 Performance of infrastructure debt

Infrastructure debt investments have shown to benefit from generally lower default rates. In particular, Moody's has analyzed a set of data referring to the 1983-2012 period, finding that the cumulative defaults for non-financial corporate debt issues (81% investment grade) and infrastructure debt issues (almost 60% regulated assets) have increased at different rates, with the former growing faster than the latter, over time. By the 10th year from the issuance, non-financial corporate debt defaults were, in absolute terms, as much as one time and half the infrastructure debt defaults. In addition, infrastructure debt has shown higher recovery rates with respect to corporate debt, with the sole exception of senior unsecured debt on unregulated utilities. [110]

EY has built an infrastructure debt index composed by five infrastructure bonds across different sectors, deemed to be representative of typical PFI/PPP opportunities that infrastructure investors may target, with a rating ranging from A to BBB and an average term of 20 years. The spread available on this index has been benchmarked with respect to the one available on indexes of A and BBB-rated traditional corporate bonds having a maturity of 15 years. Over time, the infrastructure spread has kept consistently between the spread provided by A-rated and BBB-rated corporate bonds, notwithstanding the fall recorded in last years. After the first quarter of 2015, spreads available on non-publicly rated A-to-BBB PFI/PPP issues termed 15-to-25 years ranged from 125bps to 160bps. Spreads on other infrastructure debt have varied anecdotally from 40bps to 260bps, depending on the sub-sector, rating, tenor and whether the issue is private or public. Infrastructure loans are expected to perform even better because of the additional illiquidity premium they are expected to issue. [111]

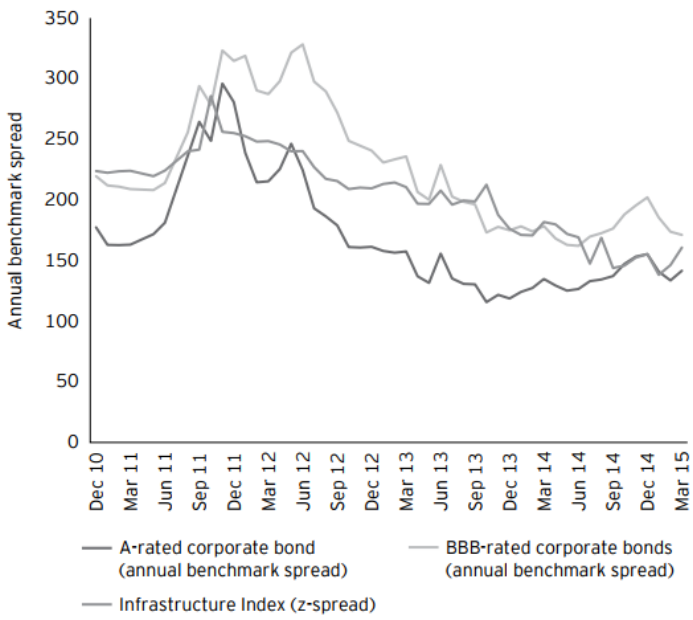


Figure 2.59 – Annual benchmark spread on infrastructure investments compared to traditional assets
Source: EY 2015

[110] Weber, Barbara; Staub-Bisang, Miriam; Alfen, Hans Wilhelm – "*Infrastructure as an Asset Class - Investment Strategy, Sustainability, Project Finance and PPP*" – II edition – Wiley - 2016

[111] EY – Allison, Ryan; Tufts, Sam – "*Infrastructure investments. An attractive option to help deliver a prosperous and sustainable economy.*" - 2015

Although, as repeatedly stated, the infrastructure universe is so broad not to allow for generalization, the findings reported in this paragraph appear remarkably positive and represent more than a valid reason for which investors with compatible risk-return and cash profiles should target infrastructure debt and equity investments.

ANNEX C: Infrastructure and the ARCADIS' Global Infrastructure Investment Index 2016[112]

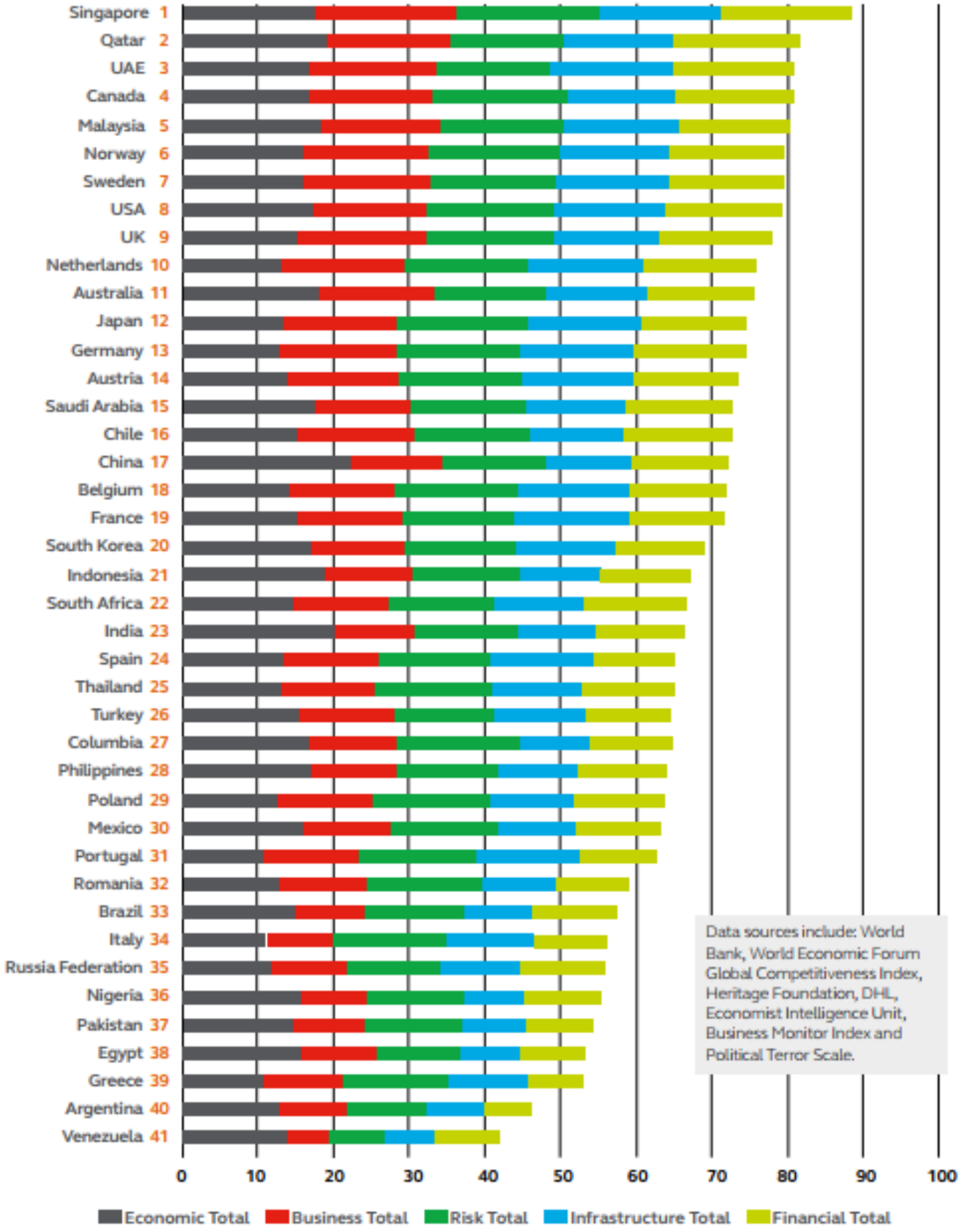


Figure 2.60 – ARCADIS' Global Infrastructure Investment Index 2016 - Countries ranking

[112] ARCADIS – "*Third Global Infrastructure Investment Index – Bridging the investment gap*" - 2016

Chapter 3

3.Insurance companies' infrastructure investments in the European environment

"Industry policymakers and consumer groups all have a role in ensuring that long-term savings products provide the combination of security, affordability, risk sharing and flexibility that is appropriate to the long-term interests of individuals"—

Bank of England, 2014

3.1 Insurance investors as an important source of infrastructure financing in Europe

Insurance companies are financial institutions specialized in the allocation of risk. In particular, their core business is about "purchasing" risk from other economic entities. They accept to issue lump sums or annuities to determined beneficiaries at the occurrence of specific events related to the human life and are in turn remunerated through the payment of policy premiums by their policyholders. In most cases, payments from insurers are characterized by uncertain existence, unknown timing or unknown amount, often in combination. Payments issued by policyholders, instead, are certain, and a significant share of the resulting capital stock is employed by insurers to invest in financial assets. Insurance services are broadly divided in life, health and non-life policies, according to the nature of the event that can trigger the agreed payments from the insurer.

More than 90% of the World insurance market is covered by the European (32%), the North American (31%) and the Asian (30%) insurance industries. By 2016, 3700 branches of insurance companies, employing almost one million workers, were operating in Europe, including branches of both European and non-European insurance companies. The 2015 total amount collected by European insurers in the form of premiums achieved as much as €1200 billion, of which more than 60% were life premiums. That year, the ratio between total premiums paid (life, non-life, health) and related benefits issued has equaled 1,23 (1,12 for the life insurance sector). [113]

There is spread consensus about the positive correlation between the development of the financial sector and economic growth. Consistently, the insurance industry tends to be larger in more developed economies, which also show higher insurance premiums-to-GDP ratios. In some countries a causality nexus has emerged between the growth of the insurance sector and the GDP growth. Insurance companies offer an important contribution to the economic development, as they are expected to facilitate economic transactions through the allocation and indemnification of risks, encourage risk management and the promotion of safe practices, stimulate a healthy and sustainable level of saving and pension provisions. In addition, they promote financial stability through long term investments.

Investing is an integral part of the insurance business model and is driven by the nature of insurers' liabilities and by their need to match them with suitable assets. Insurance companies, especially life insurers, are an important source of long-term investments, as their future payments to the beneficiaries of their policies can be estimated with a reasonable degree of confidence over time.

[113] Insurance Europe – "*European Insurance – Key Facts*" August 2016

Indeed, even during economic downturns, policyholders usually keep paying due premiums to insurers and the consequent regular flow of revenues enables insurers to buy undervalued assets during times of crisis, when other players are forced to sell them. Insurers' ability to invest when other actors withdraw from the market is likely to generate a counter-cyclical stabilizing effect, at advantage of financial markets and of the whole economy. This phenomenon appears not to be limited to economic downturns, though. From the whole 2004-2015 period, insurance companies (and pension funds) have purchased debt securities at discount and sold assets trading at premium, counterbalancing price changes on debt markets and injecting liquidity.

Insurance companies are the largest institutional investors in the European economy, with as much as €9,800 billion of assets under management, equivalent to roughly 65% of the European GDP (2015 data). They account for half of European institutional investments, holding almost a quarter of the European sovereign debt and 21% of corporate bonds, among others. Main components of insurers' portfolios are government and corporate bonds, followed by equities, loans and mortgages, investment funds (see the figure below). During most recent years, anyway, the allocation toward equities has slightly increased, together with the share of non-financial corporate bonds, while the share of government bonds has decreased. For example, from 2013 to 2015, Italian insurers' allocation toward government bonds has decreased from 57% to 54,1%, at advantage of corporate bonds, whose share has grown from 21% to 23,5%.[114]

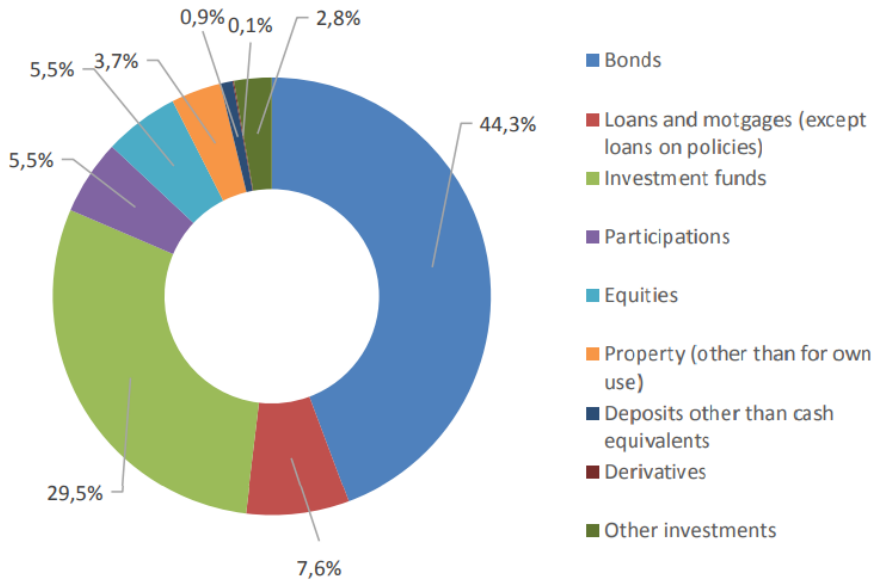


Figure 3.61 – Asset allocation of European insurance companies
Source: Focarelli, Dario - "Why insurance regulation is crucial for long-term investment and economic growth" 2015 data

[114] Focarelli, Dario – "*Can insurance companies help more SMEs to access capital markets?*" - 2016

By 2014, only the 0,3% of European insurers' capital was committed to infrastructure investments, namely €22 billion.[115] Nonetheless, it is reasonable to believe in a growth of this share. For example, in a 2014 study over 20 global players of the insurance market, with $2.000 billion of assets under management, the half of them has declared to be willing to increase their exposure in infrastructure.[116] Further, the European initiatives taken in last years to boost investments are expected to have a significant effect also on insurance companies. This sounds encouraging, especially if coupled with the estimated 8% average annual growth rate of European insurers' assets under management, from 2017 to 2022.[117]

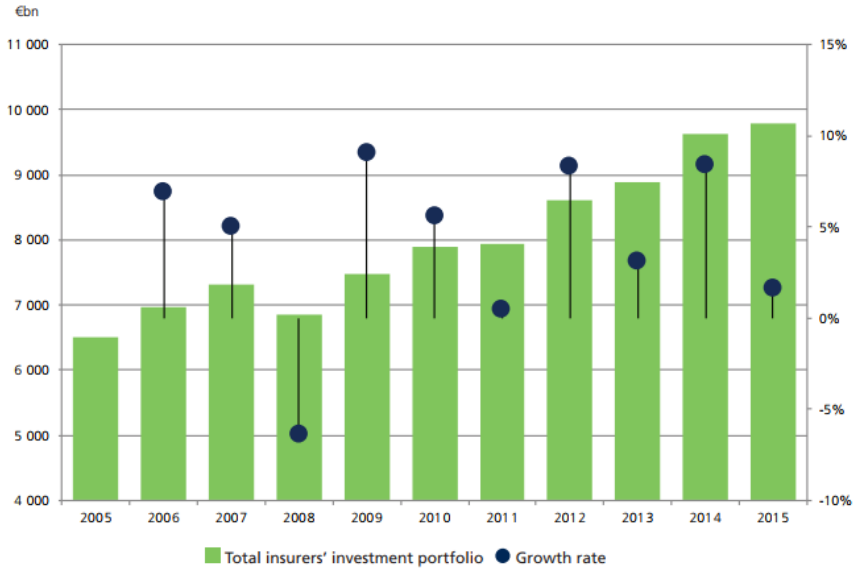


Figure 3.62 – European insurance companies' assets under management: a growing trend
Source: Insurance Europe 2016
2015 data

The main motives for which insurance companies are expected to offer a significantly valuable contribution in the financing of infrastructure projects include their long duration, which fits well in the asset allocation strategies of insurers, coupled with the potential to earn, over time, cash flows whose stability is enhanced by regulatory or contractual mechanisms of inflation hedging and the low correlation with other types of investments. Insurance companies tend to target mature brownfield investments in infrastructure, as these projects are free from the broad set of typical pre-construction risks, tend to earn stable and predictable cash flows over the long run and to receive a preferred regulatory treatment. [118] A Prequin study over 200 insurance companies showed that 85% of insurers invest in unlisted infrastructure funds managed by external advisors. Second and third ranked were direct investments in special purpose vehicles and investments in listed infrastructure funds. [119]

[115] Ship2shore – "*L'UE semplifica la vita alle assicurazioni che vogliono investire in infrastrutture*" – October 2015
[116] Insurance review - Aurilia, Fabrizio – "*Alla ricerca di investimenti alternativi*" – March 2014
[117] IPE - Bocci, Claudio; Giudetti, Gianmatteo – "*The European insurance challenge*" – February 2017
[118] ANIA & CDP – "*Il trattamento degli investimenti in infrastrutture in Solvency II*" – February 2017
[119] OECD – "*Private financing and government support to promote long-term investment in infrastructure*" – September 2014

The European insurance industry shows significant investment potential and is expected to support the economy of the Union to find a way out from the low growth caused by, among other things, a long lasting underinvestment pattern. During last ten years, insurance companies in the Euro area have increased their investment volume by 50% in spite of the financial crisis, showing a remarkable misalignment with the behavior of most other financial institutions. Indeed, they have partially contributed to fill the vacuum left by deleveraging banks. Nonetheless, the European insurance industry is not exempt from significant challenges.

First of all, the economic and political context represents the main external factor impacting on the insurance industry, scoring 10/10 in the ranking of sources of influence for European insurers in the EY 2017 European Insurance Outlook.[120] Indeed, given the current low interest rate environment, insurance companies are struggling to find investment opportunities enabling them to meet the guaranteed rate of return on their liabilities.

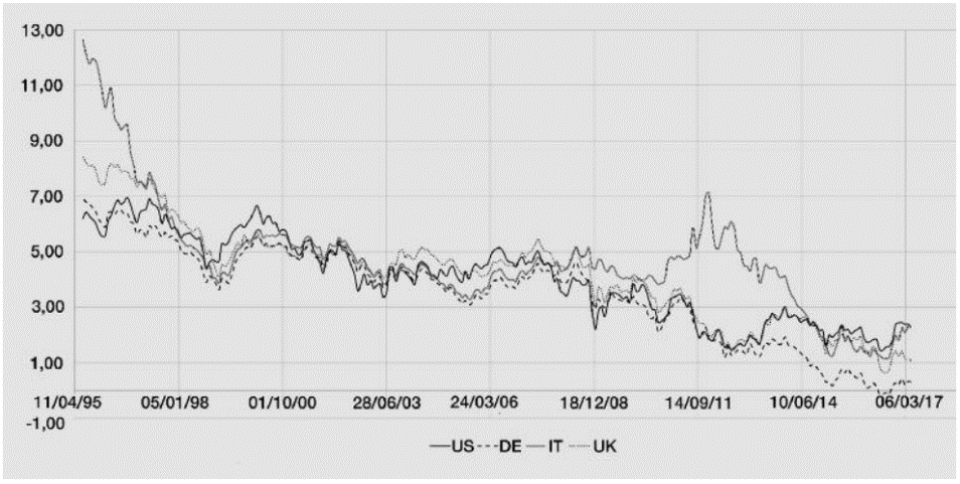


Figure 3.63 – The falling trend of sovereign bonds' returns
Source: LUISS Business School & ASTRID - Merola, Federico; Caroli, Matteo; Iaione, Christian; Fersini, Paola - "Le casse di previdenza tra autonomia e responsabilità. I professionisti, il risparmio, l'economia reale" - 2017

Since the beginning of the financial crisis, indeed, *quantitative easing* measures and other central banks' decisions have kept interest rates extremely low. This, coupled with increased volatility and inter-correlation of several traditional markets, has led to a loss of insurers' interest for traditional bonds, whose value appears excessively linked to the will of central banks. Their interest has instead shifted toward new investment opportunities that can enable a better diversification of their exposures and better matching their assets and liabilities, while possibly allowing them to earn better risk-adjusted returns on their investments. Alternative real assets like infrastructure (credit and equity), securitizations and credit, having an immediate impact on growth, have hence appeared to insurers under a new appealing light, together with Exchange Traded Funds, bank instruments and investment funds for SMEs.[116]

[120] EY – Crawford, Shaun; Freiling, Andreas; Manchester, Peter - "*2017 European Insurance Outlook*"

Secondly, insurers' allocation strategies strongly reflect the regulatory framework shaping the playing field of referral, including prudential regulation, accounting standards, tax laws and norms regulating specific investments. Regulation scores 9/10 as a source of impact in the EY ranking mentioned above.[121] To actually address the contribution potential of insurance companies, a combination of measures and actions has to take place. First of all, the referring regulatory framework needs to be consistent with insurers' natural propensity for long-term investments. Secondly, it is essential to guarantee the supply and access to suitable assets and investment vehicle, exhibiting attractive characteristics like high issuer quality, attractive risk-adjusted returns with respect to insurers' liabilities, adequate guarantees, standardization and transparency.[122]

3.2 Investment barriers

A government may exhibit lower return thresholds for viable infrastructure investments than private financers but is not likely to access unlimited facilitated low-cost financing, as its cost of capital may soar under certain circumstances, and hence needs to involve a certain amount of private capital in infrastructure projects (see Paragraph 2.2). In order to properly incentivize private actors to commit resource to infrastructure investing, governments need to take care of certain relevant exigencies of theirs, as public and private actors' different perception of risk and return associated to large infrastructure project can impair their ability to get launched.

Both the global stock of infrastructure assets and the yearly flow of investments toward the asset class, to date, appear insufficient to address both short-term and long-term needs of countries, peoples and businesses. While demand for infrastructure is still partially unmet, there is a correspondent abundance of private capital that could be potentially employed to fill the gap. During 2016, the global value of infrastructure deals has risen from $362 billion to $413 billion, corresponding to a 14% increase, but this positive result has not translated into a significant increase in the number of new deals, which has kept between 1700 and 1800 a year on since 2013 (1772 in 2016), emphasizing how an existing cash surplus is conveyed toward too few opportunities.[123] Against this background, it is worth investigating the possible causes of the enduring underinvestment pattern. Two sets of investment barriers can be pointed out.

[121] According to EY's 2017 European Insurance Outlook, besides the economic and politic context and the regulatory environment, scoring respectively 10/10 and 9/10, other important external elements of impact on European Insurers in 2017 are the cyber risk and customer expectations about digitalization and transparency (scoring 8/10), technological changes, talent gaps, competition and trends of concentration (scoring 7/10)

[122] Focarelli, Dario – "*Why insurance regulation is crucial for long-term investments and economic growth*" - 2015

[123] Financial Times – Plimmer, Jill - "*Investment in infrastructure assets soars to record*" – January 2017

The first major set of investment barriers for institutional investors is represented by the lack of adequate investment opportunities. During last years, the European market has benefitted from noticeable liquidity that could not have been opportunely conveyed toward strategic investments because of the lack of a clear and straightforward planning. Said planning has in turn lacked because of insufficient institutional support.[124] Private investors claim the existence of sustainable pipelines of infrastructure projects so that the target initiatives take part of a coherent long-term investment strategy. It is undeniable that, at least from a theoretical perspective, projects included in long term strategic plans are more likely to receive support from public institutions and investors, besides facing less demand, political and ESG risks. Still, many countries, including developed ones, often miss sufficient long-term plans for infrastructure projects. Further, projects are to be bankable, meaning that investors expect them to be supported by enough up to date, reliable, wide-ranging information and analysis. In order to reduce information asymmetries and threats of adverse selection, investors and lenders require evidence of a project's feasibility before committing resources to their own due diligence assessments. Feasibility has not to be intended as a financial matter only but also under the social, economic, technical, environmental and administrative point of view. The specific goals and sub-goals of a project must be clearly defined and measurable from the onset.[125] In addition, provided that a project is feasible, the actual involvement of resources to infrastructure investments is subordinated to the existence of suitable financial instruments and vehicles, which should be consistent with the characteristics and strategies of potential investors. This first set of barriers also includes technical limitations arising from poor knowledge and experience about investments in infrastructure, exacerbating investors' perspective about the riskiness of concerned deals. Data about past performance of infrastructure assets are still limited and evidences found in the literature are sometimes mixed.

The second major set of investment barriers include regulatory constraints.[126] A well-structured financial system, composed by adequately capitalized actors, is an unquestioned desirable outcome and appropriate forms of financial regulation are useful to minimize the likelihood of events that can generate significant negative spillovers or externalities over the whole financial, economic and social system.[127] In particular, prudential regulation is set up to ensure that funds collected by insurance companies are managed prudently enough to preserve the interest of policyholders and beneficiaries, rather than convey toward opportunistic investments that, while potentially allowing

[124] Il Sole 24 Ore & ARPINGE – "Più risorse alle grandi opere dagli assicuratori" – September 2017
[125] Institute and Faculty of Actuaries – "*Infrastructure investment. Mind the gap?*" - 2016
[126] Gatzert, Nadine; Kosub, Thomas – "*The Impact of European Initiatives to Promote Infrastructure Investments from the Insurance Industry Perspective*" – April 2016
[127] FrancoAngeli - Cappiello, Antonella – "Regolamentazione e risk management delle imprese assicurative. Profili evolutivi" - 2008

companies to magnify their profits, expose policyholders' savings to excessive risks. While the merit of this goal is unlikely to get questioned, the concrete way it is pursued represents a core issue and has been strongly debated. The regulation of the financial system is based on the economic argument of the public interest theory, according to which the exigence to regulate the insurance sector comes from inefficiencies related to asymmetric and costly information, being the cause of a series of so-called problems of agency. The recent experience from the financial crisis has brought this issue under a special focus and many policymakers have prioritized it in their agendas. [128]

The regulation of investments is a key aspect of the regulatory framework imposed on insurance companies to limit the amount of risk that each company can take on. Nonetheless, regulatory authorities need to be aware of how this kind of regulation influences investors' ability and willingness to inject money in the real economy. From the onset of the recent financial crisis, long-term investors, in several developed countries, have been overloaded with rules that have prevented them from contributing to the real economy to the extent they could have done. This has often been the result of superficial rule-designing processes, solely concentrating on the direct impact of regulation on single actors, while neglecting aggregate indirect effects, hence actually worsening markets' volatility and fueling investors' preference for securitized assets and derivative instruments. Ill-conceived rules have driven upward the overall systemic risk of markets and, as a consequence, the risk of individual investors' portfolio, that should have been lowered in consequence of these regulations. [129]

Regulation, for example, is deemed to be one of the main causes of the remarkable fall in the share of equities held in European insurers' portfolios, from 2000 to 2011: a trend that did not appear in United States. De-risking in Europe has begun as an internal risk management approach, encouraged or forced by regulation after the dotcom bubble had burst on the wake of the new millennium. Anyway, given that equity is a better risk-sharing instrument than debt and better accommodates long-term investments, due to its perpetuity, while attempting to protect the stability of institutional investors, a bad calibrated regulation can bring about poor risk sharing and weak long-term investments.[122]

[128] Il Mulino Strumenti - Andenas, Mads; Avesani, Renzo G.; Manes, Paola; Vella, Francesco; Wood, Philip R. - "*Solvency II: A Dynamic Challenge for the Insurance Market*" - 2016

[129] LUISS Business School & ASTRID - Merola, Federico; Caroli, Matteo; Iaione, Christian; Fersini, Paola - "*Le casse di previdenza tra autonomia e responsabilità. I professionisti, il risparmio, l'economia reale*" - 2017

3.3 European initiatives for the support of private long-term investments

The European Investment Banks and the European Commission have launched a number of initiative with the aim of facilitating long-term investments by private actors and reducing the European investment backlog by enhancing the productivity of economic agents and stimulating competition in certain areas. The contribution of these initiatives to overcome investment barriers is definitely valuable, as they have addressed issues regarding the availability of infrastructure projects, adequate financing vehicles, transparency and sufficient data, but there is still room for enhancement of their benefit potential. Among the initiatives in question, the most relevant for insurance companies willing to invest in infrastructure assets are the Investment Plan for Europe, also known as Juncker Plan, and the EU 2020 Project Bond Initiative, which has been merged with the former after the end of its pilot phase, in 2016.

The EU 2020 Project Bond Initiative began in 2012 as a pilot project under the control of the European Investment Bank and the European Commission supervision. The pilot phase continued until 2016 and relied on a budget of €230 million. At the onset of the project, it was meant to be officially launched under the name of "Connecting Europe Facility", as a part of the 2014-2020 Multiannual Financial Framework. The principal direction of the initiative was to stimulate private and institutional investors to finance infrastructure projects by improving the risk profiles of project bonds, at least up to an A-rating, through the use of subordinated institutional debt or contingent facilities from the European Investment Bank. The initiative was only available for selected projects, fulfilling economic and technologic feasibility criteria. Further, projects had to be approved before the end of 2014 and achieve the financial close by the end of 2016. The main focus of the initiative has been the Trans-European Network (see Paragraph 1.5.1).

The EU 2020 Project Bond Initiative was a form of Public-Private Partnership, based on a financial vehicle whose bonds' creditworthiness were to be enhanced by the European Investment Bank through the provision of a subordinated or contingent credit line. In the former case, the operation takes the name of funded Project Bond Credit Enhancement, while in the latter the operation is said to be unfunded. Hence, while several sponsors injected equity in the Special Purpose Vehicle, other investors were expected to provide it with senior debt, incentivized by the credit-enhancing measures of the European Investment Bank. The following figure provides a scheme of both funded and unfunded Project Bonds Credit Enhancements under the EU 2020 Project Bond initiative.

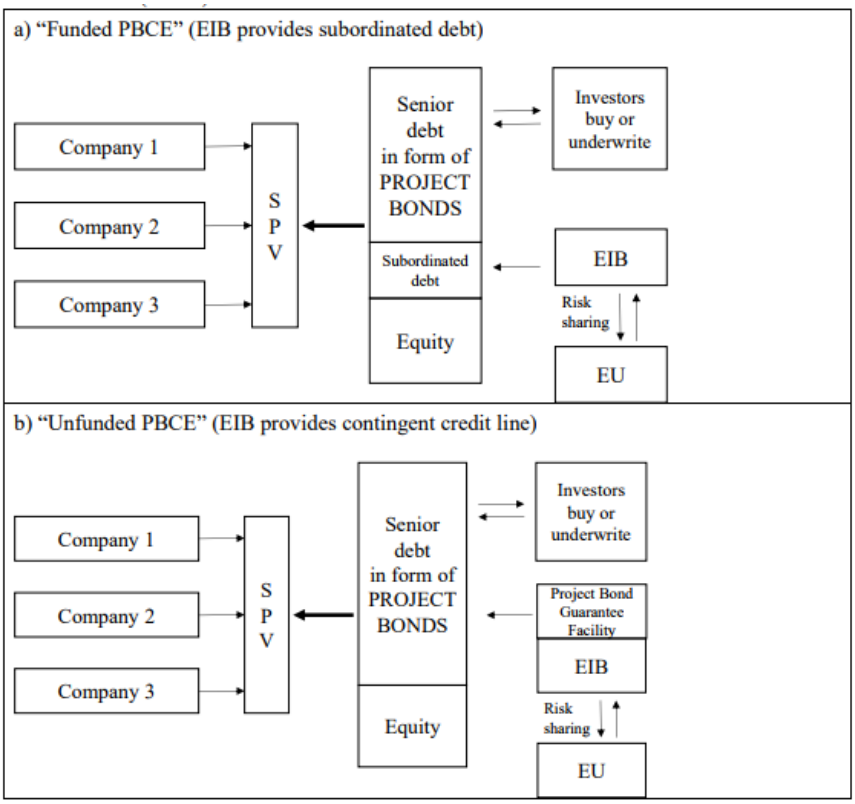


Figure 3.64 – Funded and unfunded Project Bonds Credit Enhancements from the European Investment Bank under the framework of the EU 2020 Project Bond Initiative
Source: Gatzert, Nadine; Kosub, Thomas - "The Impact of European Initiatives to Promote Infrastructure Investments from the Insurance Industry's Perspective" – April 2016

Each Credit Enhancement facility could not exceed the 20% of the project or €200 million. In the context of funded PBCEs, the debt was subdivided in tranches of senior and subordinated debt, where the former was meant to be purchased by institutional investors and the latter from the EIB. In contrast, the credit line provided in the context of unfunded PBCEs could be used in case of cost overruns in the construction phase or other events potentially preventing the issuance of adequate payments to senior debt-holders. The EIB credit line could be required several times if the previous credit lines had been paid back by the SPV. By December 2015, eight projects have been supported by the EU 2020 Project Bond Initiative, enjoying significant improvements of their bonds' rating. Three of them took place in the United Kingdom and two in France, while the others were located in Belgium, Spain and Germany.

The Investment Plan for Europe has been announced in fall 2014 by the president of the European Commission Jean-Claude Juncker. The Plan was launched with the goal to trigger the creation of a €315 billion investment vehicle for strategic long-term investments in infrastructure and investments in SMEs and mid-cap firms across the 2015-2017 period, known as the European Fund for Strategic Investments. The Connecting Europe Facility, originally planned as the continuation of the EU 2020 Project Bond Initiatives with a €3.300 million budget, has been merged with the Plan. The Initiative has started operating in 2015 with the declared objectives of:

- Reversing downward investment trends and helping boost job creation as well as economic recovering without excessive burdens on government budgets and issuance of new sovereign debt
- Taking a decisive step towards the fulfilment of long-term needs and the enhancement of competition in the European economy
- Strengthening the European human capital, productive capacity, knowledge and physical infrastructure, with a special focus on the interconnections that are essential to the best functioning of the Single Market

The Plan develops in three senses: financial, administrative and regulatory. Under the financial point of view, it provides the mobilization of as much as €315 billion of additional investments from 2015 to 2017, with the view of maximizing the impact of public resources and unlocking private capital. Of this sum, €240 billion are planned to be employed for long-term investments like infrastructure. The overall target amount is expected to be achieved with a contribution of €16 billion from the European Union and of €5 billion from the European Investment Bank. Hence, public resources are thereby expected to have a multiplying effect equal to 15. Public sector entities, utilities, companies of any size, bespoke investment platforms, national promotional banks or any other bank providing intermediate loans can all apply for EIB support.

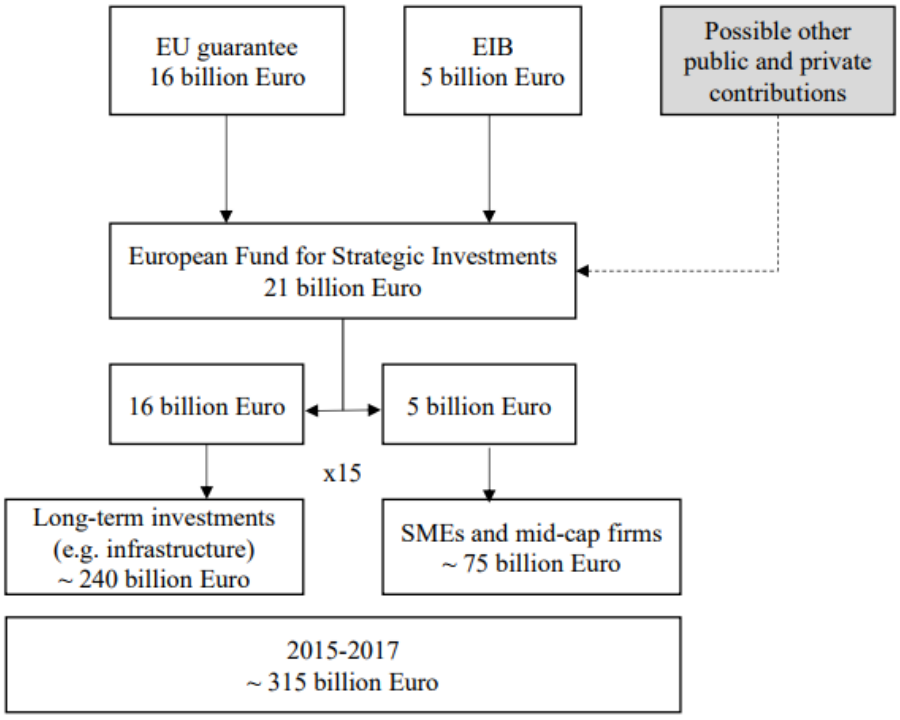


Figure 3.65 – The structure of the financial strand of the Investment Plan for Europe
Source: Gatzert, Nadine; Kosub, Thomas - "The Impact of European Initiatives to Promote Infrastructure Investments from the Insurance Industry's Perspective" – April 2016

On the administrative point of view, target initiatives are to be undertaken in order to make sure that additional capital risen actually flows toward the fulfilment of the needs of the real economy. This set of initiatives is expected to encompass the creation of a project pipeline at European level. For the pursuance of this goal, an Investment Task Force has been purposely created to screen potentially viable investment projects that are relevant for the European economy. The resulting list has been conceived as a dynamic document and eligible projects have been chosen on the basis of a simple and transparent assessment framework. The project list comprises around 2000 projects with a total value of around €1300 billion. A European Investment Project Portal was also developed in 2015 to enhance the availability of information on investment opportunities. The European Investment Project Portal has been supplemented by the European Advisory Hub, offering a single access point to wide ranging support for projects and investments at all stages of the project cycle.[132] Last, regulatory measures are expected to enhance the European regulatory environment predictability, removing some of the barriers to investments and making the European environment more attractive for investors. [130]

By September 2016, the European Commission declared that additional resources for €138,3 billion had been unlocked as a consequence of the Investment Plan for Europe, in the context of 324 new transactions in 27 of the 28 European Union Member States. This has led to the creation of up to 100.000 new jobs and to improved access to finance for 290.000 SMEs. Consistently with the positive results, the president *pro tempore* of the European Commission, Jean-Claude Juncker, declared that the Commission was willing to extend the validity of the project until 2020, enhancing the financing power of the European Fund for Strategic Investments until turning the initial target of €315 billion of additional investments in a new €500 billion target. [131]

As of December 2017, thanks to the Juncker Plan, €256 billion of investments have been triggered, equal to 81% of the initial target of €315 billion, in the context of 704 transactions in all of the 28 European Union Member States. Of the total €256 billion in additional investments, the European Fund for Strategic Investments provided €51 billion. Hence, despite the excellent results, the actual public resources multiplier ranges between 4 and 5, rather than 15. New deals have concerned social, transport, energy and digital infrastructure sectors and have deployed valuable resource for R&D and environmental projects, besides funding agricultural projects and providing better access to finance for a significant quantity of SMEs.[132]

[130] Gatzert, Nadine; Kosub, Thomas - "*The Impact of European Initiatives to Promote Infrastructure Investments from the Insurance Industry's Perspective*" – April 2016
[131] European Commission – "*The Investment Plan For Europe*" – September 2016
[132] European Commission brochure – "*The Investment Plan For Europe – InvestEU*" – December 2017

The following graphs show how EFSI capital has been distributed among countries and sectors. The first graph also provides an overview of the amount of private resources that EFSI capital deployment has been able to trigger in different European countries. Each country total investment is given by the sum of the blue bar and the orange bar. Looking at bars related to each country, it is also possible to gain an insight about the actual multiplier effect of public resources. Best performers were Hungary, Slovenia and Estonia where each euro of EFSI capital allowed to raise 17, 8,3 and 7,2 euros of private resources, respectively. Worst performers were Slovakia, Cyprus and Italy. In Slovakia, the provided capital has exhibited a multiplier of 2.6, in Cyprus of 1,8. Sadly, Italy was the only country where the ratio between raised private capital and capital provided by the EFSI has fallen below the level of 1. Indeed, of the additional €10 billion invested there, roughly two thirds have been directly injected by European institutions. The whole set of data is reported in ANNEX D.

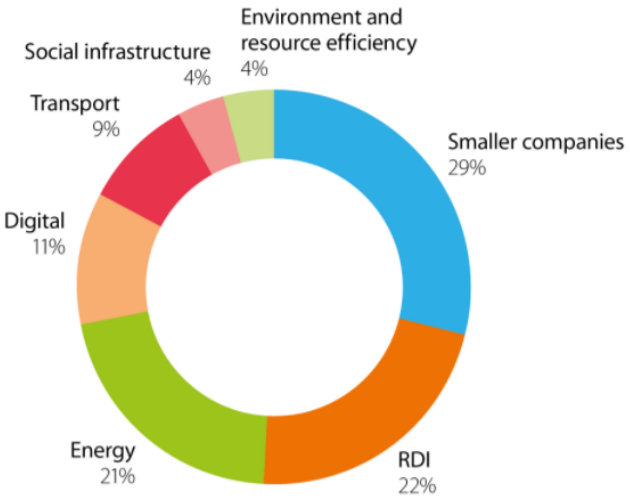


Figure 3.66 – Distribution of EFSI resources among target sectors
Source: European Commission 2017

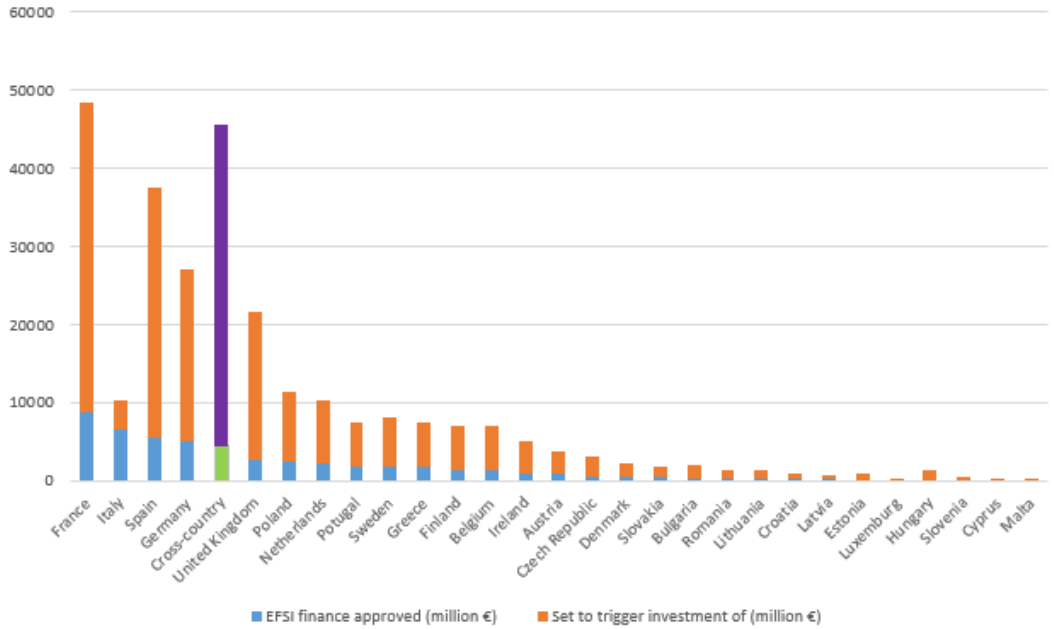


Figure 3.67 – Additional investments triggered by EFSI finance in each European Member State
Source: European Commission 2017

3.4 Types of regulatory limits to institutional investments

3.4.1 Quantitative provisions

Limitations to investments often take the form of rules directly conditioning investors' portfolio allocation choices. Purely quantitative limits are formulaic constraints set up by the regulator on specific investments, imposing a minimum or maximum allowable threshold. In most cases, they are expressed as a percentage of the total asset allocation of the regulated entity. Quantitative provisions usually take part of a complex system of rules shaping investors' behaviors. These can regard certain asset classes, as well as certain investment vehicles. Otherwise, they can be based on the nature of investment transactions, the concentration toward single counterparties and the jurisdiction originating the investment, in both its geographical and market-base characteristics, as shown in the table below.

Limits on instruments usually concern whole asset classes, depending on their characteristics such as their rating or whether they are listed on a market, their duration, the value of collaterals. This kind of constraints may hit sub-classes as well, like convertible bonds or mortgage-backed securities in the grouping of fixed-income assets. Absolute quantitative limits may exist as well.

Also the indirect investment in certain asset classes can be constrained. It can be done by limiting investments in certain vehicles, like hedge funds, or whole types of funds, like private funds. Anyway usually investment limits concerning an asset class are applied to the total exposition of the regulated entity to the asset class itself, including both direct and indirect investments. In other cases, the regulator privileges indirect exposures to some assets, limiting direct investments only. It may be the case of real estate investments, for example.

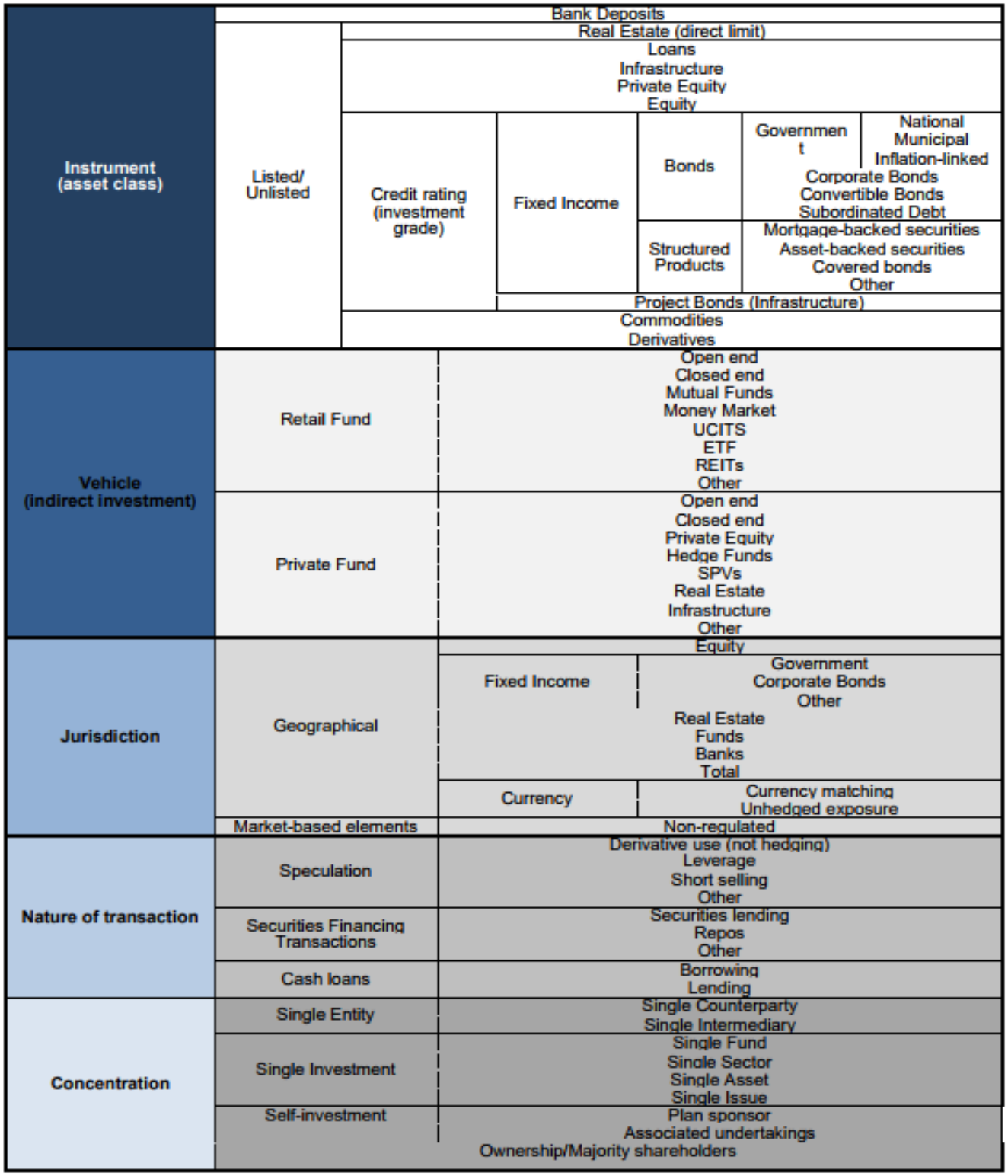


Figure 3.68 – Possible quantitative limits on insurers' investments
Source: OECD 2015

As shown by the table above, limitations may hit some investments according to the jurisdictions they are linked to. Said limitations can either be direct or indirect. Direct limitations regard investments originating or taking place in certain countries characterized by certain features. For example, non OECD countries investments can be limited, as well as countries where market participants miss some regulatory guarantees. Indirect limitations arise in the form of limits imposed to investments denominated in certain currencies.

Limits can be imposed on the nature of the transaction, typically restricting the manner or purpose of the investment. For example, the use of derivatives can be limited to hedging purposes. Lending and borrowing activities can be constrained as well.

Last, limits on concentration of investments can take place to impose diversification and prevent destabilizing events arising from single defaults. As for investment instruments, these limits are applied by fixing a given maximum percentage of assets that can refer to the same counterparty or asset class. The self-investment is likely to be limited as well, as it entails problems of conflict of interests and exposes to own credit risk. This kind of limit is usually expressed as the maximum allowable percentage of the target company's voting shares under the agent's ownership. Also in the case of limits on concentration, some absolute constraints may apply.

3.4.2 Qualitative provisions

The stability of insurance companies is not just a matter of what they invest in and how much capital they hold. As for each business, the good performance of insurers is especially a matter of good management. Experience has indeed emphasized the evident responsibility of poor management practices for crises having hit insurance companies. Quantitative requirements are therefore meant to be complemented by qualitative provisions, requiring insurance companies to meet certain behavioral standards. Usually, these take the form of guidelines and prescriptions about the way risk management, governance, controls and processes have to be performed by concerned entities. Governance requirements are meant to ensure that there is recognition of the level of risk that can be taken by the company and that explicit policies are in place to ensure adherence to sound risk management practices. While governance and risk management are often assumed to go together, the nature and characteristics of the link is variable.

The goal of qualitative prescriptions, among which the prudent person principle stands out as a particularly important and spread criterion, is to link the investment function of insurance companies to the best interest of policyholders and beneficiaries. In particular, the prudent person principle is defined as the requirement for insurance companies to invest the assets they hold for regulatory purposes so that security, quality, liquidity and profitability of their portfolio is ensured, together with a sound degree of diversification. The adherence of the prudent person to principles like due diligence and process, care, skill and delegation, duty to monitor and duty to protect policyholders' and beneficiaries' interests, as suggested by the European Insurance and Occupation Pension Authority, is unquestionable. Sound risk management is also included. The connection between risk management of investments and policyholders' protection, explicitly underlying the prudent person principle, is

increasingly considered the norm in most countries. The prudent person principle is also a crucial paradigm in the Solvency II framework regulating insurance companies in the European Economic Area.

Other main qualitative prescriptions linking governance to the investment activities of regulated entities include the obligation to clearly define roles and responsibilities in the context of decisional processes, as well as to make sure that appropriate discussion and risk management is carried out in the planning of non-routine activities. Roles and responsibilities have to be set at board and senior management level. Some countries mandate the existence of an investment committee in the board, provided with necessary knowledge and skills, so that it can perform the choice of investments, issue advice and support the board in the definition of the investment strategy. A written policy regarding investment or risk management is usually required and its content has to mirror the whole set of rules about the topic, valid in that moment. If any discrepancy exists, it has to translate in stricter internal rules, where not explicitly forbidden. If explicitly allowed, internal rules can partially derogate to general ones, subordinately to the fact that the minor burden is consistent with the characteristics of the entity. In most country the written policy must be approved by the board. According to Solvency II regulation, a written policy regarding an insurer's portfolio security, quality, liquidity and profitability has to be produced, also including information about the localization of assets held. Risk-management structures must be in place and the board is responsible for decisions, hence constantly informed.

There is a double-way causal effect between the increasing importance of qualitative provisions in the prudential regulation and the increasing awareness about the importance of setting adequate risk management mechanisms to preserve the stability of companies (above all financial entities) and to protect the interests of final users and investors. Many market players and individual countries regulations have indeed anticipated the European regulatory philosophy involving strong stimuluses to the adoption of well-designed corporate governance and risk management practices. This has been driven by the acquired awareness that qualitative and quantitative requirements based on risk management and governance have emerged as much more effective than solely quantitative prescriptions supporting strict portfolio allocation constraints and excessive administrative influence over investors' strategies, also under the point of view of investors' protection. [129]

3.4.3 Risk-based regulatory regimes

In all countries some behavior-oriented standards are valid with respect to insurance investments. These standards are particularly relevant for countries transitioning to risk-based regimes. Risk-based regulatory approaches are a recent evolution of regulatory regimes based on a mix of quantitative and qualitative prescriptions and represent both alternative and complementary solutions to strictly quantitative rules. While in most cases risk-based regulations remove purely quantitative limits on investments, they encourage or mandate single regulated entities to internally state some, consistently with their target level of risk and other internal characteristics. Most countries in the World have moved or are moving toward risk-based regimes. The European Union has done it by extending to all of its member States the Solvency II prudential regulation regime, starting from January, 1st 2016. Other countries, including United States, Canada, Australia, Japan, Korea, Switzerland, South Africa, had already their own risk-based regulation in place at that date. While some cross-country differences do exist, different approaches tend to share certain features at cross-country level. Risk-based requirements do not impose explicit limits on investments (the so-called "hard restrictions") but rather impose different "weights" on different investments, according to their riskiness, and levies capital charges to investors, accordingly, providing incentives to better manage risks. The adoption of risk-based regimes translates into the adoption of market-based forms of valuation for assets and liabilities, including a massive recourse to the so-called "fair value" evaluation method. The risk is instead measured through Value at Risk models, with local differences. Risk-based capital requirements in the insurance sector are increasingly based on an economic view of the business which apply market-consistent valuation and reflect the risk-adjusted value of future cash flows for both assets and liabilities. Risk categories that are usually encompassed in risk-based capital requirements are market risks, liability-side risks, (e.g. premium, reserve, catastrophe, biometric risks) credit-related risks (e.g. counterparty migration or default), operational risks.

While quantitative limits are still mainstream for OECD pension funds, insurers are observing a straightforward trend of abandon of explicit floors and ceilings constraining their investment strategies, with some geographical differences. Strictly quantitative rules may be coupled with risk-based rules in order to strengthen the reach of certain prescriptions, avoid inappropriate concentration of risks and limit dependence on single exposures. Also the new European Solvency II prudential regime for insurance companies leaves room for some quantitative limits on investments that can be levied by European authorities in case some risks are not adequately covered by the risk-based regulation. An example is the limit on the purpose of investments in derivative instruments, which can be used only with the view to facilitate efficient portfolio management or to reduce risk.

Hence, as risk-based regimes evolve and spread, quantitative prescriptions change their nature, purpose and scope but are not likely to completely disappear.

One of the main advantages of risk-based regulation is that the specific characteristics of single regulated entities are increasingly taken into account in the determination of their overall level of risk. Risk-based factors are more and more dynamic and comprehensive, with respect to risks covered, and keep in explicit consideration specific sources of risk and the relationship between assets and liabilities. Proper Asset Liability Management is usually encouraged by providing a lowering mechanism for capital charges if the regulated entity well matches its assets and its liabilities, while mismatching is associated to higher capital charges. In addition, several models recognize the value of diversification in the asset allocation strategies of regulated entities and hence reduce capital charges in consequence of it. The use of internal models developed by the regulated entities themselves is encouraged, so that they can adapt their calculations to really reflect their individual risk profile. In most countries, individual features of regulated entities are also accounted for through the application of the criterion of proportionality, providing differentiated treatments for companies according to their size and the complexity of performed activities.

In some instances, capital requirements can induce pro-cyclical behaviors from regulated entities, to the extent that assets and liabilities are valued according to market-based or market-adjusted values. Indeed, in case of market downturns, devaluation hits mainly, if not only, the asset side of an investor's balance sheet, resulting in a reduction of the risk-based funding ratio. If the funding ratio falls below certain thresholds, it triggers the need to divest riskier assets to keep consistency between the solvency capital and the risk borne. Fire selling riskier assets translates in pro-cyclical behaviors feeding the downturn, above all if performed by big institutional players like most insurance companies. Hence, risk-based regulations are often supported by counter-cyclical measures, also in the view of encouraging balanced investment strategies including careful long-term considerations. The European Solvency II regime includes three countercyclical mechanisms, namely a volatility adjustment, a matching adjustment and a symmetric adjustment for equity risk charges. [133]

3.5 Solvency II

The Solvency II project has been undertaken by the European Commission in 2001, with the goal to promote a radical evolution of the prudential framework for European insurance companies and to foster inter-sectoral and international regulatory convergence, in order to guarantee a level-playing field allowing all European competitors to perform their business activities under the same set of rules.

[133] OECD – "*Regulation of insurance company and pension fund investment – OECD report to G20 finance ministers and central bank governors*" – September 2015

Not just an update of the previous quantitative criteria for the computation of the solvency margin, hence, but rather a review of the whole set of rules backing the stability of insurance companies up. Besides capital requirements, the new regulation has remarkably stressed a whole set of measures aimed at fostering players' incentives to carefully manage risks. The necessity to go beyond the evident limits of the previous European insurance companies' solvency regulation "Solvency I", excessively relying on purely quantitative prescriptions that poorly accounted for the actual risk profile and characteristics of regulated entities, has driven the European legislator toward the design of this new regulatory initiative, which has actually revolutionized the prudential regime of European insurance companies. While the old rule-based system was not able anymore to cope with markets increasingly characterized by local and global competitive tensions, higher and broader financial risks, frequent introduction of new products or processes and difficult economic context, the new regime had to be principle-based, transparent, harmonized and oriented toward the future. Due care was also to be paid to the reality of groups and conglomerates, whose importance on the market has progressively grown. Under the Solvency II regime, the actual risks borne by insurance companies are meant to be represented, so that capital charges and other risk-based prescriptions can translate in a real incentive to perform sound risk management in the pursuit of the insurance and reinsurance activity.[134]

Solvency II arises as a synthesis of two recent conflicting streams of economic and financial thought, of which the former originated in 1990s and the latter around November 2007 as a reaction to the financial crisis having just burst. The first philosophy used to consider markets as self-regulated entities, well-behaving with respect to prices, deemed to fully reflect the equilibrium between demand and supply for each asset. These premises supported the idea according to which each financial institution had to develop its own risk management system to guarantee financially sound behaviors resulting, by aggregation, in stable financial systems. Also the supervisory framework for the banking system, Basel II, issued by the Basel Committee in 2006, was developed starting from these assumptions. In the same way, the design of the European prudential regulation for insurance and reinsurance companies was strongly influenced by this set of assumptions. Nonetheless, before its completion, and in particular from 2001 to 2016, several shocks hit the financial markets, including the 2001 Tech bubble, the 2007/2008 subprime crisis and the crisis of sovereign bond issuers in 2011. These experiences strongly influenced the definition of both the amendment to Basel II, Basel III, and of the European Directive 2009/138, Solvency II. In particular, before the crisis, Central Banks (especially the Federal Reserve) were acting as both providers of powerful support to the economic development and ultimate Risk Manager.

[134] IVASS – "*Solvency II: origine, struttura e sviluppo*" – November 2013

The goal of providing affordable housing in the United States, indeed, was pursued through massive injections of liquidity. At the same time the financial system was persuaded that Central Banks had the control of all necessary means to prevent any major disruption. This attitude characterized the so-called era of the "Great Moderation": going from mid-1980s to 2007. During this period, self-regulation of markets and supremacy of internal risk management models built by large financial institutions were the leading paradigm, showing its fallacy with the advent of the 2007/2008 crisis associated to the Lehman Brother fall and the subprime crisis. Until that moment, market operators were dealing with lower and lower interest rates, squeezing their financial profits. This, coupled with de-risking trends, drove a growth in the employment of financial architecture for the creation of more and more complex financial instruments in the expectation of higher returns, and a continuous increase of the risk accepted by financial entities, which were exposed to complex off-balance positions and highly leveraged. In that context, it was clear that models like Basel I and Solvency I, based on fixed parameters, could not capture the real risk taken by regulated entities. Capital requirements are computed as the difference between the "base case" value of a company's resources and their value under stress. Hence their computation depends on a market-consistent evaluation of asset and liabilities under both scenarios. This cannot happen if a standardized approach is imposed. Only internal model built by the companies themselves were somehow able to produce correct prices and risk evaluations. Supervisors and regulators, at the time, did not have enough resources and capabilities to develop the large number of models needed to perform these tasks and were left without any real regulatory framework to guide the financial system and prevent major imbalances. On a side, companies were lacking corporate governance systems that could effectively impose the balance between risk taken and risk management responsibilities, while on the other, regulators and supervisors were forced to subordinate the pursuance of their goals to the economic policy objectives. In addition, after the crisis, they were put under severe scrutiny for their complacent attitude toward risk. This political and social pressure on regulators has caused a partial reversion to old-fashioned and experimented rule-intensive approaches. This helps in explaining why the Solvency II Directive is composed by over 2000 pages where all requirements are laid down in detail to avoid ambiguous interpretations. Notwithstanding this, the possibility to make use of internally designed models has not been removed. The main difference between Solvency II and its predecessors, indeed, is the focus on governance and disclosure, as a complement of rule-based quantitative requirements.[135]

[135] Il Mulino Strumenti - Andenas, Mads; Avesani, Renzo G.; Manes, Paola; Vella, Francesco; Wood, Philip R. - "*Solvency II: A Dynamic Challenge for the Insurance Market*" - 2016 - Chapter III (Aversani) "Objective and Evolution of the new Solvency Regime"

Insurance companies are expected to put in place risk management systems that fully respond to certain requirements and that allow to keep corporate risk below given thresholds, consistent with the size and nature of the company's capital and with the nature and potential effects of risks borne. Requirements are designed to proportionally burden companies, according to the size, nature and complexity of the underlying business. Risk management systems are to identify, assess and control most significant sources of risk, namely those risks whose potential negative consequences may impair the solvency of the insurance company or represent an actual barrier between the company and the achievement of its business objectives. Hence, the effectiveness of a risk management system relies on the risk culture that has spread and is spreading among insurance companies, of which the introduction of the Solvency II regulation has represented a vehicle. Indeed, the relationships among the different business functions overseeing the business risks control, previously managed through informal links, have evolved toward a greater integration in terms of models, methodologies and tools, as a starting point for the diffusion of a risk-sensitive approach to the planning of insurance companies' strategy. [136]

The elaboration of the new system has been carried out according to the so-called Lamfalussy model, based on four institutional levels, each with its own area of regulatory intervention. This model provides a more flexible and faster decisional mechanism.

The first level is represented by the *Framework Directive*, a document having the power of law in the European Union and produced in the context of a co-decision process in which its content is negotiated within both the European Parliament and the European Counsel. This directive is functional to a simple overall representation of the regulation to introduce. It contains the general principles of the new regime and the delegating norms for the emanation of lower level rules. The Solvency II Directive 2009/138 CE of December 17th 2009 has hence entered in force to discipline the taking-up and pursuit of the business of insurance and reinsurance. By January 19th 2011, the Omnibus II Directive has amended the Directive 2009/138 (among others) to keep into account the new supervisory architecture for insurance companies, in particular the institution of the European Insurance and Occupational Pension Authority. Omnibus II also contains directions aimed at procrastinating the entrance in force of the Solvency II Directive and the abrogation of the previous regime Solvency I.

Subordinated with respect to the Framework Directive, are the *Implementing Measures*, taking their validity and the strength of law from the former. The bulk of the rules that are essential to the pursuance of regulatory goals is found here, as so they can be modified more easily. These measures represent the second level of the Lamfalussy model and lay more specific prescription in consistence

[136] FrancoAngeli - Cappiello, Antonella - "*Regolamentazione e risk mangement nelle imprese assicurative. Profili evolutivi.*" - 2008

with the principles designed by the Framework Directive and according the principles of the so-called "better regulation". Together with it, they compose the "regulatory package". Their issuance is based on a proposal of the European Commission and on the work of specific committees composed by representatives of Member States' governments. With the Omnibus II Directive, the second level of the model (Implementing Measures) has been subdivided in *Delegated Acts* and *Implementing Acts*. Both measures are proposed by the European Commission and approved by the European Parliament and Counsel. They constitute the base for the so-called *Binding Technical Standards*, lying in the middle between measures of second and third level. BTS should concern exclusively technical issues and are subdivided in *Regulatory Technical Standards* and *Implementing Technical Standards*. All of these standards are written by the EIOPA according to Delegated Acts and Implementing Acts, respectively. The formers are approved by the European Parliament and the European Counsel while for the latter the approval of the Commission is sufficient.

The third level has an its object the grouping of measures like standards, best practices, guidelines and recommendations issued by the European Insurance and Occupational Pension Authority (previously Committee of European Insurance and Occupational Pension Supervisors) with the aim to favor a converging and effective activation of first and second level rules. These measures are not formally equipollent to legislative acts but their influence under the normative profile is unquestionable.

Last, the fourth level regard the traditional activity of *enforcement*, namely the control over the correct application of community rules in single Member States. [137] [138]

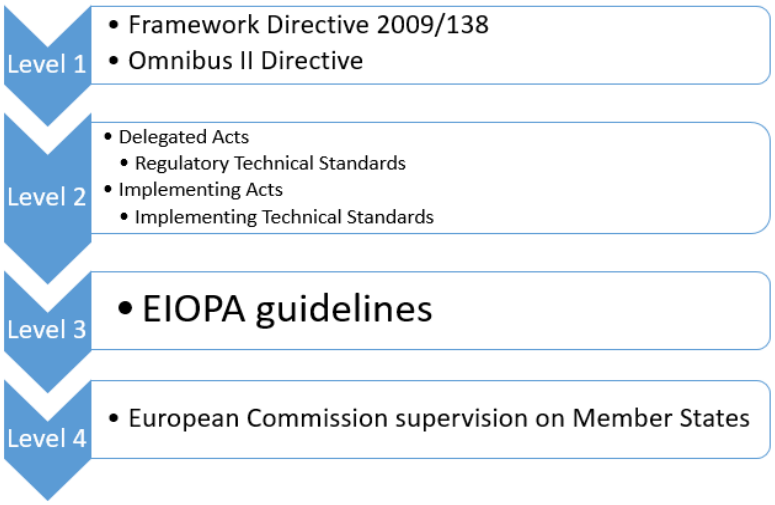


Figure 3.69 – Lamfalussy model for the design of the Solvency II regulation
Source: ANIA 2013

[137] FrancoAngeli - Cappiello, Antonella – "*Regolamentazione e risk management delle imprese assicurative. Profili evolutivi*" - 2008
[138] IVASS – "*Solvency II: origine, struttura e sviluppo*" – November 2013

The Solvency II system has entered into force as of January 1st 2016 and is adopted by all the countries belonging to the European Economic Area. Analogously to the bank supervisory regulation Basel III, Solvency II is based on a three-pillar structure where each pillar is an essential part of an integrated global solvency system. The first pillar is about *risk quantification* and contains the rules guiding insurance companies in the determination of both the Solvency Capital Requirement and the Minimum Capital Requirement. It also includes indications about how to evaluate assets and liabilities, including technical provisions, according to market-consistent principles. Further, it contains the criteria for the determination of own funds and their eligibility for capital requirements coverage. The second pillar, instead, includes norms about risk management and corporate governance, regulating the definition of roles of the Board of Directors, of the Control and Management Committee, of the various business functions. The provisions there contained widen the scope of covered risks beyond the sole risks covered by the first pillar. All the risks borne by the company have to be evaluated under a perspective light by the management, in the context of a procedure called Own Risk and Solvency Assessment, whose outcome, if not satisfying, can induce Supervisors to charge capital add-ons on regulated companies. Some key control functions are introduced, namely risk management, actuarial, compliance and internal audit. The second pillar also introduces important principles like the proportionality of the regulation and the prudent person principle. The third pillar is the pillar of transparency and *information disclosure* and determines the nature and quantity of information that the company is to let flow toward Supervisors, markets, stakeholders.

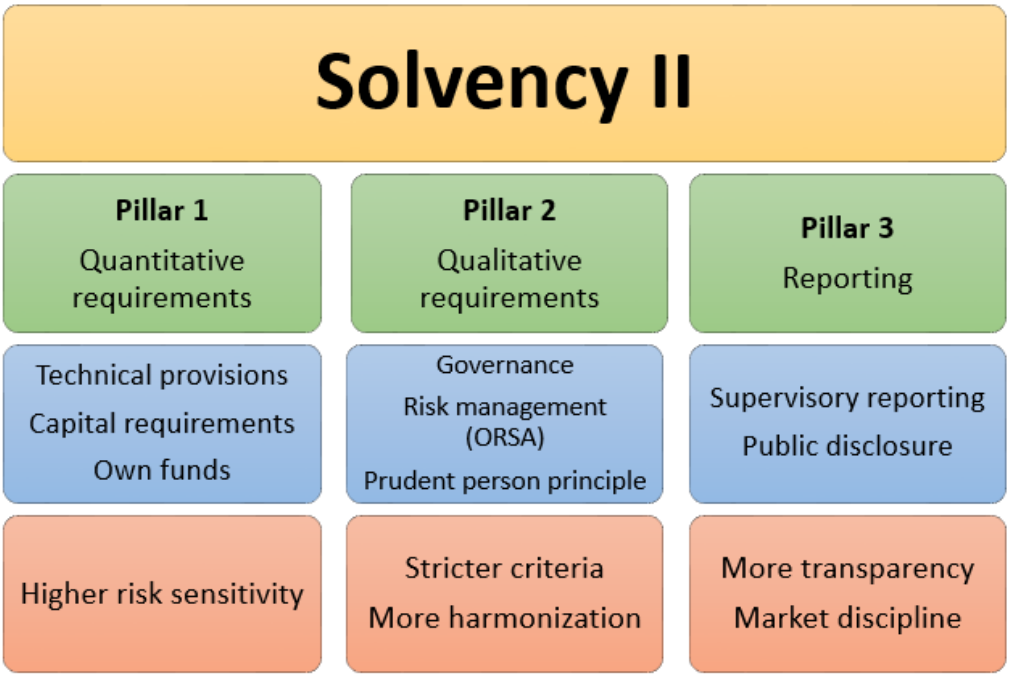


Figure 3.70 – Solvency II structure
Source: IVASS 2016

3.5.1 Pillar 1 – Quantitative requirements

The Pillar 1 represent the core set of rules within the Solvency II regulation and encompasses the risk-based quantitative requirements proposed by the European legislator to impose an adequate level of capitalization to insurance and reinsurance firms, in order to protect policyholders' and beneficiaries' interests from the occurrence of insurance companies' financial distresses. Therein, several sources of risk are identified. Many of them contribute to constitute the risk-sensitive capital requirements while some others are no or not completely quantifiable. Quantifiable risks are: 1) *non-life underwriting risk*; 2) *life underwriting risk*; 3) *health underwriting risk*; 4) *market risk*; 5) *credit risk*; 6) *operational risk*. While the underwriting risks are proper of the insurance core business and operational risks refer to risks arising in the pursuance of it, market and credit risk are borne by whatever financial institution in the performance of its asset allocation activity, and the assessment of their impact is particularly relevant to understand the impact of Solvency II regulation over insurers' investing behaviors. Other risks possibly affecting the insurance and reinsurance companies are reputational risk, strategic risk, liquidity risk and asset liability management risk.

The new regulation on the point fixed many of the inefficiencies associated to the bold application of standardized capital requirements, provided by Solvency I. The evaluation of the firm's financial position has to be performed on the basis of sound economic principles and through the optimal use of the information arising from the financial markets as well as of the general available data on insurers' technical risks. Solvency requirements are based on an economic view of insurers' balance sheets, as opposed to a statutory view, where the former makes extensive use of market-consistent valuations for assets and liabilities and adopts a future-oriented approach.

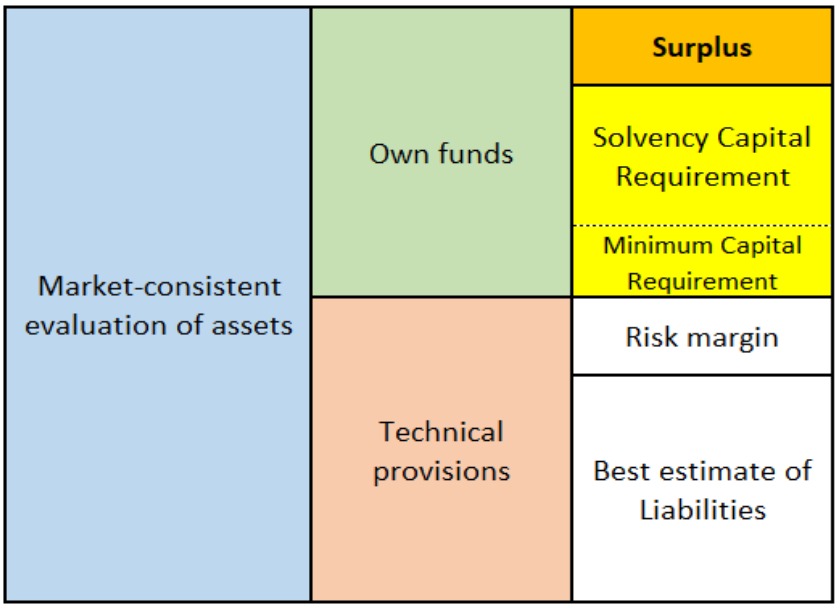


Figure 3.71 – Economic balance sheet according to the Solvency II framework
Source: Il Mulino Strumenti - Andenas, Mads; Avesani, Renzo G.; Manes, Paola; Vella, Francesco; Wood, Philip R. - "Solvency II: A Dynamic Challenge for the Insurance Market" - 2016

According to the Solvency II framework, assets and liabilities are to be evaluated at market-consistent values, namely the value at which they would be exchanged in the context of a regular market transaction. The regulator adopts the approach suggested by IAS/IFRS accounting standards, supplemented by specific evaluation criteria. Specifically, assets have to be evaluated on the basis of data collected from the market. Their value has to be computed through a comparison with the value of the same (or similar) assets traded in active markets, in the context of regular transactions (mark-to-market mechanism). In case of impossible application of the mark-to-market mechanism, the regulated entity has to employ internally designed evaluation models to estimate the value of its assets (mark-to-model mechanism). Technical provisions are equal to the amount that the insurer would need to take over and meet its insurance obligations. These are computed as the sum of the Best Estimate of Liabilities and a Risk Margin. The Best Estimate of Liabilities is the probability-weighted average of future cash outflows, estimated by applying the time value of money and by using the relevant term structure of risk-free interest rates. The risk margin is calculated by determining the cost of providing an amount of eligible own funds equal to the Solvency Capital Requirement, given the company's obligations throughout their whole duration.

An insurance company's own funds are the resources that the company can use to absorb losses related to risks borne. They are composed by the sum of *basic own funds* and *ancillary own funds*. Basic own funds are composed by the excess of assets over liabilities, valued at market-consistent value, net of the value of own shares held and coupled with subordinated liabilities. Ancillary own funds are resources that do not make part of the basic own funds but can be called up in case of need for losses absorption. They are composed by unpaid share capital or initial fund that has not been called up, letters of credit and guarantees, any other legally binding commitment toward the firm. An element of ancillary own funds that is called up ceases to make part of own funds. The value attributed to each element of ancillary own funds should reflect its real loss-absorbing capacity based on prudent and realistic assumptions. Own funds items are classified into three tiers, depending on whether they belong to basic own funds, rather than ancillary own funds, and on other characteristics, including their permanent availability and possible subordination. An element of own funds is permanently available if it is under the control of the firm or can be called up in case of losses either on a going-concern basis or in case of winding-up. Subordination indicates a status according to which, in case of financial distress, a resource can be fully called up to cover losses

	Eligible own funds	
Tier	MCR	SCR
Tier 1	≥ 80%	≥ 50%
Tier 2	≤ 20%	≤ 50%
Tier 3	Non eligible	≤ 15%

Figure 3.72 – Eligible own funds under the Solvency II framework
Source: Il Mulino Strumenti - Andenas, Mads; Avesani, Renzo G.; Manes, Paola; Vella, Francesco; Wood, Philip R. - "Solvency II: A Dynamic Challenge for the Insurance Market" - 2016

while the repayment to its provider is deferred with respect to payments to other capital holders. Further, elements like the absence of incentives to redeem, absence of mandatory servicing costs and absence of encumbrances are evaluated. Basic own funds constitute tier 1 own funds, while ancillary own funds can constitute both tier 2 and tier 3 own funds. The eligibility of own funds for the coverage of capital requirements is described in the table above.

The Solvency Capital Requirement (SCR) is the amount of capital that an insurance or reinsurance company needs to hold in order to have a 99,5% probability to withstand extreme events affecting at the same time all the sources of risk to which the company is exposed. One-year Value at Risk models are employed to compute it, hence the Solvency Capital Requirement can also be defined as the maximum yearly loss that a company may suffer in the 99,5% of cases. Following a balance sheet approach, it can be said to reflect the difference between the own funds of a company under normal circumstances and their value if a stress is applied (see figure below) and is computed through the generation of a profit/loss probability distribution. Companies that meet solvency capital requirements are able to meet their obligation toward policyholders and beneficiaries within a time horizon of 12 months, despite possible ruinous events, with the exception of one case over 200. The Solvency Capital Requirements should be calibrated to account for all the sources of quantifiable risk a firm is exposed to in that moment and in the next 12 months. Insurance companies have to compute and verify the adherence to their SCR at least annually. The figure below provides a representation of the financial meaning of the Solvency Capital Requirement.

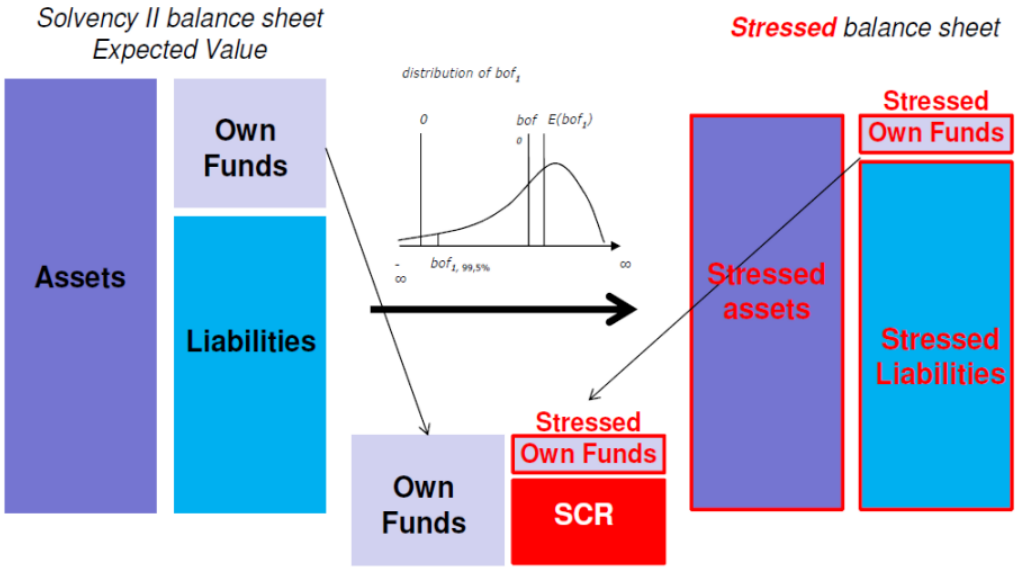


Figure 3.73 – Financial meaning of the SCR
Source: EIOPA

The Minimum Capital Requirement, instead, is a capital threshold below which the company is deemed to be exposed to an unacceptable degree of risk for itself and its policyholders, hence requiring the intervention of Supervisors. Its value ranges between the 25% and 45% of the SCR and is computed as a linear combination of a set or sub-set of the following variables: technical provisions, written premiums, capital-at-risk, deferred taxes and administrative expenses. The Solvency framework directive sets the MCR at €2,5 million for non-life insurers, €3,7 million for life insurers, including captive undertakings, and non-life insurers under special circumstances, €3,6 million for reinsurance companies, reduced to €1,2 million for captive reinsurance undertakings. Insurance and reinsurance firms have to compute their MCR at least quarterly and report to Supervisors. In case of missed fulfilment of the minimum requirements, rapid and radical actions are to be taken in order to avoid the Supervisors to impose the termination of the company's activity.

Overall, the regulation proposed in the context of the Pillar 1 of Solvency II has the effect to foster investors' preferences toward traditional investments, especially direct investments in high rated debt instruments like government bonds and investment-grade corporate bonds, whereas gaining exposure to equities, low rated bonds and securitized instruments is burdened by higher capital requirements and hence *de facto* discouraged. [139]

3.5.1.1 The Solvency II standard formula

While Solvency II does not rule out the possibility to partially or totally employ internally designed models for the computation of the Solvency Capital Requirement of regulated insurance companies, it also provides a standardized formula that can be used in the pursuance of this task by insurers that are not in the conditions or do not want to implement an internal model.

The standard formula can be straightforwardly applied by insurance companies and has the benefit of a relative simplicity and cost-effectiveness, but is obviously based on certain assumptions that may or may not realistically represent the features of each regulated company. The more the risk profile of the single regulated entity differs from the assumptions lied in the standard formula, the more it has the incentive to utilize internally designed models to be privileged in the quantification of solvency requirements, given that an internally built model can lower the overall capital requirements. For this reason, indeed, the adoption of internal models is subordinated to the approval by the national supervisory authority.[140]

[139] ANIA & ASTRID – "*Gli investimenti infrastrutturali nel contesto di Solvency II – Il ruolo delle compagnie di assicurazione*" – November 2017

[140] FrancoAngeli – Cappiello, Antonella – "Regolamentazione e risk management nelle imprese assicurative – Profili evolutivi" - 2008

The standard formula for the computation of the Solvency Capital Requirement is based on a modular process organized according to levels of aggregation and can be written as follows:

$$SCR = BasicSCR + Adj + SCR\ Op$$

Hence, it represents a linear combination of three elements. Two of them cause an increase in the value of the SCR, while the addendum in the middle is a decreasing factor. The figure below provides a graphical representation of the above equation.

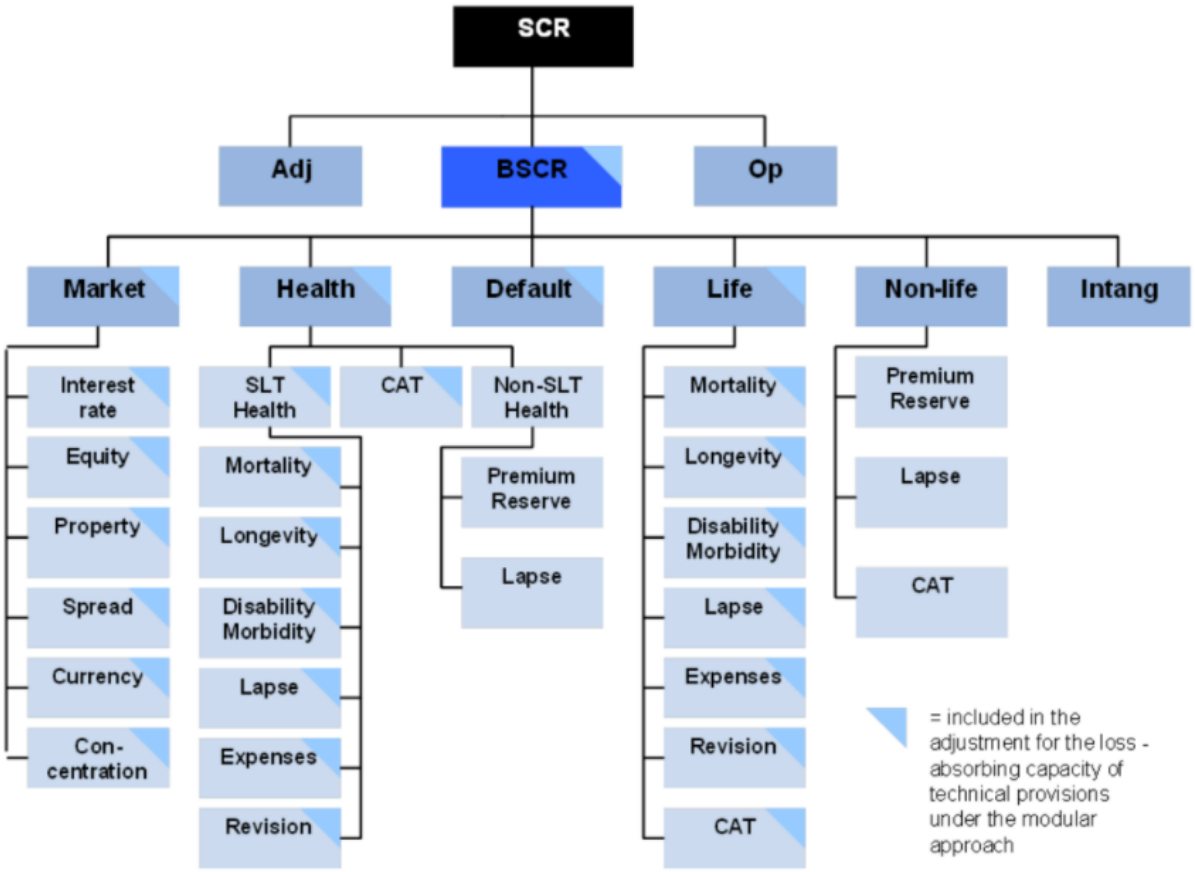


Figure 3.74 – Structure of the Solvency II standard formula
Source: EIOPA

For its nature of linear combination, the Solvency Capital Requirement can be seen as composed by a series of increasing and decreasing building blocks, like shown in the following scheme.

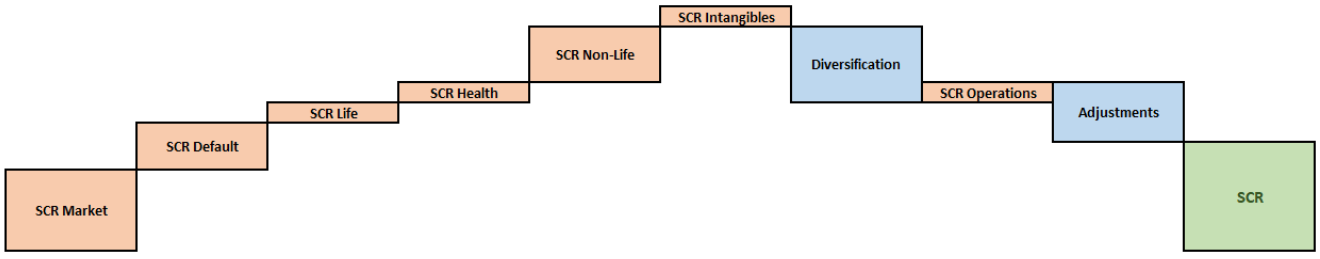


Figure 3.75 – Modular structure of the Solvency Capital Requirement
Source: Il Mulino Strumenti - Andenas, Mads; Avesani, Renzo G.; Manes, Paola; Vella, Francesco; Wood, Philip R. - "Solvency II: A Dynamic Challenge for the Insurance Market" - 2016

The basic SCR is a linear combination of six risk modules, namely Market risk, default risk, life underwriting risk, non-life underwriting risk, health underwriting risk, intangible asset risk. It can be expressed in the form of the so-called square-root formula:

$$BasicSCR = \sqrt{\sum_{i,j} Corr_{i,j} * SCR_i * SCR_j} + SCR_{intangibles}$$

With the following correlation matrix, indicated in the Solvency II framework directive:

	SCR mkt	SCR def	SCR life	SCR health	SCR non-life
SCR mkt	1,00				
SCR def	0,25	1,00			
SCR life	0,25	0,25	1,00		
SCR health	0,25	0,25	0,25	1,00	
SCR non-life	0,25	0,50	0,00	0,00	1,00

Figure 3.76 – Correlation matrix for the computation of the Basic Solvency Capital Requirement
Source: Il Mulino Strumenti - Andenas, Mads; Avesani, Renzo G.; Manes, Paola; Vella, Francesco; Wood, Philip R. - "Solvency II: A Dynamic Challenge for the Insurance Market" - 2016

The Solvency Capital Requirement for the operational risk is considered as a separate addendum of the formula instead of taking part of the Basic Solvency Capital Requirement and accounts for all the sources of operational risk that are not included in the other risk modules. The **operational risk** is the risk of losses arising from the possible inadequateness or failure of internal processes, personnel or systems, or from external events. The operational risk module is composed by *legal risk*, *compliance risk* and *IT risk*, while excluding strategic and reputational risk. Internal events influencing the extent to which operational risk is borne by the company are possible deficiencies or inefficiencies of the IT system; possible errors, negligence or willful misconduct of the personnel; deficiency, inadequacy or lack of organizational processes. External sources of operational risk may depend, among other things, on errors, negligence or willful misconduct of external actors, including outsourcers.[141]

The adjustment factor accounts for the loss absorbing capacity of technical provisions and deferred taxes and reflects the partial compensation of unexpected losses by a simultaneous decrease of one or both of them. It also can account for the risk mitigation effects arising from future discretionary benefits related to insurance contracts, depending on whether the company can actually use the reduction in those benefits to compensate for arisen losses. [141]

[141] Il Mulino Strumenti - Andena, Mads; Avesani, Renzo G.; Manes, Paola; Vella, Francesco; Wood, Philip R. – "*Solvency II: A Dynamic Challenge for the Insurance Market*" - 2016

The risk modules that directly impact the investing activity of the insurer are credit risk and market risk. The credit risk module is described below while the market risk module is scrutinized in the following because of its relevance for the regulation of insurance companies' investments in infrastructure assets. Underwriting risks are listed and defined in the ANNEX E.

The **credit risk** is the risk of loss or adverse change in the financial situation of a company, arising from fluctuations in the credit standing of issuers of securities, counterparties or debtors to which insurance and reinsurance undertakings are exposed. It can take the form of *counterparty default risk*, *spread risk* or *market risk concentration*. The counterparty default risk is associated to the risk that a debtor or guarantor called upon defaults on a part or the totality of its obligations. The risk of counterparty default also includes risk mitigation contracts such as reinsurance, derivatives and securitizations, as well as any other exposure that is not included in the credit spread risk. In the case of credit spread risk, losses or adverse change in the financial situation of the company arise from the deterioration of the creditworthiness of counterparties. In general, possible consequent losses are estimated on a 12 months' interval.

3.6 The treatment of infrastructure investments under Solvency II

Insurers allocate their assets towards the investments that, on the light of their business models and of the regulatory environment they operate in, appears as most attractive. Solvency II is, without any doubt the most relevant regulatory influence over European insurance companies, as it establishes a large set of requirements that insurers have to meet in order to perform their business, including quantitative capital requirements and qualitative governance and risk management prescriptions. The market risk module of the standard formula for the computation of the Solvency Capital Requirement (Pillar 1) includes all the computation rules for capital requirements related to each quantifiable risk, which are then combined to calculate the overall capital requirement. In general, the higher the capital requirements for a given investment, the stronger the dissuading effect that the regulation is likely to have on insurers. In turn, the effect of the regulation depends on the respective investment type.

In taking their investment decisions and deriving the Solvency Capital Requirement, insurers need to take into account both their assets and liabilities, including their interaction. For example, especially for life insurers, both assets and liabilities can be influenced by changes in the interest rate term structure, given that it alters both discount rates used to compute the present value of bonds held and discount rates used to compute the present value of life insurance cash flows, so that a duration mismatch can cause a non-simultaneous movement of assets and liabilities. Given that life insurers' liabilities are more sensitive than assets to interest rate shocks and that insurers' assets tend to be characterized by shorter maturities, this may result in an increase of capital requirements burdening insurance companies. As a response, they are likely to be willing to find long-term

investment opportunities reducing duration mismatches with their liabilities. Infrastructure investments are, for the set of reasons scrutinized in previous chapters, excellent candidates for this. In this context, an important role is played by direct project finance, infrastructure listed and unlisted funds and infrastructure loan securitization vehicles. The treatment of infrastructure under Solvency II differs considerably depending on the type of infrastructure investments and whether they fall in the category of qualifying infrastructure investments. The table below shows the treatment of different "non-qualifying" infrastructure investment types under the Solvency II standard formula.

Asset class	*Specification*	*Solvency II classification*	*Main risks*	*Solvency Capital Requirement*
Bonds	*Corporate bonds*	Corporate bonds	Interest rate risk Spread risk	Depending on rating and maturity
	Government bonds	EEA government bonds	Interest rate risk Spread risk	0%
		Non-EEA government bonds	Interest rate risk Spread risk	Depending on rating and maturity
	Debt-financed PPPs *Project bonds*	Bonds	Interest rate risk Spread risk	Depending on rating and maturity
Loans	*Corporate loans* *Project loans* *Infrastructure loan securitization*	Loan capital	Interest rate risk Spread risk	Depending on rating and maturity
Equities	*Listed equity*	Type 1 equities	Equity risk	39%
		Type 2 equities	Equity risk	49%
		Banks and financial service providers	Equity risk	0%/100%
	Unlisted private equity *Project equity*	Type 2 equities	Equity risk	49%
	Strategic participations	Strategic participation	Equity risk	22%
Real estate	*Real estate*		Property risk	25%

Figure 3.77 – Treatment of infrastructure investment under the standard model of Solvency II
Source: Gatzert, Nadine; Kosub, Thomas – "Insurers' Investment in Infrastructure: Overview and Treatment under Solvency II" – April 2014

The Investment Plan for Europe, as seen in Paragraph 3.3, is part of the European package of measure meant to support the European economy and investors in the process of overcoming the different barriers that prevent them to fully exploit their investing potential. It pursues the goal of removing the obstacles to investments by providing visibility and technical support to investment projects and by efficiently utilizing existing capital. It is active in creating an investment-friendly environment and in supporting investments in the real economy. As aforementioned, the third pillar of the Investment Plan is based on removing investment barriers, also by making sure that the European regulatory framework is predictable and not overwhelming for investors. The Digital Single Market, the Energy Union and the Capital Market Union are other initiatives sharing the goals of the Investment Plan for Europe.

One of the main goals of the Capital Market Union is indeed to mobilize more financial resources in Europe and to channel them towards long-term real investments like infrastructure projects, which are in turn likely to enable the creation of new jobs in the economic area, while providing investors with the possibility to take profitably deploy their financial resources.

In this context, institutional investors play a major role. Insurance companies, together with pension funds and asset managers, are the biggest institutional investors in Europe and are increasingly able to provide both equity and debt capital to fund long-term infrastructure projects. For this reason, consistently with the Recital 60 of the Omnibus II regulation and with the Recital 150 of the Solvency II Delegated Regulation, the European Commission has undertaken a process of review of the Solvency II standard formula for the computation of the Solvency Capital Requirements for insurers, with a specific reference to infrastructure investments as an area of priority.

Rules can be the consequence of the development of markets that spontaneously transform themselves until requiring the regulator's intervention to pursue general interest objectives. They can as well represent a useful political instrument, being itself the propellant for the expected changes. In most cases, though, rules mirror the specific material circumstances of sectors, progressively evolving as long as they do so. Under this perspective, rules need to represent each time a sound compromise between the current situation and the exigencies of change imposed by medium-term circumstances and pursued goals.[142] On the light of the significant differences existing among different infrastructure assets and of the existence of a "core" sub-set of infrastructure investments, characterized by lower risk and still attractive returns, and aware of the rising interest of insurance companies in gaining exposure to this category of alternative investments, scholars, practitioners and representatives of the industries involved have demanded the European Commission to introduce in the framework of Solvency II some provisions aimed at reducing quantitative requirements for high-quality infrastructure investments. In response to this, the Commission has required advice from the European Insurance and Occupational Pensions Authority about possible amendments to the Delegated Regulation 2015/35 and, in consequence, has introduced the provision of a separate asset class for "qualifying infrastructure investments" in the framework of Solvency II. The EU Delegated Regulation 2016/467 dated September 2015 and entered into force by April 2017 has introduced the article 164a, defining the criteria for the identification of those investments in entities that are responsible for infrastructure projects, be they carried out as bonds, loans or equity investments, that deserve a facilitated treatment under the framework of the Pillar 1. Further, the EU Delegated Regulation 2017/1542, dated June 2017 and entered into force by November 2017, has introduced the article 164b, enlarging the scope of the facilitated treatment also to investments in infrastructure companies, be they carried out as bonds, loans or equity investments, without neglecting opportune differentiations in terms of both eligibility criteria and capital requirements. If the conditions punctually listed by the regulator are not fulfilled, anyway, infrastructure debt and equity keep behaving like traditional debt and equity, under the

[142] LUISS Business School & ASTRID - Merola, Federico; Caroli, Matteo; Iaione, Christian; Fersini, Paola - "*Le casse di previdenza tra autonomia e responsabilità. I professionisti, il risparmio, l'economia reale*" – 2017

Solvency II framework, as shown in the table above. Capital absorption for eligible infrastructure exposures can be significantly lower than the one related to other investments, be they infrastructure equity or debt investments. The reduction in question can represent as much as 25% of the overall capital requirement that a regulated company should set up for non-qualifying infrastructure assets.[143]

3.6.1 The market risk module and the treatment of infrastructure investments

The **market risk** is defined as the risk of loss or adverse changes in the financial situation of an insurance or reinsurance company, resulting directly or indirectly from fluctuations in the level and in the volatility of market prices of assets, liabilities and financial instruments. It reflects the risk arising from the level or volatility of the market prices of those financial instruments whose value determines the consistence of the undertaking's assets and liabilities and has to properly account for structural mismatches between them, above all for what concerns duration mismatches. The Solvency Capital Requirement for the market risk module is computed through a correlation matrix aggregating its components according to a modular approach. It is composed by at least six sub-modules, namely *interest rate risk*, *equity risk*, *property risk*, *spread risk*, *currency risk*, *market concentration risk*.

	Interest rate	Equity	Property	Spread	Concentration	Currency
Interest rate	1,00					
Equity	A	1,00				
Property	A	0,75	1,00			
Spread	A	0,75	0,50	1,00		
Concentration	0,00	0,00	0,00	0,00	1,00	
Currency	0,25	0,25	0,25	0,25	0,00	1,00

Figure 3.78 – Correlation matrix among market risk module's sub-modules
A=0 if the capital requirement for interest rate risk is given by an upward shock.
A=0.50 if the capital requirement for interest rate risk is given by a downward shock.
Source: EY 2015

Analogously to the formula for the computation of the Basic Solvency Capital Requirement, the formula for the computation of the market risk module Solvency Capital Requirement is:

$$SCR_{market} = \sqrt{\sum_{i,j} Corr_{i,j} * SCR_i * SCR_j}$$ [144]

Where the SCR of single modules is computed as the capital required to back up the company's Net Asset Value (difference between its assets and liabilities) against related shocks, as expressed by the following formula:

[143] S&P Global – Beltran, Mar; Wilkins, Michael; Fudji, Taos – "New Capital Rules For EU Infrastructure Investments Mask Pipeline Deficiency" – September 2017
[144] EY – Thoren, Erik – "*Introduction to Solvency II SCR Standard Formula for Market Risk*" – June 2015

$$\Delta NetAssetValue = \max(NAV - NAV_{shock}; 0) = \max\big((A - L) - (A_{shock} - L_{shock}); 0\big)$$ [145]

In the following, the risk sub-modules of the market risk module are analyzed one by one, pointing out all the elements of interest for the regulation of insurers' investments in infrastructure.

3.6.1.1 Interest rate risk and spread risk sub-modules

Insurers are increasingly important providers of infrastructure debt, be it in the form of direct lending, in parallel with the contraction of the bank credit, or indirect lending through the purchase of bonds or securitized loans. The capital requirements associated to these kinds of investments mainly arise from the interest rate risk and spread risk submodules. Some specific exposures, like bonds backed by a full guarantee from a reliable institution (the European Investment Bank, for example) are exempt from the computation of the SCR associated to the spread risk. Anyway, in the generality of cases, both sources of risk contribute to generate capital requirements for regulated entities.

The *interest rate risk* is the risk that the value of an asset or liability changes due to a change in the term structure of interest rates or interest rate volatility. It is computed by evaluating the consequence of a shock consisting of either a sudden increase s^{up} or a sudden decrease s^{down} of basic risk-free interest rates for each currency at different maturities. The amplitude of the shocks is determined by the interest rate curves (base case, upward shocked, downward shocked) published monthly by EIOPA. Its absolute value has to equal at least 100 basis points. In case of negative rates, no decreasing shock is applied. The capital requirement for the interest rate risk is the largest between the capital requirements relative to the increase and the decrease in the term structure of interest rates, over all currencies.[144] It represents the difference between the present value of each debt investment, without and with the shock.

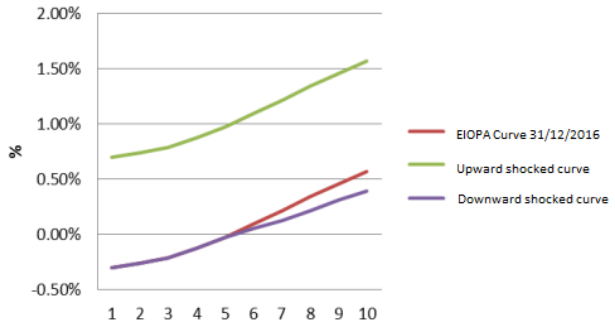


Figure 3.79 – Base case, upward shocked, downward shocked interest rate curves
Source: IVASS 2017

$$SCR_{interest} = Max\big(SCR^{up}_{interest}; SCR^{down}_{interest}\big)$$

where $SCR^{up}_{interest} = PV_{int} - PV^{up}_{int}$ [146]

and $PV^{up}_{int} = \sum_{t=1}^{T} \frac{CF(t)}{(1+r_f(t)*(1+s^{up}(t))^t}$ [145] [147]

[145] Gatzert, Nadine; Kosub, Thomas – "*Insurers' Investment in Infrastructure: Overview and Treatment under Solvency II*" – April 2014

[146] Gatzert, Nadine; Kosub, Thomas – "*The Impact of European Initiatives to Promote Infrastructure Investments from the Insurance Industry's Perspective*" – April 2016

[147] The same formula also applies for the downward movement of risk-free interest rate curves s^{down}

with PV_{int} and PV_{int}^{up}= present values of the debt instrument computed by discounting related cash flows through the base case and upward shocked risk-free rate, respectively; $CF(t)$= cash flow expected from the debt instrument at time t; $r_f(t) =$ risk-free rate at time t; $T =$ original maturity of the asset; $s^{up}(t)$= upward shock at time t.

The *spread risk* is the risk that arises from the sensitivity of the value of assets and liabilities to changes in the level or in the volatility of credit spreads over the risk-free interest term structure. According to its source, it is subdivided in spread risk from bonds and loans (other than residential mortgage loans), securitizations and credit derivatives. The applied methodology depends on the specific source. The capital charge for bonds and loans is proportional to their market value and to a risk factor based on the Macaulay duration and the credit quality of concerned assets. The nature of issuers and the presence of collateral can impact the risk factor stress. The capital charge for securities is proportional to their market value, their modified duration and a risk factor based on type and rating (type 1, type 2, re-securitizations). The capital charge for credit derivatives is given by the maximum between the loss in BOF due to an instantaneous absolute increase in the credit spread of the underlying and the loss in BOF due to an instantaneous relative decrease of 75% of the credit spread of the underlying. There is no diversification among components, hence the Solvency Capital Requirement for the spread risk is computed as: [144]

$$SCR_{spread} = SCR_{bonds} + SCR_{securitizations} + SCR_{CD}$$

Coming back to the capital requirement for bonds and loans, the following formula expresses the computation method already described:

$$SCR_{spread}^{bonds} = \max(\Delta NAV \mid spread\ shock; 0) = max(MV * stress(rating, duration); 0)$$

Where the Market Value of a bond is the present value of the cash flow that an investor expects from it (coupon and maturity payments) and the Macaulay Duration is the weighted average term to maturity of the cash flows from a bond. They are computed as:

$$P = \sum_{t=1}^{n} \frac{C_t}{(1+y)^t} + \frac{M}{(1+y)^n}$$

$$MD = \frac{\sum_{t=1}^{n} \frac{t * C_t}{(1+y)^t} + \frac{M * n}{(1+y)^n}}{P}$$

with C_t =coupon payment at time t; y =periodic yield; n =original maturity of the asset; M =maturity payment.[148] The formula for the computation of the $stress$, the last element constituting the spread risk sub-module SCR, is based on a table provided by the European regulator in the context of the Delegated Regulation 2015/35 and successively modified by the Delegated Regulation 2016/467. The formula is, for each bond i:

$$stress_i = a_i + b_i * (dur_i - K)$$

Parameters a_i and b_i depend on the credit assessment of an ECAI, if available. The value K depends on the Macaulay duration of the asset.

Credit Quality Step		0		1		2		3		4		5-6	
dur_i	$stress_i$	a_i	b_i	a_i	b_i	a_i	b_i	a_i	b_i	a_i	b_i	a_i	b_i
≤ 5	b_i*dur_i	/	0,9%	/	1,1%	/	1,4%	/	2,5%	/	4,5%	/	7,5%
> 5 ; ≤ 10	a_i+b_i*(dur_i-5)	4,5%	0,5%	5,5%	0,6%	7,0%	0,7%	12,5%	1,5%	22,5%	2,5%	37,5%	4,2%
> 10 ; ≤ 15	a_i+b_i*(dur_i-10)	7,0%	0,5%	8,5%	0,5%	10,5%	0,5%	20,0%	1,0%	35,0%	1,8%	58,5%	0,5%
> 15 ; ≤ 20	a_i+b_i*(dur_i-15)	9,5%	0,5%	11,0%	0,5%	13,0%	0,5%	25,0%	1,0%	44,0%	0,5%	61,0%	0,5%
> 20	min(a_i+b_i*(dur_i-20);1)	12,0%	0,5%	13,5%	0,5%	15,5%	0,5%	30,0%	0,5%	46,6%	0,5%	63,5%	0,5%

Figure 3.80 – Table for the computation of the spread risk Solvency Capital Requirement for debt assets for which a credit assessment from an ECAI exists
Source: European Commission Delegated Regulation 2016/467

In case the credit assessment from a nominated ECAI is not available, the following table is utilized:

dur_i	$stress_i$
≤ 5	3%*dur_i
> 5 ; ≤ 10	15%+1,7%*(dur_i-5)
> 10 ; ≤ 20	23,5%+1,2%*(dur_i-10)
> 20	min(35,5%+0,5%*(dur_i-20);1)

Figure 3.81 – Table for the computation of the spread risk Solvency Capital Requirement for debt assets for which a credit assessment from an ECAI is not available
Source: European Commission Delegated Regulation 2016/467

For example, an exposure of 40 into a corporate bond with a credit quality step of 4 (BB-rating) and a duration of 9,2 years would show a SCR spread of:

$SCR_{spread}^{BB} = 40 * \big(22{,}5\% + 2{,}5\% * (9.2 - 5)\big) = 40 * 0.33 = 13$[149]

[148] Investopedia – "*What is the Macaulay Duration*"
[149] IVASS – Roberti, Roberto – "*Solvency II: la nuova regolamentazione prudenziale*" – July 2017

The following figures show how the SCR for interest rate risk and spread risk sub-modules, hence the bond-related market risk module Solvency Capital Requirement, change according to different ratings and maturities of assets. Results are obtained through the application of the so-called squared root formula for the market risk, shown above. In the first figure, a corporate bond with both face value and market value equal to 100, 3.0% coupon and five-years maturity is employed to show the effects of changing ratings. In the second figure, the same bond with a BB rating and variable maturity is employed to observe the effects of changing maturities. The case of the downward shock on interest rate curves, namely when the correlation between the interest rate risk SCR and the spread risk SCR is different from 0, is not considered.

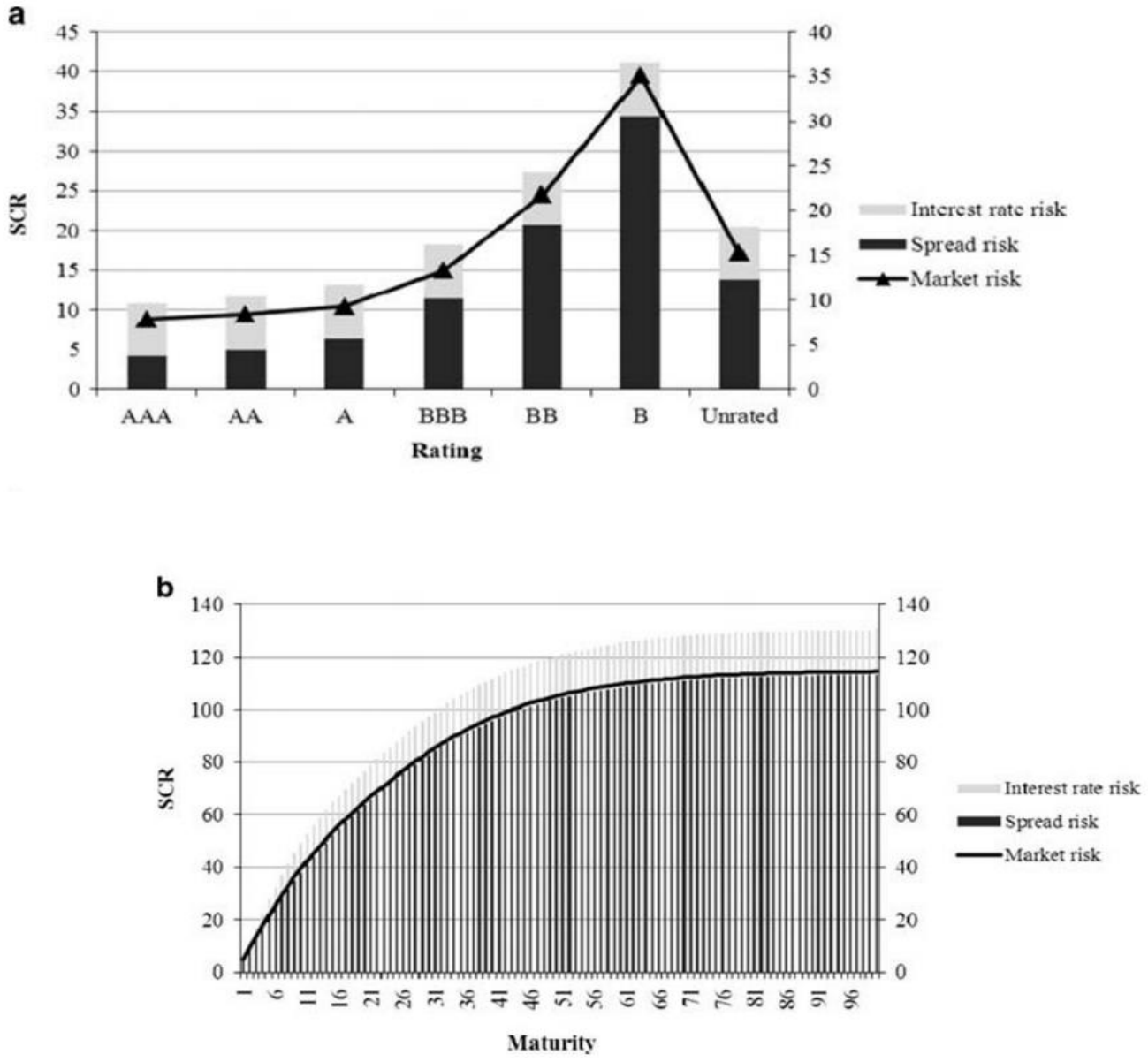


Figure 3.82 – How different bond ratings and maturities impact the market risk module SCR
Source: Gatzert, Nadine; Kosub, Thomas – "Insurers' Investment in Infrastructure: Overview and Treatment under Solvency II" – April 2014

From the above figures it is possible to observe a relevant downward pressure on the market risk module SCR due to the effect of the diversification between the two considered sub-modules. In addition, it is worth noticing that the Solvency II framework significantly favors high-rated short-term debt instruments rather than more opportunistic long-term ones.[150] Nonetheless, despite a clear increasing trend of the Solvency Capital Requirements for increases in bonds' maturities, it is possible to notice how this trend is "kinked", meaning that the interest risk sub-module SCR shows a decreasing marginal increase to the bonds' maturity. [145] The same cannot be said for the rating of bonds, whose worsening causes a marginally increasing rise in the Solvency Capital Requirement of an instrument.

The article 180 of the Delegated Regulation 2015/35, introduces a series of types of exposures characterized by differentiated treatments under the spread risk module. They include, among others, covered bonds, exposures to highly reliable institutions of the European Union, including the European Central Bank, Member States' central governments, multilateral development banks and so on (for which a 0 stress applies); governments and other institutions of non-EEA countries; other insurance and reinsurance companies differentiated according to their performance with respect to regulatory requirements. The Article has been amended to include also differentiated treatments for qualifying infrastructure bonds and loans. In particular, the facilitated treatment applies to infrastructure entities that meet the criteria stated in the Article 146a and to infrastructure companies that meet the criteria stated in the Article 146b, to which an ECAI has assigned credit quality step ranging from 0 to 3 (see below). The exposures having been assigned to a matching adjustment portfolio in accordance with the Article 77b point (2) of the Solvency II Directive, with a credit quality step ranging from 0 to 2, are excluded. In case an ECAI assessment has not been produced, the privileged treatment still applies but the exposure is treated as having a Credit Quality Step of 3. The following two tables show the computation tables for the stress under the spread risk module for qualifying infrastructure entities (Article 180.11.12.13) and companies (180.14.15.16).

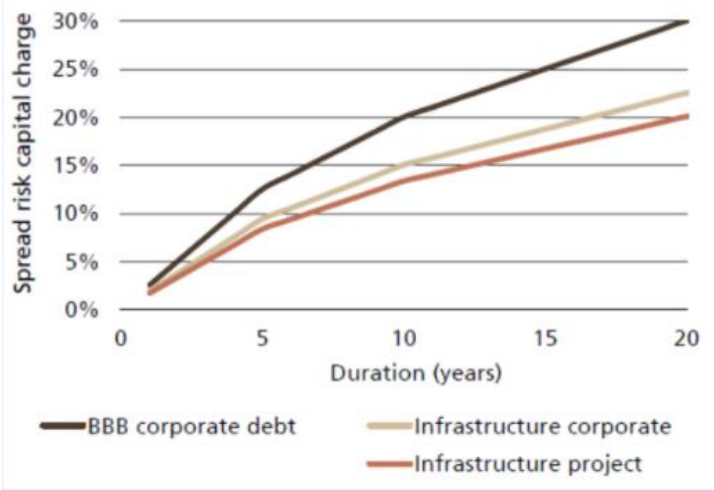
Qualifying infrastructure entities Credit Quality Step		0		1		2		3	
dur_i	$stress_i$	a_i	b_i	a_i	b_i	a_i	b_i	a_i	b_i
≤ 5	b_i*dur_i	/	0,64%	/	0,78%	/	1,00%	/	1,67%
> 5 ; ≤ 10	$a_i+b_i*(dur_i-5)$	3,20%	0,36%	3,90%	0,43%	5,00%	0,50%	8,35%	1,00%
> 10 ; ≤ 15	$a_i+b_i*(dur_i-10)$	5,00%	0,36%	6,05%	0,36%	7,50%	0,36%	13,35%	0,67%
> 15 ; ≤ 20	$a_i+b_i*(dur_i-15)$	6,80%	0,36%	7,85%	0,36%	9,30%	0,36%	16,70%	0,67%
> 20	$min(a_i+b_i*(dur_i-20$	8,60%	0,36%	9,65%	0,36%	11,10%	0,36%	20,05%	0,36%

[150] ANIA & ASTRID – "Gli investimenti infrastrutturali nel contesto di Solvency II – Il ruolo delle compagnie di assicurazione" – November 2017

Qualifying infrastructure companies Credit Quality Step		0		1		2		3	
dur_i	$stress_i$	a_i	b_i	a_i	b_i	a_i	b_i	a_i	b_i
≤ 5	b_i*dur_i	/	0,68%	/	0,83%	/	1,05%	/	1,88%
> 5 ; ≤ 10	$a_i+b_i*(dur_i-5)$	3,38%	0,38%	4,13%	0,45%	5,25%	0,53%	9,38%	1,13%
> 10 ; ≤ 15	$a_i+b_i*(dur_i-10)$	5,25%	0,38%	6,38%	0,38%	7,88%	0,38%	15,00%	0,75%
> 15 ; ≤ 20	$a_i+b_i*(dur_i-15)$	7,13%	0,38%	8,25%	0,38%	9,75%	0,38%	18,75%	0,75%
> 20	$min(a_i+b_i*(dur_i-20$	9,00%	0,38%	10,13%	0,38%	11,63%	0,38%	22,50%	0,38%

Figure 3.83 – Table for the computation of the spread risk Solvency Capital Requirement for qualifying infrastructure entities and qualifying infrastructure companies
Source: European Commission Delegated Regulation 2016/467 and European Commission Delegated Regulation 2017/1542

The graph on the side and the table below show the preferred treatment that qualifying investments in infrastructure corporate and project debt enjoy, at parity of rating and duration, under the point of view of the spread risk sub-module capital requirement, hence resulting as more competitive in comparison with traditional corporate debt investments. Vanilla debt instruments with a duration of ten years and a rating of BBB are chosen as a model asset. [151]



Type of investment	BBB corporate debt	BBB infrastructure corporate debt	BBB infrastructure project debt
Exposure	€ 50 million	€ 50 million	€ 50 million
Nominal return	2,5%	4,0%	4,0%
Percentage capital requirement	20%	15%	13,4%
Absolute capital requirement	€ 10 million	€ 7,5 million	€ 6,7 million
Adjusted return	12,5%	26,6%	30,0%

Figure 3.84 – A comparison between the spread risk sub-module Solvency Capital Requirement for traditional debt instruments and qualifying infrastructure debt instruments
Source: ANIA & ASTRID 2017

About Credit Quality Steps, they are the object of a framework meant to give a transparent and comparable assessments of the creditworthiness of bond issuers, as assessed by External Credit Assessment Institutions (ECAIs), in the context of Solvency II. An ECAI is a credit rating agency registered or certified in accordance with EC Regulation 1060/2009 of the European Parliament and of the Council. Article 1 of said regulation explicitly states that banking, insurance, reinsurance and investment undertakings, among others, are supposed to make use of ECAIs' assessments in the computation of their capital requirements.

[151] ANIA & ASTRID – "*Gli investimenti infrastrutturali nel contesto di Solvency II – Il ruolo delle compagnie di assicurazione*" – November 2017

Each Credit Quality Step is equivalent to a given rating in the framework adopted by different External Credit Assessment Institutions. The lower the Credit Quality Step, the higher the quality of the issuer. According to the Commission Implementing Regulation 2016/1800, referencing Article 3 of EU Delegated Regulation 2015/35, the number of Credit Quality Steps from ECAIs has to be set at seven, whereas the mapping methodology for credit institutions and financial institutions is based on a six-step scheme. Anyway, while still applying the opportune modifications, the correspondence between ratings and Credit Quality Steps is based on the scheme adopted for credit and financial institutions, for the sake of consistency and comparability. The mentioned regulation provides a complete table where a comparison between Credit Quality Steps and ratings issued by different ECAIs is made. [152] Below, a portion of it is reported for demonstrative purposes.

	Credit Quality Steps						
	0	*1*	*2*	*3*	*4*	*5*	*6*
Moody's Long-term rating scale	Aaa	Aa	A	Baa	Ba	B	Caa, Ca,
Standard & Poors' Long term issuer credit rating scale	AAA	AA	A	BBB	BB	B	CCC, CC, SD/D
AM Best Europe-Rating Services Ltd Long-term issuer credit ratings scale	aaa	aa+, aa, aa-	a+, a, a-	bbb+, bbb, bbb-	bb+, bb, bb-	b+, b, b-	ccc-, ccc ccc+ cc, c, rs
BCRA — Credit Rating Agency AD Insurance long-term ratings scale	iAAA	iAA	iA	iBBB	iBB	iB	iC, iD
Cerved Rating Agency SpA Corporate long-term rating scale	A1.1	A1.2 A1.3	A2.1, A2.2 A3.1	B1.1 B1.2	B2.1 B2.2	C1.1	C1.2 C2.1

Figure 3.85 – ECAI ratings and Credit Quality Steps (sample)
Source: European Commission 2016

The Credit Quality Step attributed to a given asset significantly impacts the capital requirement that it triggers. A good positioning under this point of view is one of the conditions that determines whether or not an infrastructure investment can be encompassed in the category of qualifying infrastructure investments. In general, a debt asset gaining an improvement in the Credit Quality Step scale can enjoy significant improvements under the point of view of the standard formula market risk capital requirement. Under this light, indeed, the contribution offered by European Initiatives like the Juncker Plan and its predecessor, the EU 2020 Project Bond Initiative (see Paragraph 3.3), supporting the enhancement of bond issuers' creditworthiness, earn a further element of value. In the following figure, a comparison is performed between the market risk Solvency Capital Requirement of qualifying and non-qualifying infrastructure bonds carrying different Credit Quality Steps.

[152] European Commission – "*Implementing Regulation 2016/1800*"

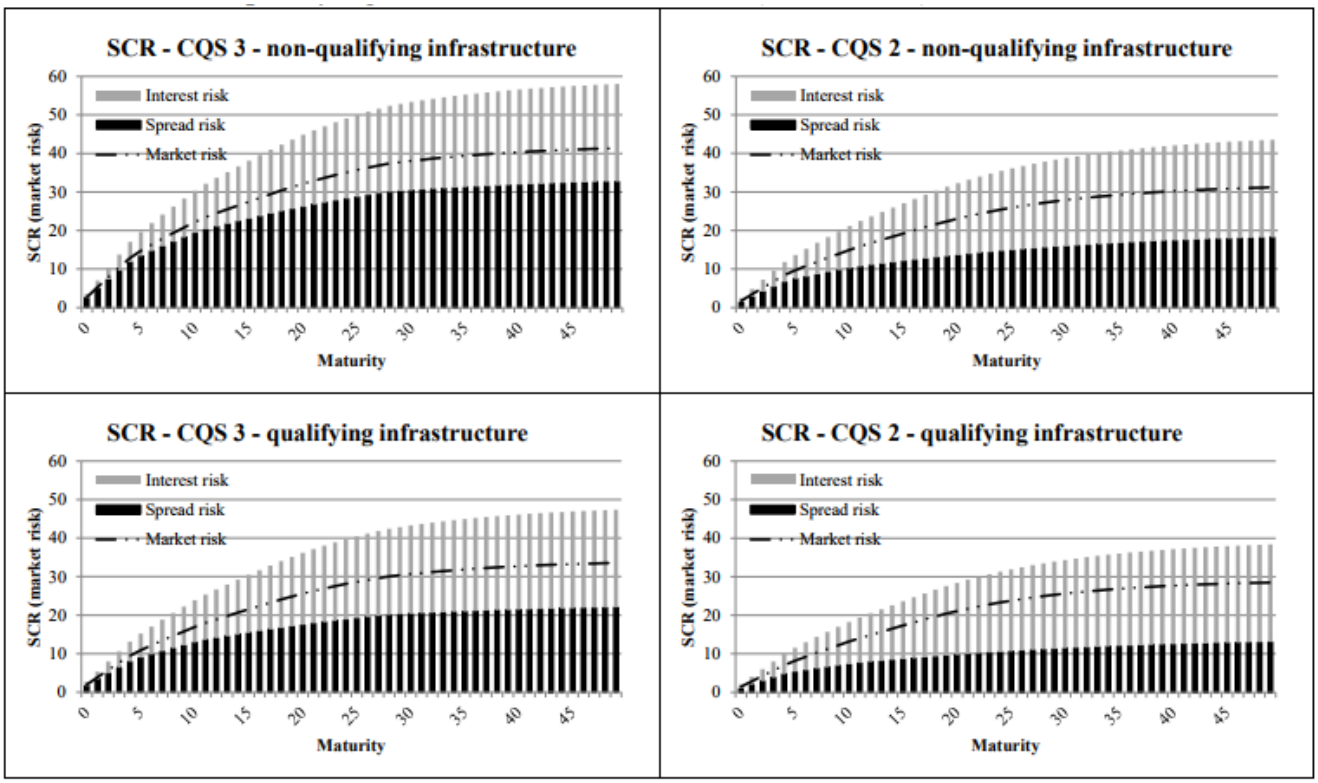


Figure 3.86 – How different Credit Quality Steps translate in different market risk Solvency Capital Requirements for qualifying and non-qualifying infrastructure bonds
Source: Gatzert, Nadine; Kosub, Thomas – "The Impact of European Initiatives to Promote Infrastructure Investments from the Insurance Industry's Perspective" – April 2016

3.6.1.2 Equity risk submodule

The *equity risk* is the risk that the value of assets or liabilities changes due to fluctuations in the level or volatility of the market price for equities. [144] Before the amendments to the Article 168 of the EU Delegated Regulation 2015/35, Solvency II used to make a distinction between Type 1 equities and Type 2 equities solely. With the changes brought about by EU Delegated Regulations 2016/467, first, and 2017/1542, in a second moment, these categories have been redesigned and two further types of equity have been added, namely qualifying infrastructure entities' and infrastructure companies' equity. *Type 1 equities* are equities listed in regulated markets in OECD or EEA countries, including also Multilateral Trading Facilities whose registered office or head office is in EU Member States (Article 168.2). They also encompass capital instruments held by collective investment institutions like qualifying funds for the social entrepreneurship (UE regulation 2013/346), qualifying venture capital funds (UE regulation 2013/345), unleveraged closed-end funds located in the European Union or there commercialized (Alternative Investment Fund Management Directive 2011/61), European Long Term Investment Funds (UE Regulation 2015/760).[153] *Type 2 equities* are equities listed only in emerging markets, unlisted equities, hedge funds and any other investments not included elsewhere in the market risk module.[144] Infrastructure entities and companies are those defined in Articles 164a and

[153] ANIA & ASTRID – "*Gli investimenti infrastrutturali nel contesto di Solvency II – Il ruolo delle compagnie di assicurazione*" – November 2017

164b, respectively, and are included in the Type 1 equities, according to the Article 168.6, while still enjoying further SCR reliefs. The applied shock consists in a sudden decrease of the market value of equities held. The following table summarizes the amplitude of the shock to be applied to different types of investments.

Type of investment	Base capital requirement	Symmetric adjustment
Type 1 equity	39%	Full
Type 2 equity	49%	Full
Private equity	49%	Full
Hedge funds	49%	Full
Infrastructure entities	**30%**	**77%**
Infrastructure corporate	**36%**	**92%**
Strategic participations	22%	N/A
Real estate	25%	N/A

Figure 3.87 – Facilitated treatment for qualifying investments in infrastructure equity
Source: ANIA & ASTRID 2017

While the base shock for Type 1 equity is of 39% and the one for Type 2 equity is 49%, the base shock for eligible infrastructure equity investments are significantly lower, at 30% for infrastructure Special Purpose Vehicles and 36% for infrastructure companies. Strategic participation or duration-based equity approaches are recognized a shock equal to 22% of their value, whether they represent qualifying infrastructure exposures or not (Article 171 of EU Delegated Regulation 2015/35). The base capital requirement for the equity risk of single exposures has to be added with a symmetric adjustment computed monthly by the EIOPA and applied to prevent pro-cyclical effects. The symmetric adjustment is computed as:

$$SA = \frac{1}{2}\left(\frac{CI - AI}{AI} - 8\%\right)$$

where CI is the current level of the equity index and AI is the weighted average of its daily levels during last 36 months (Article 172). By the end of December 2013, it was equal to +7.5%, for example. Obviously, it can assume negative levels as well. [154] As opposite to other equity investments, qualifying infrastructure exposures are subject to the application of a reduced adjustment, equal to the 77% and to the 92% of the symmetric adjustment proposed by the EIOPA.

For example, by the end of September 2017, a qualifying equity investment in an infrastructure Special Purpose Vehicle or in an infrastructure company would have faced a shock of 31,8% and 38,2% of their value, respectively, instead of 51,4%, representing the requirement for traditional type 2 equities, given the symmetric adjustment valid at the moment, equal to +2,4%.[153]

[154] IVASS – Roberti, Roberto – "*Solvency II: la nuova regolamentazione prudenziale*" – July 2017

In the original version of the Article 168 of the EU Delegated Regulation 2015/35, the calculation formula for the equity risk Solvency Capital Requirement was:

$$SCR_{equity} = \sqrt{SCR_{type\ 1}^2 + SCR_{type\ 2}^2 + 2 * 0{,}75 * SCR_{type\ 1} * SCR_{type\ 2}}$$

After the Article has been amended by the already mentioned interventions to keep into account also qualifying investments in infrastructure entities and infrastructure companies, the formula has become:

$$SCR^*_{equity} =$$

$$= \sqrt{SCR_{tyoe\ 1}^2 + (SCR_{type\ 2} + SCR_{QIE} + SCR_{QIC})^2 + 2 * 0{,}75 * SCR_{type\ 1} * (SCR_{type\ 2} + SCR_{QIE} + SCR_{QIC})}$$

Where SCR_{QIE} and SCR_{QIC} represent the Solvency Capital Requirements for qualifying infrastructure entities and qualifying infrastructure companies, respectively.[155][156] [157]

3.6.1.3 Other risk sub-modules

The *property risk* is the risk that arises as a result of sensitivity of assets, liabilities and financial investments to the level or volatility of market prices of property. Properties are lands, buildings, immovable-property rights, property investments for the own use of the insurance undertaking, investments in real estate through collective investment undertakings or other investment packages as funds. Investments in companies engaged in real estate management or investments in a company engaged in real estate project development or similar are included in the equity risk module, instead. The shock consists of a 25% immediate reduction in the value of investments in real estate. [144]

The *currency risk* is the risk arising from changes in the lever or volatility of currency exchange rates. The approach interests all exposures denominated in currencies different from the entity local currency, unless they are hedged. For each currency, both a 25% upward shock and a 25% downward shock are applied and the capital requirement for that currency is the maximum between the capital requirements arising from the two shocks. [144]

The *concentration risk* is an additional measure of risk that arises in consequence of large exposures toward single counterparties and groups of linked counterparties. The related SCR is computed as:

$$SCR_{concentration} = \sqrt{\sum_i Conc_i^2}$$

[155] European Commission – *Commission Delegated Regulation 2015/35 supplementing the EU Directive 2009/139*
[156] European Commission – *Commission Delegated Regulation 2016/467 amending Delegated Regulation 2015/35*
[157] European Commission – *Commission Delegated Regulation 2017/1542 amending Delegated Regulation 2015/35*

There, $Conc_i$ is the risk concentration requirement for the single-name exposure i. It is equal to the loss in basic own funds that is caused by an instantaneous decrease in the value of the assets corresponding to that single-name exposure and is computed as:

$$Conc_i = g_i * XS_i$$

Where $g_i$is a risk factor ranging from 0 to 73% depending on the Credit Quality Step or, in case of missing assessment, on the undertaking's solvency ratio. XS_i, instead, is the excess exposure per single-name exposure, computed as the maximum between 0 and the difference between the total exposure to the single-name investment i (E_i) and the product between the total value of all the assets held by the undertaking (with some exclusions) and the exposure threshold, ranging between 15% and 1.5%, depending on credit quality steps and asset class (CT_i). [144]

$$XS_i = Max(0; E_i - CT_i * Assets)$$

3.7 Qualifying infrastructure investments under the Solvency II framework

According to the Delegated Regulation 2016/467, amending the Solvency II treatment of high-quality infrastructure investments, infrastructure assets are defined as physical assets, structures or facilities, systems and networks that provide or support essential public services, while an infrastructure entity is an entity or corporate group which, during the most recent financial year of that entity or group for which figures are available or in a financing proposal, derives the substantial majority of its revenues from owning, financing, developing or operating infrastructure assets. The first paragraph of the article 164a indicates six requirements that infrastructure investments need to meet in order to apply for the facilitated treatment provided to qualifying infrastructures. Qualifying infrastructure investment shall include investment in an infrastructure entity that meets the following criteria:

(a) the cash flows generated by the infrastructure assets allow for all financial obligations to be met under *sustained stresses* that are relevant for the risks of the project;

(b) the cash flows that the infrastructure entity generates for debt providers and equity investors are *predictable*;

(c) the infrastructure assets and infrastructure entity are governed by a regulatory or contractual framework that provides debt providers and equity investors with a *high degree of protection* including the following:

   a. the contractual framework shall include provisions that effectively protect debt providers and equity investors against losses resulting from the termination of the project by the party which agrees to purchase the goods or services provided by the infrastructure project, unless one of the following conditions is met:

i. the revenues of the infrastructure entity are funded by payments from a large number of users; or

ii. the revenues are subject to a rate-of-return regulation;

b. the infrastructure entity has sufficient reserve funds or other financial arrangements to cover the contingency funding and working capital requirements of the project;

Where investments are in bonds or loans, this contractual framework shall also include the following:

(i) debt providers have security or the benefit of security to the extent permitted by applicable law in all assets and contracts that are critical to the operation of the project;

(ii) the use of net operating cash flows after mandatory payments from the project for purposes other than servicing debt obligations is restricted;

(iii) restrictions on activities that may be detrimental to debt providers, including that new debt cannot be issued without the consent of existing debt providers in the form agreed with them, unless such new debt issuance is permitted under the documentation for the existing debt;

Notwithstanding point (i) of the second subparagraph, for investments in bonds or loans, where undertakings can demonstrate that security in all assets and contracts is not essential for debt providers to effectively protect or recover the vast majority of their investment, other security mechanisms may be used. In that case, the other security mechanisms shall comprise at least one of the following:

(i) pledge of shares;

(ii) step-in rights;

(iii) lien over bank accounts;

(iv) control over cash flows;

(v) provisions for assignment of contracts;

(d) where investments are in bonds or loans, the insurance or reinsurance undertaking can demonstrate to the supervisor that it is able to *hold the investment to maturity*;

(e) where investments are in bonds or loans for which a credit assessment by a nominated ECAI is not available, the investment instrument and other *pari passu* instruments are *senior to all other claims* other than statutory claims and claims from liquidity facility providers, trustees and derivatives counterparties;

(f) where investments are in equities, or bonds or loans for which a credit assessment by a nominated ECAI is not available, the following criteria are met:

(i) the infrastructure assets and infrastructure entity are located in the EEA or in the OECD;

(ii) where the infrastructure project is in the construction phase the following criteria shall be fulfilled by the equity investor, or where there is more than one equity investor, the following criteria shall be fulfilled by a group of equity investors as a whole:

- the equity investors have a history of successfully overseeing infrastructure projects and the relevant expertise;
- the equity investors have a low risk of default, or there is a low risk of material losses for the infrastructure entity as a result of their default;
- the equity investors are incentivized to protect the interests of investors;

(iii) where there are construction risks, safeguards to ensure completion of the project according to the agreed specification, budget or completion date;

(iv) where operating risks are material, they are properly managed;

(v) the infrastructure entity uses tested technology and design;

(vi) the capital structure of the infrastructure entity allows it to service its debt;

(vii) the refinancing risk for the infrastructure entity is low;

(viii) the infrastructure entity uses derivatives only for risk-mitigation purposes.

Letters (a), (b) and (c) of the Article 164a lay down general prescriptions for qualifying infrastructure investments, be they in the form of equity or debt, as they make direct referral to the infrastructure Special Purpose Vehicle and the cash flows it earn from its activity. They state that cash flows earned by a qualifying infrastructure SPV are expected to be predictable, enough substantial to provide an acceptable degree of certainty about their capacity to meet debt-holders' claims and backed by a regulatory and contractual framework oriented toward investors' protection. The ability of projected cash flows to meet investors' expectations has to be assessed through the performance of multiple stress tests, in order to ascertain whether the project's financial stability is likely to withstand severe recurring exogenous shock. In this context, the SPV is required to achieve certain levels of financial performance, assessed by means of several financial ratios. The debt service coverage ratio, for example, indicates how many times the SPV's income available for the payment of financial interests (EBIT) of a year is able to cover that year's debt servicing payments. Clearly, the lower the coverage ratio, the higher the risk that any unexpected event eats away a part of the cash flows that should have

been issued to debt-holders. In any case, the SPV is expected to have enough cash reserves to face unforeseen contingent needs and finance the project's working capital.

The second paragraph of the Article 164a, introduced by the EU Delegated Regulation 2016/467, goes deeper into the question and lays down the criteria that are to be met in order to enable earned cash flows to be considered as "predictable", with referral to the requirement stated by the Article 164a at paragraph 1, letter (b). In particular, the totality of the revenues earned (except for, at most, a negligible share of them) has to satisfy the following two conditions:

a) One of the following criteria is met:

(i) Revenues are availability-based

(ii) The revenues are subject to a rate-of-return regulation

(iii) The revenues are subject to a take or pay contract

(iv) The level of output or the usage and the price independently meet one of the following criteria:

- Is regulated
- Is contractually defined
- Is sufficiently predictable in consequence of low demand risk

b) where the revenues of the infrastructure project entity are not funded by payments from a large number of users, the party which agrees to purchase the goods or services provided by the infrastructure project entity shall be one of the following:

(i) an entity listed in Article 180(2) of the Regulation;

(ii) a regional government or local authority listed in the Regulation adopted pursuant to Article 109a(2)(a) of Directive 2009/138/EC;

(iii) an entity with an ECAI rating with a credit quality step of at least 3;

(iv) an entity that is replaceable without a significant change in the level and timing of revenues.'

Hence, to be considered as predictable, virtually the totality of the entity's revenues has either to be backed up by a favorable contractual/regulatory arrangement or to rely on multiple purchasers. The favorable regulatory arrangement may consist in the provision of an availability-based payment scheme, financial protection in the form of rate-of-return regulation, regulated output or usage and price, independently. Any of these, indeed, is likely to significantly mitigate the revenue risk borne by the entity. Availability payments scheme involve a public party paying for a service provided to the community independently from its actual level of usage. A rate-of-return regulation, instead, allows a company to raise prices in case of decreasing demand, to a level that is suitable to allow shareholders to earn a fair rate of return on their investment, hence also providing additional resources for payments

to lenders. Clearly, a rate of return regulation can be considered as a guaranty against revenue risk only if coupled with low counterparty risk (required in the context of Article 164a, paragraph 2, letter b)) and with the provision of an essential service determining relative inelasticity of demand. A favorable contractual arrangement, on the revenue side, can consist of a take-or-pay contract or the contractual definition of the output or the usage and price, independently. A take-or-pay contract is a contract through which the entity's output purchaser agrees, with reference to a determined period of time, to periodically purchase at least the agreed-on quantity of output and to pay a penalty (usually lower than the unit price of the output) for each unit not purchased. It is possible to observe that, although being explicitly provided by the regulator as a form of guarantee of an infrastructure entity's revenue stability, a take-or-pay contract does not involve many purchasers but rather one or few big off-takers. If the target market is not characterized by the presence of many potential users, hence, few or single purchasers of the SPV's output have to fulfil certain criteria, so that the risk of relying on few counterparties is anyway offset. First of all, no concern arises if the single purchaser of an infrastructure entity output is an extremely reliable subject like the European Central Bank, Member States' central banks and central governments, multilateral development banks or "low risk" international organizations. Other institutions deemed as safe are regional administration and local authorities defined in the regulation adopted pursuant to Article 109a(2)(a) of Directive 2009/138/EC. Private single large off-takers are instead required to exhibit a rating from an External Credit Assessment Institution, equivalent to, at least, BBB. These requirements cease to be mandatory if the entity can substitute the off-taker without significant changes in the timing and amount of its revenues. Anyway, if there are not many potential users, the regulator demands that safety mechanisms are provided by the contractual arrangements to protect equity and debt investors from losses possibly arising from off-takers withdrawal, unless revenues are protected by a rate-of-return regulation.

Article 164a also provides a solid framework for the protection of qualifying infrastructure entities' debt providers, in the second part of letter c) and in the section marked by the letter d). This framework is consistent with several of the elements that generally characterize project finance deals. In particular, the contractual arrangement has to restrict the use of the operating income (revenues net of operating costs) for purposes that differ from debt servicing and to limit activities that may have an impairing effect on the fulfilment of the obligations the SPV takes on with regard to lenders. In particular, the emission of new debt is subordinated to the explicit authorization of existing lenders, be it *ex ante*, hence included in the original contract between lenders and the SPV, or *ex post*, hence given right before the new issuance in accordance with a previously agreed-on procedure. Importantly, the SPV is responsible of providing debt-holders with guarantees or the benefit of guarantees on all the essential contracts and assets related to the project, subordinately to the limits imposed by the *pro*

tempore applicable law. Alternatively, if the entity is able to demonstrate that this is not necessary to make sure that debt is serviced, other guarantees can be employed, including pledge of shares, step-in rights, lien over bank accounts, control over cash flows, provisions for the assignment of contracts. The first four guarantees involve the collateralization of, respectively, the entity's shares, its position in the project, a portion of the liquidity the SPV has on its bank account, a portion or all of its future cash flows. Guarantees may be either triggered by a debt servicing default of by a repeated or grave non fulfillment with contractually established financial performance thresholds (covenants). According to the provision at letter d), an insurance or reinsurance company willing to invest in infrastructure debt, be it in the form of a loan or bonds, has to demonstrate to the supervisory authority its ability and willingness to hold the investment until maturity, in order to apply for the treatment of qualifying infrastructure debt.

In sections e) and f), Article 164a regulates qualifying investments in infrastructure entities having not received an assessment from an External Credit Assessment Institution. The former regards infrastructure debt only, and states that if no credit assessment is available for an infrastructure SPV, the sole senior debt can apply for the treatment of qualifying infrastructure debt. In other words, the debt provided by the insurance or reinsurance company has to be prioritized with respect to all other sources of credit capital, for what concerns debt servicing, with the exception of statutory claims and claims from liquidity facility providers, trustees and derivatives counterparties. In section f), the requirements that the project and the Special Purpose Vehicle are to fulfil when an external credit assessment is not available are listed. They refer both to equity and debt investments. Allegedly, the conditions imposed mock the characteristic of an entity that is likely to receive a high-quality rating (Credit Quality Step from 0 to 3). First of all, both the infrastructure asset and the SPV have to be located in either OECD or EEA countries, so to minimize country-related risks. Also operating, refinancing and technological risks have to be negligible or efficiently managed until minimization. The capital structure has to be structured so that debt servicing is guaranteed and derivatives can be employed only for hedging purposes. Regulation opens to greenfield projects. This comes partially unexpected, given that the regulation in question is aimed at extending a preferred treatment only to low-risk infrastructure investments. Nonetheless, stricter requirements are set up for greenfield infrastructure projects' sponsors. In particular, they are required to have a track record of successful overseeing of infrastructure projects and the necessary capabilities. There must be an alignment between their interests and the interests of the generality of investors. In addition, their default risk has to be low, unless it is demonstrated that there is limited risk of relevant losses from their possible

default. About the project, construction risk has to be properly hedged through safety measures guaranteeing its on-time and on-budget completion. [158]

The most recent amendment to the EU Delegated Regulation 2015/35 has also introduced the Article 164b, extending the regulation of qualifying infrastructure investments laid down in Article 164a for Special Purpose Vehicles, also to infrastructure companies. This has very significantly extended the range of targetable infrastructure investments that can apply for the preferred treatment, eliminating the trenchant preference for infrastructure project finance deals, previously exhibited by the regulator. For the purpose of the regulation therein embodied, qualifying infrastructure corporate investment shall include investment in an infrastructure entity that meets the following seven criteria:

1) The substantial majority of the infrastructure *entity's revenues* is derived from owning, financing, developing or operating infrastructure assets located in the EEA or the OECD;
2) The revenues generated by the infrastructure assets satisfy one of the criteria set out in Article 164a(2)(a);
3) Where the revenues of the infrastructure entity are not funded by payments from a large number of users, the party which agrees to purchase the goods or services provided by the infrastructure entity shall be one of the entities listed in Article 164a(2)(b);
4) The *revenues shall be diversified* in terms of activities, location, or payers, unless the revenues are subject to a rate-of-return regulation in accordance with Article 164a(1)(c)(a)(ii) or a take-or-pay contract or the revenues are availability based;
5) Where investments are in bonds or loans, the insurance or reinsurance undertaking can demonstrate to the supervisor that it is able to hold the investment to maturity;
6) Where no credit assessment from a nominated ECAI is available for the infrastructure entity:
    a. the capital structure of the infrastructure corporate shall allow it to service all its debt under conservative assumptions based on an analysis of the relevant financial ratios;
    b. the infrastructure entity shall have been active for at least three years or, in the case of an acquired business, it shall have been in operation for at least three years;
7) Where a credit assessment from a nominated ECAI is available for the infrastructure entity, such credit assessment has a credit quality step between 0 and 3.

[158] ANIA & ASTRID – "*Gli investimenti infrastrutturali nel contesto di Solvency II – Il ruolo delle compagnie di assicurazione*" – November 2017

Despite the number of strict criteria that target investments need to fulfil in order to be considered as qualifying infrastructure investments, according to Articles 164a and 164b of the amended Regulation 2015/35, a remarkable number of infrastructure entities and investment vehicles are actually eligible for the preferred treatment. Project finance infrastructure deals and a number of standardized contracts, for example, are generally compliant, especially if infrastructure entities operate in regulated environments. Direct project finance equity investments, bonds and loans to infrastructure entities or corporates and shares of Alternative Investment Funds are all eligible investment vehicles. A criticality to be pointed out is the nebulous definition of some of the requirements. When there is not punctual description of how each criterion has to be satisfied, indeed, the one-to-one relationship between the regulated entity and its national supervisory authority assumes a greater importance, with risk of misalignments between treatments of qualifying infrastructure investments in different countries.

3.8 Additional requirements for accessing the qualifying infrastructure status

In exchange for the significantly favored treatment under the quantitative point of view, insurers on their way to gain exposure to qualifying infrastructure assets have to perform some tasks to demonstrate that the target investments are actually qualifying investments in infrastructure. The Article 261a of the Delegated Regulation 2015/35, as amended by the Delegated Regulation 2017/1542, lays down some qualitative requirements for insurance and reinsurance companies that are willing to make qualifying infrastructure investments. In particular, it is stated that before embarking in the investment firms are to conduct careful due diligence, including:

1) a documented assessment of how the infrastructure entity satisfies the criteria set out in Article 164a or Article 164b, which has been subject to a validation process, carried out by persons that are free from influence from those persons responsible for the assessment of the criteria, and have no potential conflicts of interest with those persons;
2) a confirmation that any financial model for the cash flows of the infrastructure entity has been subject to a validation process carried out by persons that are free from influence from those persons responsible for the development of the financial model, and have no potential conflicts of interest with those persons.

Once the qualifying investment has been carried out, the holding company has to regularly monitor it and run stress tests on cash flows and collaterals supporting the infrastructure entity. Any stress tests shall be commensurate with the nature, scale and complexity of the risk inherent in the infrastructure project.

In the context of the mentioned stress tests, risks borne by the investee company have to be taken into account also when they arise from non-infrastructure activities. On the other hand, revenues arising from non-infrastructure activities of the investee companies shall not be taken into account when assessing their capacity to meet their financial obligations.

When insurance or reinsurance companies hold material qualifying infrastructure investments, they must insert provisions for an active monitoring of these investments during the construction phase and for the maximization of the amount covered from the investment themselves in case of failure, in the documentation already required by the Article 41 (3) of the Solvency II Directive. The Article in question prescribes that each insurance or reinsurance company has to develop and actually implement written policies related to at least the risk management, internal control, internal audit and, if relevant, outsourcing. The policies have to be reviewed at least annually and be adapted to any significant change in the system of area concerned.[159]

The last provision of the new Article 261a states that if the qualifying infrastructure investment is in the form of a bond or a loan, the company has to set up its asset-liability management so that it can make sure, on an ongoing basis, that it is able to hold the investment to maturity, consistently with point d) of the first paragraph of Article 164a.[160]

3.8.1 Disclosure for qualifying infrastructure investments – The look-through approach

In addition to what required by the reported Article 261a, the Solvency II framework imposes some other requirements that apply to investments in qualifying infrastructure assets. Among these, one of the most important and influent is the "look-through" approach, included in the Pillar 3 (Disclosure) and regarding insurers' indirect investments by means of investment funds, namely the most frequent exposures to infrastructure assets. This approach is introduced by Article 84 of the Delegated Regulation 2015/35, stating that the Solvency Capital Requirement has to be calculated on the basis of each of the underlying assets of collective investment undertakings and other investments packaged as funds. In other words, under the Solvency II framework the company keeps responsible for all of its open financial position, independently from whether it entrust external professional to manage their investments or whether they invest in funds. There is no Solvency II-compliant fund. Rather, each of a fund's exposures has to be compliant in order to apply for the preferred treatment of qualifying infrastructure investments.[161]

[159] EU Directive 2009/138 on the taking-up and pursuit of the business of Insurance and Reinsurance – *Solvency Framework Directive* – Article 41 point 3.
[160] European Commission – *Commission Delegated Regulation 2017/1542 amending Delegated Regulation 2015/35*
[161] ANIA & ASTRID – "*Gli investimenti infrastrutturali nel contesto di Solvency II – Il ruolo delle compagnie di assicurazione*" – November 2017

The look-through approach also applies to indirect exposures to concentration and underwriting risk, besides exposures to market risk sources other than collective investment undertakings and other investments packaged as funds.

Solvency II does not force insurance companies to gather and spread market data disclosing their investment holdings, but doing so can allow them to enjoy significant benefits under the point of view of both the quantitative measure of the Solvency Capital Requirement and the ease of computing the Minimum Capital Requirement. Actually, these both represent important potential sources of saving. A study from Global Actuarial has confirmed that the Solvency Capital Requirement for companies putting in place look-through compliant data management systems have emerged as significantly lower.[162]

One of the main problems arising from the approach in question, anyway, is the difficulty of accessing relevant data, especially in the case of investments in funds of funds. If the look-through approach is not applicable to certain collective investment undertakings or investments packaged as funds, the related Solvency Capital Requirement may be computed on the basis of the target underlying asset allocation of the fund, as long as it detailed enough to calculate all relevant sub-modules and scenarios of the standard formula and the target asset allocation is actually implemented by the fund. For the purposes of that calculation, data groupings may be used, provided that they are applied in a prudent manner, and that they do not apply to more than 20% of the total value of the assets of the insurance or reinsurance undertaking,[163]

The look-through approach encourages a sufficient level of granularity for data to be clear, regular and wholly reliable. The chain of data extraction consists of numerous steps, including: sourcing of information, uploading data, processing data, internal output, packaging and delivery. Data should be sourced directly from concerned fund companies, in order to guarantee their reliability. Because of the multitude of funds involved there are many points where the chain could break or get disrupted.[164] If insurance companies employ excellent data analysts and maintain strong relationships with all of the selected asset managers, they can find it convenient to set up in-house teams to ensure the cleanliness and ready availability of data, time by time. Otherwise, they will find it convenient to outsource these tasks to third parties with a consolidated reputation for strong data quality assurance.[162]

[162] Morningstar – "*Solvency II: The Look-through Approach*" - 2012
[163] European Commission – *Commission Delegated Regulation 2015/35 supplementing the EU Directive 2009/139*
[164] Molvidsson, Josef – "*Processing data for look-through reporting*" – August 2012

As a response to the inner complexities of gathering the sets of data enabling a regulated insurance company to demonstrate that its high-quality low-risk infrastructure exposures actually fit into the definition provided by the European regulator for qualifying infrastructure investments, some public institutions and private funds are developing and implementing procedures aimed at making the endeavor faster and simpler. This does not relieve insurance companies from the final responsibility on each of the investments they are exposed to, but if reliable institutions or market players are involved, it is possible to expect that they offer readymade qualifying infrastructure investment solutions supported by transparent convenient information, so that insurance companies face limited challenges in ascertaining whether they are targeting qualifying infrastructure investments and are facilitated in demonstrating the status of their exposures to national supervisors. This phenomenon is still at its early stage and initiatives in place are currently limited, but the demand of institutional investors, coupled with competition among funds on the market and increasing awareness at institutional level, is expected to drive its development. Among most important institutional initiatives currently under way, it is worth listing the European Investment Bank's Infrastructure Aggregation Platform and the International Finance Corporation's Managed Co-Lending Portfolio Program (MCPP).

3.9 Institutional solutions for Solvency II compliance

3.9.1 EIB's Infrastructure Aggregation Platform

The Infrastructure Aggregation Platform is going to be an open-ended investment vehicle sponsored by the European Investment Bank. The associated initiative has been approved by the EIB Board at the begin of December 2017 and further developments are to come in the closest future. Its goal is to enable small and middle-sized investors to co-invest in new selected infrastructure projects by providing senior debt alongside the European Investment Bank. It can emerge as a particularly advantageous tool for insurance companies missing in-house skills for the construction of an own project finance desk but still willing to invest in infrastructure assets.

The EIB is going to be responsible for the sourcing of projects but the Infrastructure Aggregation Platform will be a separate legal entity with no recourse to the former. Indeed, investments will be taken on the basis on the vehicle's own policies and guidelines. Once projects are selected, an interested third party Asset Manager will underwrite the IAP tranche of senior debt, which will be *pari passu* with respect to the tranches of debt provided by other lenders and by the European Investment Bank on its own. The Asset Manager will then issue investment grade project bonds for the sale to institutional investors. The bonds issued by the Asset Manager for each selected project will convey toward the platform, which will be monitored and managed by the Asset Manager itself.

The EIB will provide a further (unfunded) credit rating enhancement facility for these bonds, for a value amounting up to the 20% of the overall value of the IAP tranche. While being part of the same platform, each project's bonds will be ring fenced and different investors will be able to participate in each of the bonds issued. [165]

Institutional investors participating to the initiative in question will hence benefit from the project selection carried out by an extremely reliable institution like the European Investment Bank, having significant in-house skills and knowledge to perform it at the best. The institution in question will be exposed twice to selected projects: once directly, in the form of senior debt financing, and once indirectly, in its role of guarantee provider. The investment-grade status of project bonds issued by the Asset Manager, the seniority of the underlying debt and the unfunded guarantee provided by the EIB represent a unique set of risk reducing factors, leading to a significant improvement of the risk-return trade-off of target projects debt. This is expected to determine an increase in the appeal of the projects in question, from the point of view of small and medium-sized institutional investors.

In the next page, a graphical representation of the structure of the EIB Infrastructure Aggregation Platform is provided. By the time the initiative is actually undertaken, something may change with respect to the current design of the project.

[165] European Investment Bank – "*Infrastructure Aggregation Platform*" – December 2017

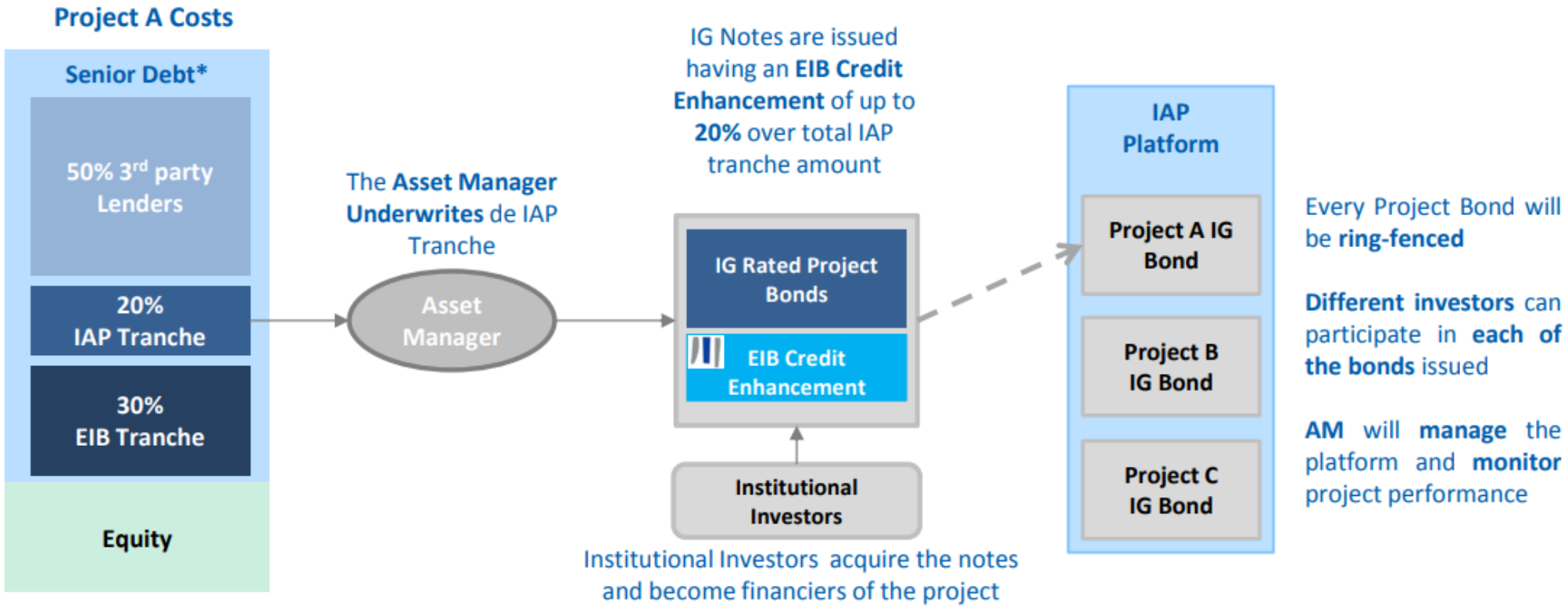


Figure 3.88 – The structure of the EIB Infrastructure Aggregation Platform
Source: EIB 2017

3.9.2 IFC's Managed Co-Lending Portfolio Program Infra

The International Finance Corporation is a member of the World Bank Group and was created sixty years ago with the view of enabling the employment of the private sector potential for the pursuance of economic prosperity. It is the first global development institution focused on the private sector in emerging markets. As a member of the World Bank Group, the IFC shares the goal of ending extreme poverty and boosting shared prosperity. [166]

The Managed Co-Lending Portfolio Program is an initiative of the International Finance Corporation to allow institutional investors to allocate debt capital to the IFC on a portfolio basis. It is meant to represent an efficient and cost-effective syndication process. The capital raised is conveyed by the IFC toward several regions and sectors, consistently with its strategy and processes, then a portion of new debt investments is offered to MCPP investors, according to a passive rule-based process. The IFC is in charge of managing the project evaluation, approval, commitment and supervision, besides being the only interface of the initiative borrowers. After having provided a pre-mandate approval for each project, the MCPP investor limit themselves to follow its decisions. The initiative is a complement to other co-investment programs of the International Finance Corporation, and it aimed at enlarging the scope of co-investors to those institutional investors which are not able to invest on a "deal by deal" basis. The principal IFC partner in the context of this initiative is the State Administration for Foreign Exchange of the People's Bank of China.

The Managed Co-Lending Portfolio Program Infrastructure of the International Finance Corporation is a spin-off of the MCPP and is aimed at addressing the challenges related to the financing of infrastructure in emerging countries through the improvement of institutional investors' access to the related infrastructure markets. Infrastructure financing need for emerging countries is estimated to be around $1.000 billion a year and to be mainly in the form of demand for long-term credit. The Managed Co-Lending Portfolio Program for Infrastructure is meant to represent a response to the need of finding alternative long-term debt financing to the one of banks, which appear more and more reluctant to provide long-term loans. It is expected to raise $5.000 million of additional private debt financing for emerging countries' infrastructure systems. The first partner of this platform is Allianz Global Investors, having committed $500 million of capital.[167]

[166] International Finance Corporation – "*IFC History*" - 2017
[167] International Finance Corporation – "*Managed Co-Lending Portfolio Program (MCPP)*" - 2017

As shown in the figure on the side, the IFC is supporting the creation of new private sector infrastructure debt vehicles (fourth layer from the top of the figure), with the purpose of having them investing in infrastructure loans originated by the IFC itself and syndicated through the MCPP platform described above (third layer from the top of the figure). Each vehicle is designed to meet the regulatory and commercial requirements of large institutional investors.

Importantly, the IFC backs up the exposures of institutional investors in the platform by providing first loss capital (fifth layer from the top of the figure), whose claims are subordinated to those of other senior debt providers, hence granting their loans an investment grade status. The provision of the guarantees is performed in co-operation with the Swedish International Development Cooperation Agency (SIDA), which aims to share risk by guaranteeing coverage on a portion of the first loss of the portfolio of loans. It is estimated that the collaboration between IFC and SIDA enables to unlock $8-$10 of third party capital for each dollar of capital invested. Anyway, the contribution of SIDA is limited to those projects that meet the Swedish priorities for development co-operation.

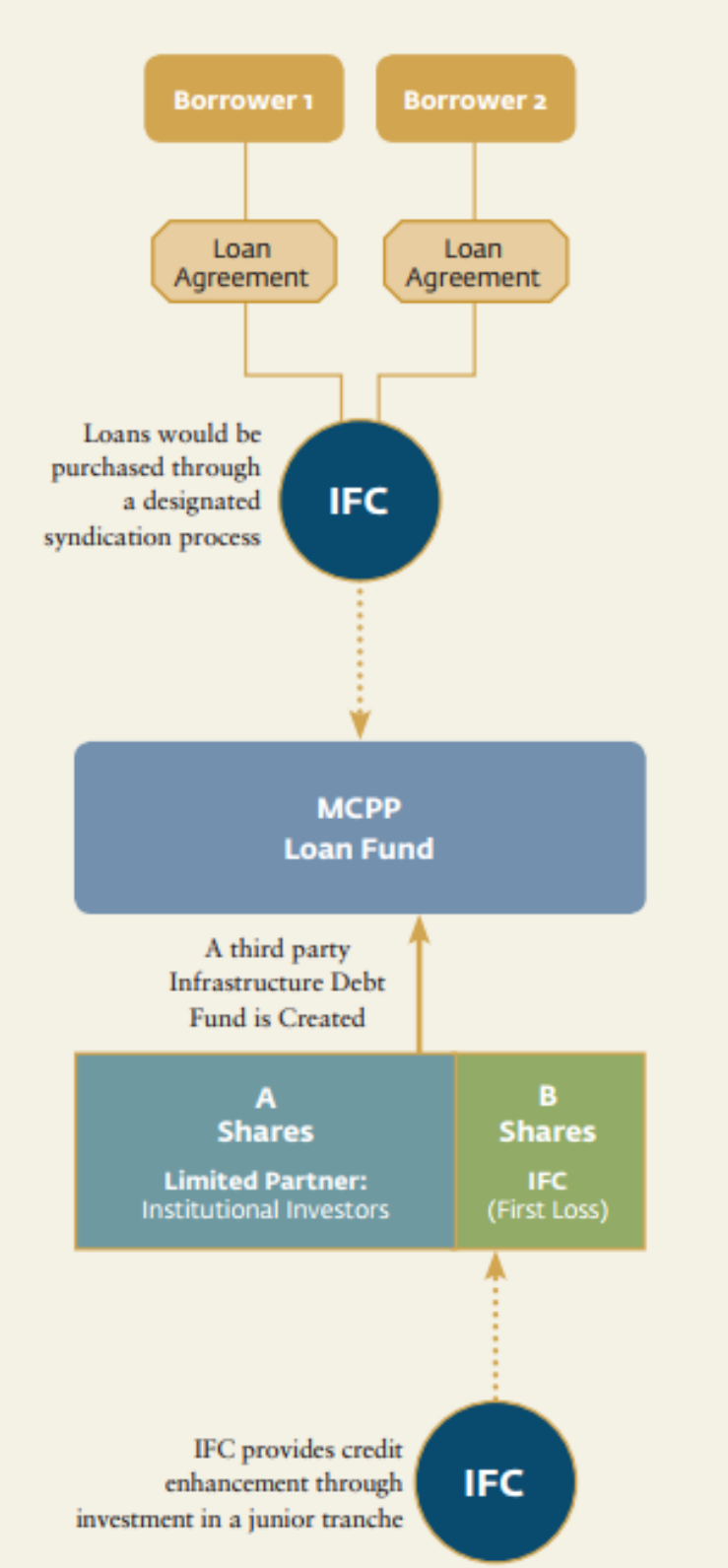


Figure 3.89 – Structure of the IFC's Managed Co-Lending Portfolio Platform Infrastructure (modified)
Source: IFC 2017

Through the MCPPI, institutional investors are expected to leverage the IFC capacity to originate and manage a portfolio of bankable infrastructure project, in exchange for the possibility to gain exposure to a sufficiently sized and diversified portfolio of investment-grade-like infrastructure debt. [168] Hence, once again, the initiative allows institutional investors missing in-house capabilities, to gain exposure to high-quality low-debt infrastructure investments. This aspect gains further importance in the context of the MCPPI, as it makes referral to emerging markets, where it is more difficult to find investment-grade opportunities and where returns are potentially higher.

3.10 The UBS Archmore Infrastructure Debt Platform

The UBS Archmore Infrastructure Debt Platform represents an excellent example of a "market-based" solution for the complexities faced by European insurers in force of the Solvency II regime, with a particular focus on the look-through approach and the selection of investment opportunities. It is a Luxembourg-based regulated alternative investment vehicle composed by a closed-ended fund and parallel managed accounts. Its investments are managed by UBS Asset Management Funds Ltd. In force of the supposed convenience of infrastructure private debt under the risk-return perspective, the fund targets infrastructure private placements, loans and bonds. In particular, 90% of its target is composed by primary mid-sized private unrated debt opportunities, showing investment-grade characteristics, innovative structures and limited competitive tension in the markets of referral. The target maturity of investments ranges between 7 and 10 years. By November 2015, investors in the fund were European and Asian insurance companies and pension funds. Allegedly the situation has not significantly changed since then. A declared objective of the fund is to gain exposures to issuers and deal types for which the access to finance is harder, so to drive returns up. Despite its opportunistic approach to investments, aimed at achieving a yearly return of 300 to 400 bps over the reference rate, the fund targets operational assets denominated in euros or pounds, supporting core infrastructure sectors, including transport, utilities, energy and social services and located in OECD countries (especially Western Europe). The target size of the fund is equal to €1.0 billion, subdivided among 12-18 positions. The following figure shows the structure of the Archmore Infrastructure Debt Platform.

[168] International Finance Corporation – "*IFC MCPP Infrastructure*" – May 2016

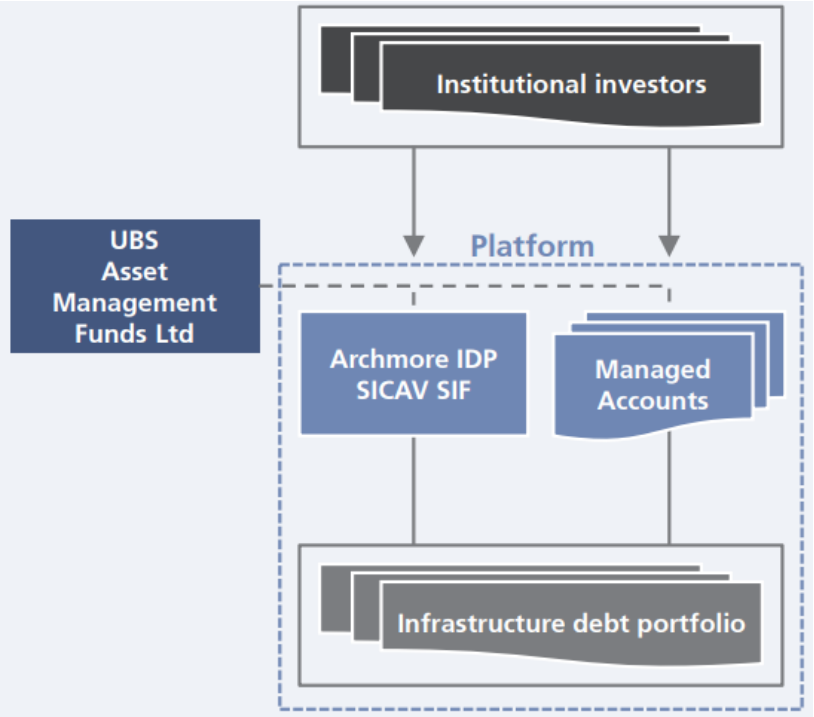


Figure 3.90 – Structure of the UBS Archmore Infrastructure Debt Platform
Source: UBS 2015

The integrated investment process adopted by the fund managers is composed by three phases, namely sourcing, structuring and monitoring. The first phase is aimed at gaining access to primary market debt financings through several channels; the second phase involves the identification, analysis and mitigation of deal-related risks, together with endeavors to reduce transaction costs; the third phase is aimed at monitoring the credit rating and the performance of each investment, through the annual update of internal and external assessments. Each phase is in turn subdivided in two steps. Along the process, allegedly eligible deals are scrutinized deeper and deeper, so that the tens of deals identified in the sourcing phase are reduced to the 12-18 investments actually pursued by the fund. The process is undertaken by a group of dedicated experienced professionals, composing the Investment Committee, in charge of finding solutions to the challenges underlying the activities of sourcing, structuring, analyzing and monitoring infrastructure debt investments. The investment Committee operates in a context characterized by a system of checks and balances, both within and outside from the team itself. [169]

The following figure provides a graphical representation of the investment process of the UBS Archmore Infrastructure Debt Fund.

[169] UBS – "*Archmore Infrastructure Debt Fund*" – November 2015

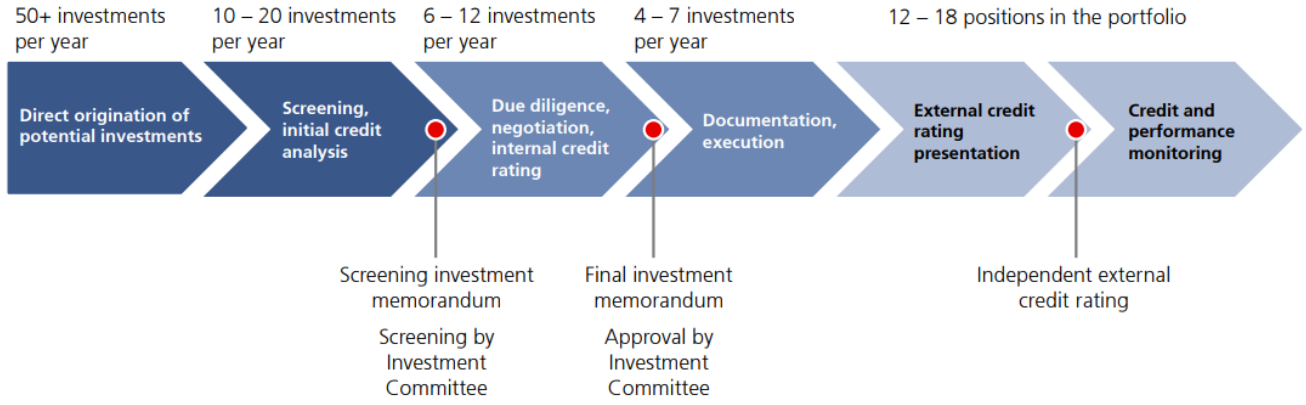
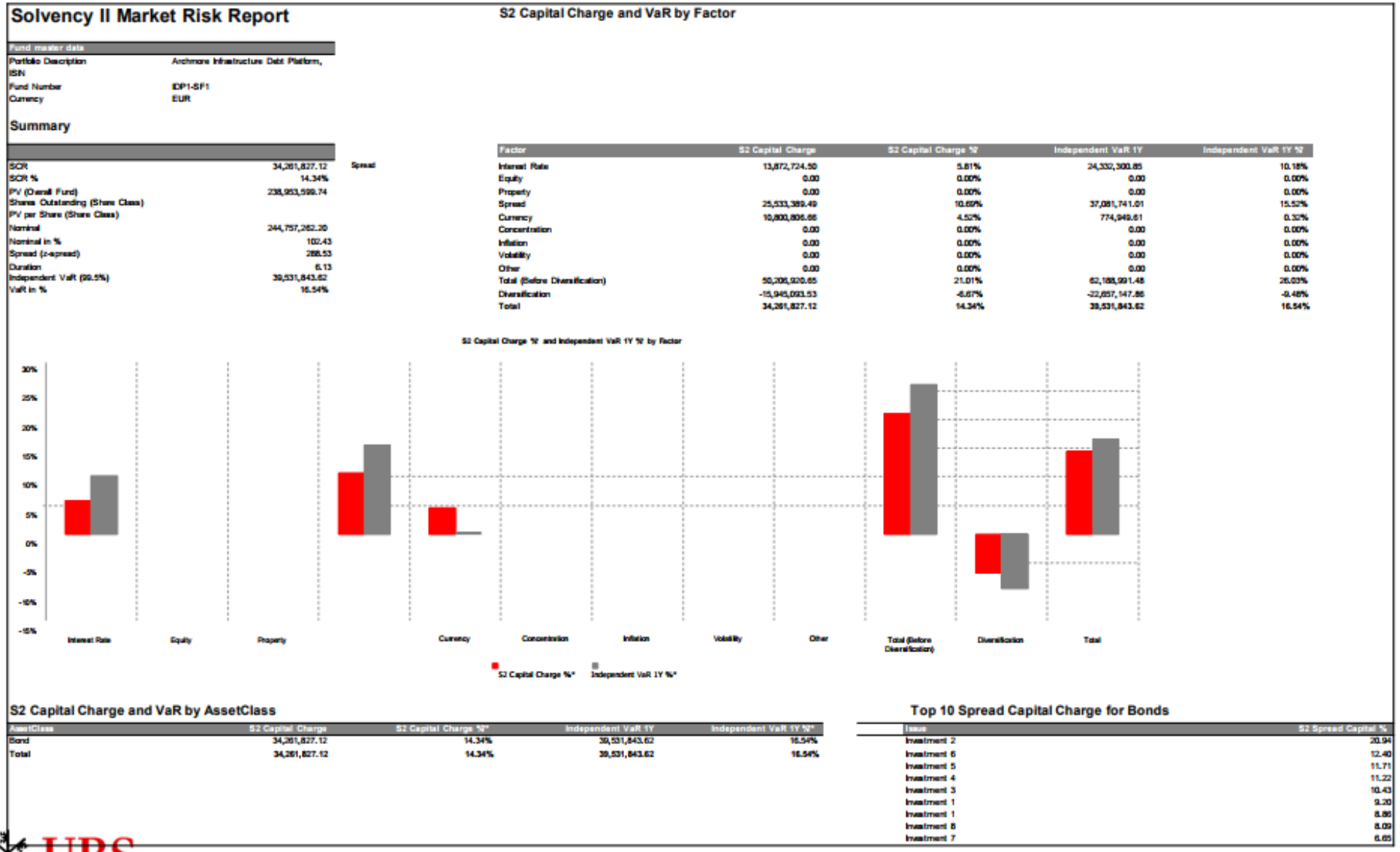


Figure 3.91 – The integrated investment process of the UBS Archmore Infrastructure Debt Fund
Source: UBS 2015

Besides being compliant with the European Alternative Investment Funds Management Directive, the UBS Archmore Infrastructure Debt Fund wants to represent a Solvency II compliant solution for insurance companies willing to gain exposure to qualifying infrastructure assets. The eligibility of each investment, according to the criteria laid down in Articles 164a and 164b of the EU Delegated Regulation 2015/35, is ascertained by the Investment Team through a purposely created checklist. The analysis carried out takes part of the Investment Memorandum, and is successively validated by independent members of the Investment Committee, consistently with the provisions included in Article 261a of the EU Delegated Regulation 2015/35. The analysis is reviewed annually, unless credit events cause earlier or more frequent reviews. To address the requirements imposed specifically by the look-through approach, the mentioned Investment Committee Memorandum is drafted with the view to ensure full transparency and hence thoroughly report the outcome of the analyses performed by the Investment Committee. In addition, the look-through reporting and the Solvency II analysis are realized and quarterly updated. The former is a complete set of relevant data about each of the fund's investments. Among most important pieces of information provided therein, it is worth mentioning the type of deal, the sector and industry of referral for each deal, the currency, the seniority of the underlying claims, the weight of each investment on the whole portfolio of the fund, the rating of the debtor (external and internal). The Solvency II analysis, instead, aims at quantifying the Solvency Capital Requirement that regulated insurance companies are expected to face for each of the fund's investments. [170] An example of the look-through reporting and of the Solvency II analysis are displayed in the following pages. The Solvency II eligibility checklist is utilized in the next paragraph to assess the eligibility of a specific infrastructure asset for the treatment of qualifying infrastructure investments under Solvency II.

[170] UBS – "*Infrastructure Debt and Solvency II - Opportunities and challenges: the experience of an infrastructure debt fund*" – October 2017



Solvency II Market Risk Report

Fund master data	
Portfolio Description	Archmore Infrastructure Debt Platform,
ISIN	
Fund Number	IDP1-SF1
Currency	EUR

Summary

SCR	34,261,827.12	Spread
SCR %	14.34%	
PV (Overall Fund)	238,953,599.74	
Shares Outstanding (Share Class)		
PV per Share (Share Class)		
Nominal	244,757,262.20	
Nominal in %	102.43	
Spread (z-spread)	288.53	
Duration	6.13	
Independent VaR (99.5%)	39,531,843.62	
VaR in %	16.54%	

S2 Capital Charge and VaR by Factor

Factor	S2 Capital Charge	S2 Capital Charge %	Independent VaR 1Y	Independent VaR 1Y %
Interest Rate	13,872,724.50	5.81%	24,332,300.85	10.18%
Equity	0.00	0.00%	0.00	0.00%
Property	0.00	0.00%	0.00	0.00%
Spread	25,533,369.49	10.69%	37,081,741.01	15.52%
Currency	10,800,806.66	4.52%	774,949.61	0.32%
Concentration	0.00	0.00%	0.00	0.00%
Inflation	0.00	0.00%	0.00	0.00%
Volatility	0.00	0.00%	0.00	0.00%
Other	0.00	0.00%	0.00	0.00%
Total (Before Diversification)	50,206,920.65	21.01%	62,188,991.48	26.03%
Diversification	-15,945,093.53	-6.67%	-22,657,147.86	-9.48%
Total	34,261,827.12	14.34%	39,531,843.62	16.54%

S2 Capital Charge % and Independent VaR 1Y % by Factor

S2 Capital Charge and VaR by AssetClass

AssetClass	S2 Capital Charge	S2 Capital Charge %*	Independent VaR 1Y	Independent VaR 1Y %*
Bond	34,261,827.12	14.34%	39,531,843.62	16.54%
Total	34,261,827.12	14.34%	39,531,843.62	16.54%

Top 10 Spread Capital Charge for Bonds

	Issue	S2 Spread Capital %
	Investment 2	20.94
	Investment 6	12.40
	Investment 5	11.71
	Investment 4	11.22
	Investment 3	10.43
	Investment 1	9.20
	Investment 1	8.86
	Investment 8	8.09
	Investment 7	6.65

UBS

Figure 3.92 – UBS Archmore Infrastructure Debt Fund Look-Through report
Source: UBS 2017

Fund details as of 30/09/2017					
Fund's name	Archmore Infrastructure Debt Platform				
Underlying asset category	Infrastructure debt				
Total fund's committed capital	569,750,000				
Total committed capital	569,750,000				
Total invested capital	344,064,782		CIC code (Solvency II)	49	
% of commited capital	60.39%		Final close date	24/08/2016	
Reporting currency	EUR		Investment period	2.5 years from final close	24/02/2019
Total all-in spread (bps)	471	*LTM (3)*	Re-investment period	7 years from final close	24/08/2023
Total all-in yield (%)	5.16%	*LTM (3)*	Repayment period	starts 7 years after final close	24/08/2023
Total all-in yield (%)	3.48%	*Last quarterly coupon annualised*	Mandate term	10 years after final close	24/08/2026
Total residual WAL (yrs)	7.4 years		Maximum extension period	2x one year	24/08/2028

Investments as of 30/06/2017											
Investment name	Investment 1		Investment 2	Investment 3	Investment 4	Investment 5	Investment 6		Investment 7		Investment 8
Borrowing entity											
Country of issue	France	France	France	Belgium	Spain	Spain	Sweden	Republic of Ireland	Republic of Ireland	Republic of Ireland	France
Type of transaction	Secondary	Secondary	Secondary	Primary	Primary	Secondary	Primary	Secondary	Secondary	Secondary	Primary
Sourcing	Direct	Direct	Direct	Advisory firm	Investment Bank	Investment Bank	Advisory firm	Advisory firm	Advisory firm	Advisory firm	Advisory firm
Financing purpose	Refinancing	Refinancing	Refinancing	Acquisition financing	Refinancing	Refinancing	Refinancing	Project Financing	Project Financing	Project Financing	Acquisition financing
Investment date	19/06/2015	05/08/2015	05/08/2015	30/12/2015	26/08/2016	10/01/2017	27/01/2017	02/03/2017	02/03/2017	02/03/2017	30/06/2017
GICS Sector	55 - Utilities	55 - Utilities	55 - Utilities	35 - Health Care	55 - Utilities	55 - Utilities	20 - Industrials	20 - Industrials	20 - Industrials	20 - Industrials	10 - Energy
Industry	Energy	Energy	Energy	Social Infrastructure	Renewables	Renewables	Transport	Transport	Transport	Transport	Energy
Currency	EUR	EUR	EUR	EUR	EUR	EUR	DKK	EUR	EUR	EUR	EUR
Initial notional amount (Local)	10,000,000	9,897,000	5,000,000	75,000,000	71,354,500	30,000,000	576,109,108	13,421,064	-	-	60,000,000
Initial notional amount (EUR) (1)	10,000,000	9,897,000	5,000,000	75,000,000	71,354,500	30,000,000	77,466,298	13,421,064	-	-	60,000,000
Initial notional amount total (EUR) (1)	10,000,000	9,897,000	5,000,000	75,000,000	71,354,500	30,000,000	77,466,298	13,421,064	-	-	60,000,000
Commitment amount total (EUR)	-	-	-	-	-	-	-	-	788,146	1,513,241	-
% of total financing	0.7%	0.7%	10.0%	40.3%	66.5%	52.9%	29.9%	7.9%	7.9%	7.9%	32.4%
Current notional amount (Local)	8,495,000	8,495,000	5,236,306	73,944,000	68,075,740	28,995,765	576,109,108	12,781,412	-	-	60,000,000
Current notional amount (EUR) (2)	8,495,000	8,495,000	5,236,306	73,944,000	68,075,740	28,995,765	77,438,704	12,781,412	-	-	60,000,000
Current value (GP's valuation - EUR)	8,495,000	8,495,000	5,236,306	73,944,000	68,075,740	28,995,765	77,438,704	11,503,270	-	-	60,000,000
Current value total (GP's valuation - EU	8,495,000	8,495,000	5,236,306	73,944,000	68,075,740	28,995,765	77,438,704	11,503,270	-	-	60,000,000
Type of debt	Loan	Loan	Bonds	Bonds	Loan	Loan	Loan	Term Loan	WCF (Undrawn)	DSRF (Undrawn)	Bonds
Seniority	Senior secured	Senior secured	Junior	Senior secured	Senior secured	Senior secured	Senior secured	Senior secured	Senior secured	Senior secured	Senior secured
Covenant-lite	No	No	No	No	No	No	No	No	No	No	No
Arrangement/initial fees	0.000%	0.000%	0.000%	0.000%	0.000%	2.500%	1.000%	10.0% (7)	10.0% (7)	10.0% (7)	2.000%
Coupon type	Fixed	Floating	Fixed	Fixed	Fixed	Floating (with 0% Euribor floor)	Fixed	Floating	Commitment fee	Commitment fee	Fixed
Coupon (%)	3.208%	Euribor 6M + 1.75%(3)	9.400%	4.000%	3.678%	Euribor 3M + 3.00%	3.864%	Euribor 6M + 0.90%	0.350%	0.350%	2.6401% (8)
Current coupon (%)	3.208%	1.750%	9.400%	4.000%	3.678%	3.000%	3.864%	Euribor 6M + 0.90%	0.350%	0.350%	2.6401% (8)
Spread vs. MS	234 bps	175 bps	844 bps	325 bps	332 bps	300 bps	320 bps	90 bps	35 bps (7)	35 bps (7)	250 bps (8)
Coupon Frequency	Semi-annual	Semi-annual	Semi-annual	Semi-annual	Semi-annual	Quarterly	Semi-annual	Semi-annual	Semi-annual	Semi-annual	Semi-annual
Initial WAL (years)	7.5	7.5	8.8	7.6	10.6	10.7	9.0	4.4	8.8	8.8	5.0
Current WAL (years)	6.4	6.4	6.3	6.0	10.0	10.3	8.3	4.0	8.3	8.3	4.8
Final maturity date	30/06/2030	30/06/2030	31/12/2031	31/12/2026	30/09/2036	31/12/2032	27/01/2029	31/12/2025	31/12/2025	31/12/2025	30/06/2022
First non-call option	NA	NA	29/07/2027	31/12/2023	NA	NA	27/01/2026	NA	NA	NA	NA
Modified Duration	5.8	NA (4)	5.0	5.3	8.5	NA (4)	7.2	NA (4)	NA (4)	NA (4)	4.4
Spread duration	5.8	NA (5)	5.0	5.3	8.5	NA (5)	7.2	NA (5)	NA (5)	NA (5)	4.4
LTV (%)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ICR (current)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Post Maintenance ICR (current)	NA	NA	NA	NA	NA	NA	4.0x	NA	NA	NA	2.7x
DSCR (current)	1.58x	1.58x	1.45x	1.54x	1.56x	1.20x	NA	1.25x	1.25x	1.25x	NA
External Rating	BBB (S&P) / Baa3 (Moody's)	BBB (S&P) / Baa3 (Moody's)	-	BBB (S&P)	Baa3 (Moody's)	-	-	-	-	-	-
Internal Rating	Baa2	Baa2	Ba1	Baa2	Baa2	Baa3	Baa3	Baa3	Baa3	Baa3	Baa3
ISIN	NA	NA	NA	XS1336574527	NA	NA	NA	NA	NA	NA	NA
% of portfolio	2.5%	2.5%	1.5%	21.6%	19.9%	8.5%	22.6%	3.4%	0.0%	0.0%	17.5%
Impairment	-	-	-	-	-	-	-	-	-	-	-

Figure 3 93 – UBS Archmore Infrastructure Debt Fund Look-Through Report
Source: UBS 2017

3.10.1 Application of the Solvency II eligibility checklist to a parking facility

The Archmore fund's checking list is a useful tool to assess the eligibility of an infrastructure investments for the preferred treatment provided by Solvency II regulation at advantage of insurance companies investing in high-quality low-risk infrastructure assets. To see how it works, a concession deal for the management of an operational rotating parking facility in a middle-sized Italian city is taken as an example. The choice of the investment is not linked to whether it is actually included in the portfolio managed by the UBS Archmore fund.

The deal in question grants to the primary operator the exclusive right to manage the facility and gravitates around a Special Purpose Vehicle financed according to a full equity model. The target investment equals €25 million and a stable stream of yearly revenues of €2 million is expected. Revenues arise from parking fees, whose size is determined according to an agreement between the operator and the municipal administration. The operator is entitled to earn of share of said revenues, with a minimum guaranteed amount.

The following figure shows the forecast streams of revenues, costs and income for the operator of the facility.

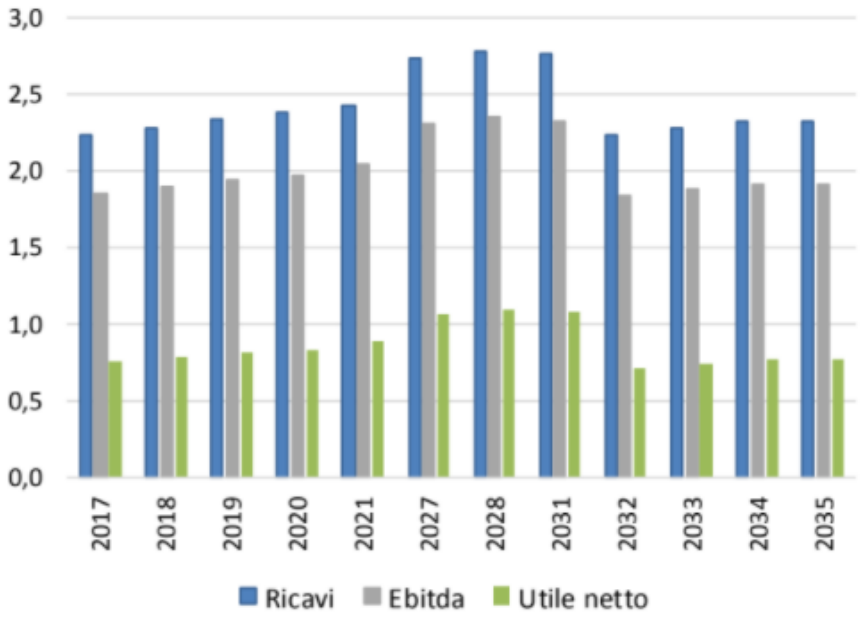


Figure 3.94 – Forecast streams of revenues, costs and income for the operator of a parking facility in a middle-sized Italian city
Source: ANIA & ASTRID 2017
Data in € millions

Stress tests have been carried out to ascertain whether the project keeps financially convenient also in case of negative changes of relevant endogenous and exogenous variables. The project has shown resistance to stress tests, including those involving a reduction of revenues, absence of inflation, a threefold increase in Operating and Management costs. In all these cases, the rate of return has shown to be enough higher than the hurdle rate of the project, namely the minimum rate of return that investors are willing to accept for that investment. [171]

Given all these premises, it is possible to compare the investment opportunity with the Archmore checklist, which actually mirrors the provisions included in Article 164a of EU Delegated Regulation 2015/35.

Summary criteria	**[Y/N]**	**Evidence**
Asset consists of physical structures or facilities, systems and networks that provide or support essential public services.	YES	Physical structure Mobility sector Parking services
Entity is not permitted to perform any other function other than owning, financing, developing or operating infrastructure assets and the primary source of payments to investors is the income generated by the assets being financed.	YES	Project finance deal The SPV is entitled to do all and only the activities related to the project itself
Can meet its financial obligations under sustained stresses relevant for the risk of the project.	YES	Stress tested
Cash flows are predictable, meaning all except an immaterial part of the revenues are: - availability based; - subject to a rate-of-return regulation; - subject to take-or-pay contract; or - the level of output or the usage and the price is regulated, contractually fixed or sufficiently predictable as a result of low demand risk.	YES	Mature business Low demand risk Low technology risk Minimum revenues guaranteed by a public institution and backed by a suretyship from a reliable bank
Revenues from a large number of users or contractual protections in the event of termination by the off-taker and the off- taker is: - the EU/ECB, an EU member state or a multilateral development bank; - a regional government or local authority; - rated BBB- or higher; or - replaceable without significant change in the level and timing of revenues.	YES	One million customers expected each year
Entity has sufficient reserve funds or other financial arrangements to cover contingency funding and working capital requirements.	YES	Existence of a significant reserve for extraordinary maintenance

[171] ANIA and ASTRID – "*Gli investimenti infrastrutturali nel contesto di Solvency II – Il ruolo delle compagnie di assicurazione*" – November 2017

Debt providers have security to the extent applicable by law in all assets and contracts necessary to operate the project.	N/A	Full equity financial structure
Equity is pledged to debt providers such that they are able to take control of the entity prior to default.	N/A	Full equity financial structure
Net operating cash flows after mandatory payments from the project for purposes other than servicing debt obligations is restricted.	N/A	Full equity financial structure
Financing documentation includes restrictions on borrower's ability to perform actions detrimental to debt investors such as limitations on financial indebtedness.	N/A	Full equity financial structure
Transaction cash flow financial model has been independently validated.	YES	

No credit rating available		
The debt must be senior ranking (except to statutory obligations and hedging).	N/A	Full equity financial structure
The entity and assets are in the EEA or OECD.	YES	The facility is in Italy (EEA)
If the project is in construction phase: - Sponsors have a successful track record and relevant experience; - Sponsor has a low risk of default, or there is a low risk of material losses as a result of their default; and - Sponsor is incentivised to protect the interests of investors.	N/A	Operational asset
Safeguards exist to ensure completion of the project according to specification, budget and timetable.	N/A	Operational asset
Material operating risks are properly managed.	YES	Low operating risks
Project uses tested technology and design.	YES	No technologic risk
Project capital structure allows it to service its debt.	N/A	Full equity financial structure
Refinancing risk is low.	YES	No leverage Possible recourse to debt
Derivatives only used for risk mitigation purposes.	YES	No derivatives

From this example and the prospectuses reported above, it is possible to see how the UBS Archmore Infrastructure Debt Fund puts in place a smart strategy to ensure that pursued investments are Solvency II compliant and that insurance companies can access the whole set of data required by the look-through approach to access the treatment of qualifying infrastructure assets. Assuming that the fund in question is a reliable market player, this translates in a remarkable advantage for companies investing in the fund.

ANNEX D: Data about the utilization of EFSI funds from different European countries

The spreadsheet below provides an overview of the data published by the European Commission with referral to the financing capital issued by the European Fund for Strategic Investments and the private capital that has been triggered in consequence, within each country (second and third columns, respectively). The multiplier effect of the public financing capital, reported in the fourth column, is the ratio between additional private capital triggered and public capital injected, so it indicates how many euros of private investments have been raised by each euro of public investment, in the context of the Juncker plan. The last column, instead, provides a ranking among EU countries according to the quantity of private capital triggered in comparison with the country's GDP. [172]

	EFSI finance approved (million €)	Private investments triggered (million €)	Multiplier effect	Ranking*
France	8697	39592	4,55	11
Italy	6572	3676	0,56	9
Spain	5572	31875	5,72	5
Germany	5091	21987	4,32	23
Cross-country	4445	41052	9,24	
United Kingdom	2659	18871	7,10	22
Poland	2515	8869	3,53	10
Netherlands	2252	8091	3,59	19
Potugal	1898	5480	2,89	4
Sweden	1779	6314	3,55	17
Greece	1703	5753	3,38	2
Finland	1409	5590	3,97	6
Belgium	1261	5832	4,62	16
Ireland	982	3990	4,06	14
Austria	931	2825	3,03	21
Czech Republic	543	2484	4,57	15
Denmark	531	1620	3,05	25
Slovakia	475	1247	2,63	13
Bulgaria	349	1575	4,51	3
Romania	327	1092	3,34	24
Lithuania	324	934	2,88	8
Croatia	187	745	3,98	12
Latvia	182	615	3,38	7
Estonia	112	803	7,17	1
Luxemburg	89	284	3,19	26
Hungary	73	1241	17,00	20
Slovenia	59	490	8,31	18
Cyprus	45	81	1,80	27
Malta	11	34	3,09	28

Figure 3.95 – Data about the results of the Juncker Plan in each European Member State
Source: European Commission 2017 and own calculations

[172] European Commission – "*Investment Plan Results*" – December 2017

ANNEX E: Definition of underwriting risks according to the Solvency II standard formula

The **underwriting risk** is the risk that a loss or adverse change in the value of insurance liabilities arise in consequence of inadequate pricing and provisioning assumptions. It is divided in non-life and life underwriting risk.

The technical insurance risk related to non-life business reflects the risk arising from non-life insurance obligations, taking into account the events and the processes of the activities covered by the policies. The related module is given by the combination of *premium and reserve risk*, *catastrophe risk*, *lapse risk*. The premium and reserve risk represents the risk of loss or adverse changes in the value of insurance liabilities resulting from: fluctuations in the timing or frequency or severity (or a combination of the three) of insured events as well as in the timing and amount of claim settlements. Catastrophe risk relates to the high level of uncertainty associated to pricing and provisioning assumptions related to irregular, extreme or exceptional events. Lapse risk, instead, relates to changes in the level or volatility in the rates of policy lapses, terminations, renewals and surrenders.

The technical insurance risk related to life business reflects the risk arising from life insurance obligations, in relation to the perils covered and the processes used in the conduct of businesses. The related module is given by the combination of *mortality*, *longevity*, *disability/morbidity*, *lapse*, *expenses*, *revision*, *catastrophe risks*. Mortality risk, longevity risk and morbidity risk are the risks of loss or adverse change in the value of insurance liabilities due to changes in the level, trend or volatility of mortality and morbidity rates, where an increase of the mortality rate, a decrease of the mortality rate and an increase in the disability rate, respectively, lead to an increase of insurance liabilities. Life expense risk is the risk associated to changes in the level, trend or volatility of the expenses incurred in servicing insurance and reinsurance contracts. Revision risk, instead, is the risk of loss or adverse change in the value of insurance liabilities resulting from fluctuations in the level, trend or volatility of the revision rates applied to annuities, due to changes in the regulatory environment or in the state of health of the insured person. Lapse and catastrophe risk have been defined above.

The **health underwriting risk** is the risk arising from health insurance obligations, whether or not it is pursued on a technical basis similar to life insurance, following both the events covered and the business processes followed. The related model should include at least the *health expenses risk*, the *premium and reserve risk* and the *catastrophe risk*. [173]

[173] Il Mulino Strumenti - Andenas, Mads; Avesani, Renzo G.; Manes, Paola; Vella, Francesco; Wood, Philip R. - "*Solvency II: A Dynamic Challenge for the Insurance Market*" - 2016

Conclusions

In the course of this dissertation, an analysis has been carried out about the regulatory, institutional and market-based initiatives taken at European level with the view of enhancing the access of insurance companies to infrastructure investments and of limiting the impact of the factors that are likely to prevent the demand and the supply for infrastructure assets to meet, with a specific referral to the European economy. Two sets of regulatory barriers have been pointed out, namely technical and regulatory limits to long-term investments. For each of these, the main solutions proposed by the European Institutions, represented by the European Investment Bank and the European Commission, have been scrutinized. The Juncker Plan, born with the objective of raising €315 billion of additional long-term investments in all European Member States, and the recent amendments to the insurance companies' Solvency II prudential regulation to include the category of qualifying infrastructure debt and equity investments in the market risk module of the standard formula, have indeed represented important and significantly effective steps that the European Union has taken toward the objective of closing its infrastructure gap. In addition, other smaller public and private initiatives have been analyzed, including the European Investment Bank's Infrastructure Aggregation Platform (not yet launched), the International Finance Corporation's Managed Co-Landing Portfolio Platform and the UBS Archmore Infrastructure Debt Platform. These initiatives share the goal of enabling small and medium-sized insurance companies to better and easier access high-quality low-risk infrastructure debt investments.

In Chapter 1, infrastructure works have been described as long-lived structures and facilities that are crucial to enable the provision of essential services to communities and to spur their socio-economic development. The undeniable desirability of providing each country with a qualitatively and quantitatively adequate infrastructure system has been explained on the light of the need to enable basic human needs to be met and to create socio-economic environments that are propaedeutic to the pursuance of the self-actualization of each individual. The contribution of infrastructure to sustainable development and the current status of each of the World countries' infrastructure endowments have also deserved a brief treatise in that context. The infrastructure sectors have been sub-divided in social industries (e.g. education, health), utilities (e.g. transmission and distribution of electricity, gas, water; waste management), economic sectors (e.g. telecommunications, transports) and scrutinized one by one. Provided that virtually all these sectors are characterized by monopolistic or oligopolistic structures, regulatory schemes that authorities may employ to safeguard the public interest with respect to poor competition in infrastructure sectors, including rate-of-return regulation and price-cap regulation, have been described. Then, the infrastructure gap, at both global and European level, has

been introduced and quantified. It has been said to amount to around $1000 billion a year and to depend on the progressive withdrawal of the public sector from infrastructure financing and ownership and on several types of investment barriers that prevent private investors from allocating enough capital to this investment category. Specifically, it has been stressed that the infrastructure gap is not a matter of capital shortage but rather it depends on the lack on suitable investment opportunities and vehicles. The Chapter 1 has concluded with the fundamental consideration that boosting infrastructure investments in Europe may represent a radical solution to fix the structural deficiencies that affect the European economy causing low growth and unemployment, as a consequence of the long underinvestment pattern began already fifty years ago.

In Chapter 2, infrastructure assets have been defined as a set of heterogeneous long-term capital-intensive alternative investments carrying several elements of interest for different types of investors. The potential advantages and disadvantages of investing in infrastructure have been listed. In particular, the possibility to gain a straight and predictable long-term stream of revenues, backed by low demand inelasticity and protection from inflation, has been mentioned among the important advantages that infrastructure investments are likely to bring about, together with an excellent capacity to complement traditional assets in a diversified portfolio and provide attractive risk-adjusted yields, particularly appealing in the current macroeconomic environment characterized by very low interest rates. Among disadvantages, instead, low liquidity, complexity, high upfront costs and severe and frequent lacks of data have been included. Along the chapter, after an overview of the methods and tools for infrastructure financing, the elements that concretely determine the risk-return profile of infrastructure assets have been listed and scrutinized. In particular, infrastructure assets have been sub-divided, according to a growing level of risk and return, in core, value-added and opportunistic assets. Core infrastructure assets are located in geographical areas where the political, legal and regulatory framework is developed, transparent and predictable, and are backed up by a contractual framework tending to ensure both the supply of inputs and the possibility to sell outputs over a long period of time, as well as limiting market risks borne by the infrastructure company or entity. Also the industrial sector of referral has been considered. In particular, the contribution of public entities in making an infrastructure company's or entity's revenues stable and predictable, like in the case of social infrastructures and regulated utilities, has been emphasized as an important risk reducer, whereas the telecommunications and transport sectors have been indicated as allegedly riskier, to the extent to which they rely on market-based competitive dynamics and bear full demand risk.

Life insurance companies and pension funds, as representatives of the broader category of institutional investors, have been identified as a possible remedy to the scarce flow of infrastructure investments clogging World countries, especially in Europe. These financial players are indeed

interested in matching their long-term foreseeable liabilities with suitable long-term assets for matching purposes. The exposures they seek resemble traditional conservatively-structured long-term fixed-income instruments like sovereign and investment-grade corporate bonds. Hence, they are likely to be willing to increase their exposure toward alternative real investments, including core infrastructure investments. In exchange, they are available to withstand the very low level of liquidity they exhibit, in force of their tendency to hold assets to maturity. Institutional investors have been said to target especially indirect investments in infrastructure assets, performed through listed and unlisted infrastructure funds, in force of the noticeable capital and managerial requirements associated to direct equity participations and loans to infrastructure companies or entities.

A treatise about the European insurance industry has opened Chapter 3, where European insurers have been presented as the main institutional investors in Europe, with a total stock of assets under management worth around €10.000 billion, expected to increase at an 8% rate over next five years. Aware of the interest that insurance companies have shown for gathering further access to infrastructure investments and of their huge investing potential, the treatise has focused on the investing barriers that may be preventing the full expression of insurers' potential for infrastructure funding. Two sets of barriers have been identified: technical barriers and regulatory barriers. While technical barriers represent undesirable elements to be removed, to the extent it is possible, regulations are indeed necessary to preserve the stability of financial systems and the interests of financial institutions' customers, investors and other stakeholders. Nonetheless, if regulatory provisions are badly designed, they will not be able to induce a sound trade-off between that need and the need of financial players not to be overwhelmed by excessive rules limiting their ability to pursue strategies that are fully consistent with their internal characteristics and the features of the environment of referral. On the light of this consideration, the objective of assessing the impact of the prudential framework for insurance companies currently adopted in Europe, over insurance companies' investments in infrastructure, finds its *raison d'être*. The rules determining limits on institutional investors' asset allocation have been sub-divided in quantitative, qualitative and risk-based provisions, with the last representing an evolution and a sound synthesis of the first two. The Solvency II regulation has been introduced as a typical modern risk-based prudential regulation framework. Its three-pillar structure has been described, together with the main quantitative and qualitative principles it is based on. In the following core part of this dissertation, the treatment of infrastructure investments under the Solvency II framework has been analyzed. First, each sub-module of the standard formula market risk module has been scrutinized, with a particular focus on the interest rate risk, spread risk and equity risk sub-modules, being these the determinants of infrastructure investments-related Solvency Capital Requirement. In that context, their actual impact on the

treatment of infrastructure exposures has been described. Then, the sub-division between qualifying and non-qualifying investments in infrastructure assets, introduced by the amendments to the EU Delegated Regulation 2015/35 included in EU Delegated Regulation 2016/467 and EU Delegated Regulation 2017/1452, has been explained through a conjunct analysis of the regulation and the two amendments in question. The qualitative and disclosure requirements regarding qualifying infrastructure investments under Solvency II have also been described. In particular, the analysis has focused on the "look-through" approach, requiring regulated insurance companies to disclose a significant amount of data when applying for the facilitated treatment of qualifying infrastructure assets. The dissertation has concluded with the description of some recently launched institutional or market-based initiatives having the effect to facilitate the access of insurance companies to either qualifying infrastructure investments and to the set of data they need to access the related preferred treatment. These have included the European Investment Bank Infrastructure Aggregation Platform, the International Finance Corporation Managed Co-Lending Portfolio Program, the UBS Archmore Infrastructure Debt Fund.

From the analysis of the treatment of qualifying infrastructure investments under the Solvency II regulation, it is evident how the European Commission has reacted fast and soundly to a challenge that was actually threatening to impair the insurance companies' ability to convey financial resources toward infrastructure investments. Indeed, at the very begin of the Solvency II era, the regulation in question used to treat infrastructure equity and debt as any traditional equities and debt investments, without making any difference between core and opportunistic infrastructure assets. Besides potentially jeopardizing the interest of insurance companies to deploy resources toward infrastructure assets, hence, the theoretical structure on which the regulation is based was neglecting an undeniable element of reality, namely the impressive heterogeneity existing among infrastructure assets.

Rules can be the consequence of the development of markets that spontaneously transform themselves until requiring the regulator's intervention to pursue general interest objectives. They can as well represent a useful political instrument, being itself the propellant for the expected changes. In most cases, though, rules mirror the specific material circumstances of economic sectors, progressively evolving as long as they do so. Under this perspective, rules need to represent each time a sound compromise between the current situation and the exigencies of change imposed by medium-term circumstances and pursued goals. [174]

[174] LUISS Business School & ASTRID - Merola, Federico; Caroli, Matteo; Iaione, Christian; Fersini, Paola - "*Le casse di previdenza tra autonomia e responsabilità. I professionisti, il risparmio, l'economia reale*" – 2017

Consistently, the European Commission, through the amendments to the Solvency II frameworks, has responded to inputs provided by practitioners, scholars and institutions, including the European Insurance and Occupational Pensions Authority, which were all agreeing about the necessity to recognize the existence of qualifying infrastructure investments and to grant them a significantly facilitated treatment under the standard formula for the computation of the Solvency Capital Requirement.

While the requirements laid down in Articles 164a and 164b for the identification of qualifying infrastructure investments have appeared as bulky and restrictive to insurance companies, in a first moment, they can be summarized in a few points. To apply for the preferred treatment dedicated to qualifying investments in infrastructure entities and companies, indeed, investment opportunities have to:

- Be located in OECD or EEA countries
- Be expected to produce stable and foreseeable cash flows over time, so that the likelihood of investors' claims to be met is maximized
- Be backed up by contractual structures oriented toward the protection of investors, especially debt-holders, where significant guarantees are in place to ensure that their claims are eventually met
- Be characterized by low demand risk, technological risk, counterparty risk, construction risk, operational risk
- Be brownfield investments or greenfield investments backed by substantial guarantees

Read under this light, the definition of qualifying infrastructure investments included in the Solvency II framework and the definition of core infrastructure assets appear to completely overlap. This set of characteristics describe the high-quality low-risk infrastructure investments that insurance companies are actually looking for to improve the diversification of their portfolios, earn higher yields and matching their long-term liabilities. Regulation does nothing but accommodating the strategies of long-term investors in infrastructure assets, by granting them a preferred treatment mirroring the high-quality of their investments. In addition, while still drawing precise boundaries to the category of core infrastructure assets, the criteria laid down are not expected to emerge as extremely selective, as they include virtually all infrastructure project finance deals and most infrastructure companies, without even excluding greenfield assets and unrated entities. In a sense, here, the market has determined the behavior of regulators rather than the opposite. The facilitated treatment is expected to further enhance the interest of insurers for core infrastructure and let the European economy hope for a valuable contribution in its almost complete, though slow, recovery from the recent period of financial and economic crisis.

Investment limits are likely to apply to purely opportunistic infrastructure assets only. This does not produce any inconsistency with respect to the objectives of Solvency II, given that prudential regulation does exist to dissuade insurance companies from taking on an excessive amount of risk. Insurance companies, especially life insurance companies, are not even likely to target short-term speculative investments opportunities carrying expectations about J-curved profits and significant appreciation of the capital invested.

What should be done now, is focusing on the technical barriers that still prevent many investors to access the market and commit financial resources toward infrastructure, including slow and excessive bureaucracy, corruption, bad planning. During last years, the European market has benefitted from abundant liquidity that could not have been opportunely conveyed toward strategically important investments because of the lack of a clear and straightforward planning. Said planning has in turn lacked because of insufficient institutional support. If this scenario does not change, also the amendments to the Solvency II framework are expected to generate unsatisfying improvements. If governments do not develop new financing models to trigger the realization of new big projects, private actors will not be able to benefit from abundant liquidity and low interest rates. The Juncker Plan has provided an extremely valuable contribution in this sense, but much has still to be done also at national level. Italy, as a case in point, still misses a real national infrastructure project pipeline like the one that has been recently developed in UK. In addition, there is not a unique public institution that is responsible for the planning of infrastructure interventions and that can fast grant or deny the authorization for an infrastructure intervention to be undertaken. Often, conflicts arise between regional and national public authorities, and many times the solution of consequent controversies is put in charge of administrative tribunals, allegedly well-equipped to manage judicial cases but not as much equipped to deal with the complex task of assessing the feasibility of complex infrastructure project and their economic convenience. Politically induced misallocation of resources, frequent cases of corruption and shameful approval times requirements threaten to widen the infrastructure gap of our country, especially in the South, where it is already more acute.

To overcome technical barriers, as well as the inner complexities of investing in infrastructure assets, a more and more important role is expected to be played by purposely designed initiatives to leverage private investors' capital with the expertise, due diligence and processes of reliable market-based and institutional actors like the European Central Bank and other important development institutions.

The number of yearly infrastructure deals in the World is slowly increasing, year after year, with special reference to the sector of renewable sources of energy. The deployed financial resources are growing as well, at a faster pace than the number of deals, indicating that plentiful capital resources is still available to accommodate further increases in the number of new infrastructure deals. If European countries succeed in removing long-term investment barriers, an encouraging improvement in the current stock of their infrastructure endowments will be seen, together with all the benefits that infrastructure brings about to the people of today and to those who will come in the future.

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Degree Examination Summary

How Solvency II supports infrastructure investments:
A tighter connection between insurance companies and the real economy.

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ACADEMIC YEAR 2016-2017

Abstract [1]

The herein dissertation deals with the regulatory, institutional and market-based initiatives taken at European level with the view of enhancing the access of insurance companies to infrastructure investments and of limiting the impact of the factors that are likely to prevent the demand and the supply for infrastructure assets to meet, with a specific referral to the European economy. Two sets of regulatory barriers are pointed out, namely technical and regulatory limits to long-term investments. To address these barriers, the main solutions proposed by the European Institutions and market-based players. The amendments to the insurance companies' Solvency II prudential regulation to include the category of qualifying infrastructure debt and equity investments in the market risk module of the standard formula are discussed in their essence of important and significantly effective steps that the European Union has taken toward the objective of closing its infrastructure gap. In addition, other smaller scale public and private initiatives are scrutinized, including the European Investment Bank's Infrastructure Aggregation Platform (not yet launched), the International Finance Corporation's Managed Co-Landing Portfolio Platform and the UBS Archmore Infrastructure Debt Platform. These initiatives share the goal of enabling small and medium-sized insurance companies to better and easier access high-quality low-risk infrastructure debt investments.

[1] Adapted for the Degree Examination Summary. For the full abstract, please refer to the full version of the thesis.

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Infrastructure and socio-economic development

Infrastructure is whatever physical structure, network or facility that is essential for the provision of crucial services to peoples and communities, including but not limited to mobility, telecommunications, education, healthcare, supply of energy and water, waste management. Modern infrastructure includes highways, canals, ports and airports; phone towers and broadband networks; water conduits, gas pipelines, electric transmission and distribution systems; schools and universities; hospitals and clinics; public parks, administrative buildings, firefighters' headquarters, dams. One of the most important measures of state leaders' achievements can be represented by the level and type of infrastructural development they engage in compared to the agitation of the people and the available resources. Causality runs both ways between economic growth and infrastructure investments, with the former reacting more than proportionally to increases of the latter. For this reason, most prosperous countries are the ones that exhibit most quantitatively and qualitatively adequate infrastructure stocks. Adequate infrastructure systems facilitate socio-economic exchanges and business activities, widening the scope of possible production and consumption patterns, improving input factors' productivity and reducing their cost. They create employment, stimulate welfare, confer vitality to cities and communities. They are also crucial to enable the introduction and diffusion of sustainable production and consumption schemes and are a core instrument for the pursuance of the United Nations 2030 Sustainable Development Goals. Inadequate infrastructure systems, instead, slow and even reverse economic growth, driving unemployment, crime, and urban decay.

The infrastructure gap

Demand for infrastructure works to face the challenges that the XXI century is bringing about, including the call for sustainable development, is expected to be as sizeable as never in the history of humanity and the issue is constantly included in the agendas of global policymakers. Among its drivers, it is possible to list demographic trends, the rise of the middle class of consumers, migration flows from rural areas to cities and between countries, the advent of the digital revolution. *I*nfrastructure needs are gigantic if compared with the projected increase in the World population from now to one century to come and with the new multifaceted needs that will emerge as a consequence of increasing mobility and enhanced education. In addition, significant infrastructure investments have to be carried out to address the necessity of raising 800 million people from extreme poverty conditions.

In order to accommodate the projected growth of the World GDP, a $3.300 annual amount is to be invested in infrastructure assets, from now to 2030. This amount should be spent for the construction or upgrading of energy (30%), telecom (17%), transport (38%) and water (17%)

infrastructure facilities. Most of the demand for greenfield infrastructure investments comes from underdeveloped and emerging countries, while OECD countries mainly demand maintenance and upgrading of their existing infrastructure works. During the last decade, anyway, the World has invested around $2.500 billion a year in infrastructures, subdivided among the energy (30%), telecom (16%), transport (46%) and water (8%) industries. Hence, each year, the World falls short of infrastructure investments for almost $1.000 billion. The estimated gap grows threefold if the need to pursue the UN 2030 Sustainable Development Goals is accounted for.

Infrastructure shortages in Europe

The European Economic Area faces roughly one third of the global infrastructure gap. More than 30% of this backlog relates to the energy infrastructure investments that are needed to guarantee an adequate supply of energy to the European Union, modernize distribution networks and improve energy efficiency for industrial use. Telecom infrastructure, instead, accounts for 19% of the gap, as improved data capacity and enhanced cyber-security are needed. The lasting portion of the gap is represented by transport and logistics (24%), water and waste management infrastructure (27%).

It is important to identify and fix the long term investment barriers that have dug the European infrastructure gap, as it can represent a valuable contribution in supporting the economy of the European Union, especially Southern countries, to overcome the long period of low investments, scarce productivity and high unemployment.

The dwindling public contribution to infrastructure financing

Traditionally, governments have been the primary financers, owners and operators of infrastructure assets and companies, given their essence of public goods and the noticeable positive externalities they are likely to bring about. Nonetheless, from 1960s onward, governments have been progressively forced to cut on long term expenses and to withdraw from infrastructure industries, because of the overwhelmingly increasing cost of the welfare state, enhanced by the trends of ageing population. The situation has also been significantly exacerbated by politically induced misallocation and dissipation of resources. The 2007-2008 financial crisis, before, and the 2011 sovereign issuers crisis, after, have revealed the unsustainability of the public spending models adopted since then, which have caused European countries' public debt-to-GDP and public deficit-to-GDP ratios to soar. After the crises, countries belonging to the European Economic Area, have found themselves in the impossibility of inflation spending, having ceded the responsibility over the monetary policy to the European Central Bank, while austerity policies imposed by the Union have prevented them from taking excessive new debt or further deficit spending. Against this background, national policymakers have often preferred

to defer expenses related to infrastructure building and maintenance rather than cutting on existing services, in order to mitigate dissatisfaction and avoid excessive losses of political consensus.

Private infrastructure financers

Both the global stock of infrastructure assets and the yearly flow of investments toward the asset class, to date, appear insufficient to address both short-term and long-term needs of countries, peoples and businesses. While demand for infrastructure is still partially unmet, there is a correspondent abundance of private capital that could be potentially employed to compensate the dwindling public contribution for infrastructure investments. Several private sector players are expected to increase the importance of infrastructure investments in their asset allocation strategies, assuming that they have access to infrastructure investments that do meet their investment needs. Institutional investors are financial players pooling large amounts of money to invest in securities, properties and other investments. They include insurance companies, pension funds, investment advisors and mutual funds and represent an increasingly important group of investors in infrastructure, because of their growing interest for alternative investments in the real economy, characterized by high productivity and hence able to generate long-term stable and predictable cash flows. Institutional investors are gaining increasing importance in global financial markets and their stock of capital under management has soared. In OECD countries, by the end of 2010, they were managing assets for a value of as much as $75.000 billion, subdivided among pension funds ($20.400 billion), insurance companies ($24.300 billion) and other investment companies ($28.800 billion). By 2012, this value had already achieved $97.000 billion. Hence, they are expected to partly offset the reduction in the flow of bank loans to infrastructure companies and entities, induced by the banks deleveraging process that has been triggered by the financial crises and by the consequent introduction of the banking sector prudential framework Basel III.

Infrastructure as an asset class

Most investors in infrastructures consider it as a separate asset class mixing together some characteristics of fixed income investments, real estate and private equities. The asset class in question belongs to the grouping of alternative asset classes, whose importance has soared in the last decade, because of their attractive returns, their tight bound with the real economy and their low correlation with other asset classes.

Infrastructure investments can be carried out in the form of either direct or indirect equity and debt investments. Underlying infrastructure projects or companies can be either private or listed on pubic markets. Direct investments require significant financial and managerial resources from investors

but involve tighter bonds with the investee entities. They are the least common way to invest in infrastructure, while the recourse to listed and unlisted funds, pooling financial resources from various market players and leveraging them through their expertise and market access, is the most common investment route. While infrastructure projects are typically undertaken under balance sheet finance schemes, project finance technique are increasingly employed for infrastructure deals characterized by high specificity, low re-deployable value and high capital intensity, where the public sector acts as either regulator or counterparty. Recently, co-investment platforms for the leveraging of institutional investors' capital in project finance have been developed and spread.

Stylized economic characteristics of infrastructure assets include high barriers to entry, high fixed and low variable costs generating economies of scale, inelastic demand for services and consequent pricing power, low operating costs with high target operating margins and long duration. As a consequence, the value proposition for infrastructure as an asset class is about capturing advantages like attractive risk-adjusted returns, low correlation with the short-term swings of the economic cycle, low correlation of returns with respect to other asset classes, long-term stable and predictable cash flows, good inflation hedge, low default rates and a natural fit with long lasting inflation-linked pension liabilities. In addition, the investment in infrastructure is usually deemed to be socially and environmentally responsive.

In contraposition with expected benefits, infrastructure projects also carry some elements that deserve attention and awareness from investors. Capital intensity, high upfront costs, poor liquidity and a long investment horizon, in combination, translate into significant requirements in terms of both financial and managerial resources. Often, the information required by investors to assess single infrastructure projects and the infrastructure market in general is lacking or highly scattered, creating uncertainty.

While all infrastructure assets are characterized by capital intensity, long economic and physical life and support in the provision of essential services, the assets encompassed in the class are extremely heterogeneous and can differ according to multiple country-based, industry-based and asset-based elements. Hence, also their ability to provide expected benefits is noticeably variable. The size, sector, life stage, financial structure and contractual arrangement of infrastructure investments are the main determinants of their risk return profiles. The grouping of infrastructure assets that are likely to grant investors all the listed benefits is the sub-class of core infrastructure investments, as opposed to value added and opportunistic infrastructure investments. Core infrastructure assets can include bridges, tunnels, toll roads, pipelines, facilities for the transportation and distribution of energy, waste and wastewater management systems. Value-added infrastructure may encompass airports and seaports,

railways, contracted power generation. Finally, development projects, non-OECD exposures, satellite networks and merchant power generation can be considered as opportunistic investments, whose risk is significantly higher in exchange for the expectation of robust capital gains in case of success.

Core infrastructure assets are revenue generating brownfield works and are mostly located in OECD countries. Related operations are based on reliable well-known technologies in mature sectors and face reduced demand and supply risk. In exchange for low risk, core infrastructure return is lower, showing GDP-level increases in the value of the underlying asset but granting investors stable periodic cash flows. Core infrastructure assets are found in mature markets for essential services where demand is inelastic and often enjoy a monopolistic position, screened by natural, contractual and/or regulatory entry barriers. Their return tends to be insensitive to periods of economic weakness.

European insurers' investments in infrastructure assets

There is spread consensus about the positive correlation between the development of the financial sector and economic growth. Insurance companies offer an important contribution to the economic development, as they are expected to facilitate economic transactions through the allocation and indemnification of risks, encourage risk management and the promotion of safe practices, stimulate a healthy and sustainable level of saving and pension provisions. In addition, insurance companies, especially life insurers, are an important source of long-term investments.

Insurance companies are the main institutional investors in Europe, with almost €10.000 billion of assets under management, expected to grow by an 8% annual rate in the next five years. They invest roughly 50% of their assets in loans and bonds and another 30% in investment funds. Most insurers targeting infrastructure assets invest in unlisted infrastructure funds managed by external advisors. Otherwise, they target direct investments in special purpose vehicles and investments in listed infrastructure funds. By 2014, only the 0,3% of European insurers' capital was committed to infrastructure investments, namely €22 billion. This amount is expected to increase, both in relative and absolute terms. European insurance companies are indeed increasingly interested in gaining exposure to core infrastructure investments, because of their long duration, which fits well in their asset allocation strategies, coupled with the potential to earn foreseeable streams of cash flows, whose stability is enhanced by regulatory or contractual mechanisms of inflation hedging and by low correlation with both other asset classes and the whole market. Insurance companies tend to target mature brownfield investments in infrastructure, as these projects are free from the broad set of typical pre-construction risks. They are also well equipped to deal with low liquidity of infrastructure investments, as they are prone to hold them to maturity. In addition, the associated liquidity risk

premium can represent a very valuable source of additional income in the current environment characterized by very low returns.

Barriers to infrastructure investments

The first major set of investment barriers for insurance companies is represented by the lack of adequate investment opportunities and by reduced access to infrastructure markets. Private investors claim the existence of sustainable pipelines of infrastructure projects so that the target initiatives represent a part of a coherent long-term investment strategy. Still, many countries often miss sufficient long-term plans for infrastructure projects. In addition, projects have to be bankable, meaning that investors expect them to be supported by enough up to date, reliable, wide-ranging information and analysis. In order to reduce information asymmetries and threats of adverse selection, investors and lenders require evidence of a project's financial, social, economic, technical, environmental and administrative feasibility before committing resources to their own due diligence assessments. The specific goals and sub-goals of a project must be clearly defined and measurable from the onset. Again, once a project feasibility has been ascertained, the actual involvement of resources to infrastructure investments is subordinated to the existence of suitable financial instruments and vehicles, whose features should be consistent with the characteristics and strategies of potential investors. This first set of barriers also includes technical limitations arising from poor knowledge and experience about investments in infrastructure, exacerbating investors' perspective about the riskiness of concerned deals.

The second major set of investment barriers include regulatory constraints. A well-structured financial system, composed by adequately capitalized actors, is an unquestioned desirable outcome and appropriate forms of financial regulation are useful to minimize the likelihood of events that can generate significant negative spillovers over the whole financial, economic and social system. In particular, prudential regulation is set up to ensure that funds collected by insurance companies are managed prudently enough to preserve the interest of policyholders and beneficiaries, rather than convey toward opportunistic investments that are likely to expose policyholders' savings to excessive risks. While the merit of this goal is unlikely to get questioned, the concrete way it is pursued represents a core issue and has been strongly debated. Regulation is the second most important element of influence for insurance companies in Europe, superseded only by the very low level of interest rates.

The Solvency II framework

Solvency II is a European prudential framework for insurance companies, representing a complex integrated set of risk-based rules aimed at ensuring the stability of the insurance industry and to guarantee that the insurance and reinsurance businesses are pursued in a prudent manner, for the best protection of policyholders and beneficiaries. Its overall structure is consistent with the risk-based prudential frameworks found in most countries worldwide. These frameworks all contemplate the prudent person principle as an essential component. According to it, most hard restriction on insurance companies' investments are removed and are substituted by a structure imposing companies a thorough reflection about all the risks actually taken and requiring them to set up all the possible safeguards to minimize the likelihood of dramatic events. Hence, risk management and corporate governance are, in a sense, the protagonists of the Solvency II framework. Solvency II contemplates an economic vision of insurers' balance sheets and sets up rules aimed at realistically representing the risks borne by regulated entities, including a principle of proportionality and several measures to mitigate possible pro-cyclical side effects.

The Solvency II system is embodied in the EU Directive 2009/138, (Solvency II Framework Directive) and has entered into force as of January 1st 2016. Analogously to the bank supervisory regulation Basel III, it is based on a three-pillar integrated structure. The first pillar is about *risk quantification* and contains the rules guiding insurance companies in the determination of both the Solvency Capital Requirement and the Minimum Capital Requirement. It also includes indications about how to evaluate assets and liabilities, according to market-consistent principles. Further, it contains the criteria for the determination of own funds and their eligibility for capital requirements coverage. The second pillar, instead, includes norms about *risk management and corporate governance*. The provisions there contained widen the scope of covered risks beyond the sole risks covered by the first pillar. All the risks borne by the company have to be evaluated under a perspective light by the management, in the context of a procedure called Own Risk and Solvency Assessment, whose outcome, if not satisfying, can induce Supervisors to charge capital add-ons on regulated companies. The third pillar is the pillar of transparency and *information disclosure* and determines the nature and quantity of information that the company has to disclose to supervisors, markets and stakeholders.

The Pillar 1 encompasses the risk-based quantitative requirements proposed by the European legislator to impose an adequate level of capitalization to insurance and reinsurance firms. Therein, several sources of risk are identified. Many of them contribute to constitute the risk-sensitive capital

requirements while some others are no or not completely quantifiable. Quantifiable risks are: 1) *non-life underwriting risk*; 2) *life underwriting risk*; 3) *health underwriting risk*; 4) *market risk*; 5) *credit risk*; 6) *operational risk*. Regulated companies are required to hold a given quantity of own resources, determined by the nature and degree of risks taken, to face the risks associated to their operations and each of their investments. Quantitative requirements are the Solvency Capital Requirement and the Minimum Capital Requirement. The Solvency Capital Requirement is the amount of capital that an insurance or reinsurance company needs to hold in order to have a 99,5% probability to withstand extreme events affecting at the same time all the elements of their balance sheets exposed to risks taken, according to a one-year Value at Risk horizon. Hence, the SCR can be defined as the maximum yearly loss that a company may suffer in all cases, exception made for one year each 200, or as the difference between its base case own capital and its stressed own capital. The Minimum Capital Requirement, instead, is a variable portion of the SCR and represents the capital threshold below which the company is deemed to be exposed to an unacceptable degree of risk for itself and its policyholders, hence requiring the intervention of Supervisors. A prolonged noncompliance can trigger the termination of the regulated entity's activities.

While Solvency II does not rule out the possibility to partially or totally employ internally designed models for the computation of the Solvency Capital Requirement of regulated insurance companies, it also provides a standardized formula that can be straightforwardly applied by insurance companies and has the benefit of a relative simplicity and cost-effectiveness, but is based on certain assumptions that may or may not realistically represent the features of each regulated company. The more the risk profile of the single regulated entity differs from the assumptions lied in the standard formula, the more it has the incentive to utilize internally designed models.

According to the standard formula, the overall SCR of an insurance or reinsurance company is computed as a linear combination of three building blocks: the Base Solvency Capital Requirement, the Operational risk SCR and some adjustment factors. The Base Solvency Capital Requirement is computed through the so-called square root formula and is a linear combination of the Solvency Capital Requirements associated to the standard formula sub-modules referring to market, health, default, life, non-life, intangible risks. The formula considers the correlation factors among different risk factors, to account for the benefits brought about by diversification in the balance sheets of insurers. The correlation matrix is provided by the regulator. The Solvency Capital Requirement for the operational risk is considered as a separate addendum of the formula and accounts for all the sources of operational risk that are not included in the other risk modules. The adjustment factors, instead,

account for the loss absorbing capacity of technical provisions and deferred taxes and reflects the partial compensation of unexpected losses by a simultaneous decrease of one or both of them.

The treatment of infrastructure investments under Solvency II

The market risk module of the standard formula is the referring element of the Solvency II regulation for what concerns the effects of insurance companies' investments in infrastructure assets on their Solvency Capital Requirement. In particular, infrastructure debt investments contribute to the formation of the SCR for the interest rate risk and the spread risk market sub-modules, while infrastructure equity investments are regulated by the equity risk sub-module.

The *interest rate risk* is the risk that the value of an asset or liability changes due to a change in the term structure of interest rates or interest rate volatility. It is computed by evaluating the consequence of a shock consisting of either a sudden increase s^{up} or a sudden decrease s^{down} of basic risk-free interest rates for each currency at different maturities. The capital requirement for the interest rate risk is the largest between the capital requirements relative to the increase and the decrease in the term structure of interest rates, over all currencies. It covers the discrepancy between the "base case" and the shocked present value of each debt investment.

The *spread risk* is the risk that arises from the sensitivity of the value of assets and liabilities to changes in the level or in the volatility of credit spreads over the risk-free interest rate term structure. The capital charge for bonds and loans is proportional to their market value and to a risk factor based on the Macaulay duration and the credit quality of concerned assets. The nature of issuers and the presence of collateral can impact the risk factor stress.

$$SCR_{spread}^{bonds} = \max(\Delta NAV \mid spread\ shock; 0) = max(MV * stress(rating, duration); 0)$$

$$\text{where } stress_i = a_i + b_i * (dur_i - K)$$

Parameters a_i and b_i depend on the credit assessment of an External Credit Assessment Institution, if available. The value K depends on the Macaulay duration of the asset. The regulator provides some tables for the identification of the value of these parameters according to the characteristics of each investment. For some specific high-quality investments, the regulator provides differentiated tables determining a favored treatment.

The *equity risk* is the risk that the value of assets or liabilities changes due to fluctuations in the level or volatility of the market price for equities. The original formulation of the equity risk sub-module of the market risk module provided two types of equities: type 1 and type 2. *Type 1 equities* are equities listed in regulated markets in OECD or EEA countries, including also Multilateral Trading Facilities whose registered office or head office is in EU Member States. They also encompass capital

instruments held by certain collective investment institutions. *Type 2 equities* are equities listed only in emerging markets, unlisted equities, hedge funds and any other equity investments not included elsewhere in the market risk module. The applied shock consists in a sudden decrease of the market value of equities held, whose size depends on the type of equity.

Qualifying infrastructure investments

According to the Solvency II regulation, infrastructure assets are defined as physical assets, structures or facilities, systems and networks that provide or support essential public services, while an infrastructure entity is an entity or corporate group which, during the most recent financial year of that entity or group for which figures are available or in a financing proposal, derives the substantial majority of its revenues from owning, financing, developing or operating infrastructure assets.

On the basis of the strong impulses arising from scholars, practitioners and industry representatives, the European Commission has amended the Solvency II framework introducing the categories of qualifying debt and equity investments in infrastructure entities and companies. In order to be eligible for the associated favored treatment, infrastructure investments need to fulfil certain criteria. In particular:

1. The reliability of associated cash flows has to be demonstrated through repeated stress tests concerning all the relevant exogenous and endogenous variables
2. Cash flows generated have to be predictable
3. The deal has to be backed up by a regulatory or contractual framework providing a high degree of protection for investors and lenders
4. The company or entity has set up significant reserves to buffer against unforeseen events and to finance the project's working capital
5. The regulated company has to demonstrate that it is able to hold debt investments to maturity
6. Significant guarantees have to be set up for debt providers, including restrictions on alternative uses of cash flows available for debt servicing and restrictions on activities that may be detrimental to debt providers
7. If a target infrastructure entity or company has received a credit evaluation from an External Credit Assessment Institution, this has to range between Credit Quality Steps 0 and 3
8. In case of debt investment in infrastructure projects or companies lacking a credit assessment from an External Credit Assessment Institution, debt capital provided has to be senior to all other claims other than statutory claims and claims from liquidity facility providers, trustees and derivatives counterparties

9. In case of equity and debt investment in infrastructure projects or companies lacking a credit assessment from an External Credit Assessment Institution, they have to fulfill certain additional criteria, including
    a. EEA or OECD location (low country risk)
    b. No or mitigated construction risks
    c. Properly managed operational risks
    d. Low technological risk
    e. A capital structure allowing debt servicing
    f. Low refinancing risk
    g. Use of derivatives limited to hedging purposes

Qualifying infrastructure investments enjoy significant reductions in the capital requirements charged according to the standard formula equity and spread risk sub-modules, as reduced equity shocks and lower stress factors for the computation of the spread risk Solvency requirement apply. The reduction in question can represent as much as 25% of the overall capital requirement that a regulated company should set up for non-qualifying infrastructure assets.

Credit Quality Step		0		1		2		3		4		5-6	
dur_i	$stress_i$	a_i	b_i	a_i	b_i	a_i	b_i	a_i	b_i	a_i	b_i	a_i	b_i
≤ 5	b_i*dur_i	/	0,9%	/	1,1%	/	1,4%	/	2,5%	/	4,5%	/	7,5%
> 5 ; ≤ 10	$a_i+b_i*(dur_i-5)$	4,5%	0,5%	5,5%	0,6%	7,0%	0,7%	12,5%	1,5%	22,5%	2,5%	37,5%	4,2%
> 10 ; ≤ 15	$a_i+b_i*(dur_i-10)$	7,0%	0,5%	8,5%	0,5%	10,5%	0,5%	20,0%	1,0%	35,0%	1,8%	58,5%	0,5%
> 15 ; ≤ 20	$a_i+b_i*(dur_i-15)$	9,5%	0,5%	11,0%	0,5%	13,0%	0,5%	25,0%	1,0%	44,0%	0,5%	61,0%	0,5%
> 20	$\min(a_i+b_i*(dur_i-20);1)$	12,0%	0,5%	13,5%	0,5%	15,5%	0,5%	30,0%	0,5%	46,6%	0,5%	63,5%	0,5%

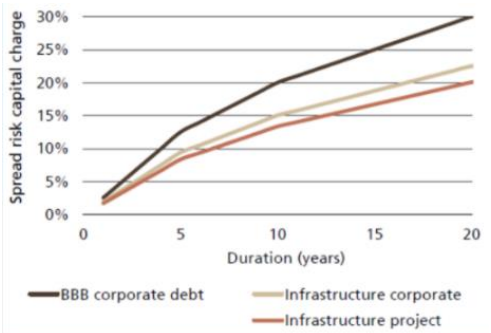
Qualifying infrastructure entities Credit Quality Step		0		1		2		3	
dur_i	$stress_i$	a_i	b_i	a_i	b_i	a_i	b_i	a_i	b_i
≤ 5	b_i*dur_i	/	0,64%	/	0,78%	/	1,00%	/	1,67%
> 5 ; ≤ 10	$a_i+b_i*(dur_i-5)$	3,20%	0,36%	3,90%	0,43%	5,00%	0,50%	8,35%	1,00%
> 10 ; ≤ 15	$a_i+b_i*(dur_i-10)$	5,00%	0,36%	6,05%	0,36%	7,50%	0,36%	13,35%	0,67%
> 15 ; ≤ 20	$a_i+b_i*(dur_i-15)$	6,80%	0,36%	7,85%	0,36%	9,30%	0,36%	16,70%	0,67%
> 20	$\min(a_i+b_i*(dur_i-20$	8,60%	0,36%	9,65%	0,36%	11,10%	0,36%	20,05%	0,36%

Qualifying infrastructure companies Credit Quality Step		0		1		2		3	
dur_i	$stress_i$	a_i	b_i	a_i	b_i	a_i	b_i	a_i	b_i
≤ 5	b_i*dur_i	/	0,68%	/	0,83%	/	1,05%	/	1,88%
> 5 ; ≤ 10	$a_i+b_i*(dur_i-5)$	3,38%	0,38%	4,13%	0,45%	5,25%	0,53%	9,38%	1,13%
> 10 ; ≤ 15	$a_i+b_i*(dur_i-10)$	5,25%	0,38%	6,38%	0,38%	7,88%	0,38%	15,00%	0,75%
> 15 ; ≤ 20	$a_i+b_i*(dur_i-15)$	7,13%	0,38%	8,25%	0,38%	9,75%	0,38%	18,75%	0,75%
> 20	$\min(a_i+b_i*(dur_i-20$	9,00%	0,38%	10,13%	0,38%	11,63%	0,38%	22,50%	0,38%

Spread risk tables. Standard debt investments (above) vs qualifying infrastructure debt (to the side).
Source: EU Delegated Regulation 2015/35

Type of investment	Base capital requirement	Symmetric adjustment
Type 1 equity	39%	Full
Type 2 equity	49%	Full
Private equity	49%	Full
Hedge funds	49%	Full
Infrastructure entities	**30%**	**77%**
Infrastructure corporate	**36%**	**92%**
Strategic participations	22%	N/A
Real estate	25%	N/A

Favored treatment of infrastructure equity and debt under the amended Solvency II
Source: LUISS Business School & ASTRID 2017



The look-through approach

If the infrastructure investments performed by insurance companies meet the requirements laid down by the regulator for the definition of qualifying infrastructure investments, they can access the facilitated treatment purposely introduced. Nonetheless, the "burden of proof" lies on regulated entities themselves, which can access the favored treatment in question subordinately to their ability to provide their national supervisors with evidences concerning the qualifying status of each of their infrastructure investments. Insurance companies keep responsible also for the compliance of the investments they perform indirectly, as no infrastructure fund can be automatically considered Solvency II compliant, by now. Despite the actual convenience of doing so, insurers may face significant challenges in gathering the necessary sets of data, unless they employ excellent data analysts and maintain strong relationships with all of the selected asset managers.

As a response, some initiatives have been undertaken by private or institutional actors to facilitate insurance companies willing to gain exposure to qualifying infrastructure investments. This phenomenon is still marginal but the competition among investment funds and the increased awareness of public entities about the importance of stimulating infrastructure investments by institutional investors are hoped and expected to drive up the number of initiatives taken in this sense.

The UBS Archmore Infrastructure Debt Platform

The UBS Archmore Infrastructure Debt Platform represents an excellent example of market-based solution to address the complexities faced by European insurers in force of the Solvency II regime. It is a Luxembourg-based regulated alternative investment vehicle composed by a closed-ended fund and parallel managed accounts. The fund targets infrastructure private placements, loans and bonds. In particular, 90% of its target is composed by primary mid-sized private unrated debt opportunities, showing investment-grade characteristics, innovative structures and limited competitive tension in the markets of referral. The target maturity of investments ranges between 7 and 10 years. The fund targets operational assets denominated in euros or pounds, supporting core infrastructure sectors including transport, utilities, energy and social services, and located in OECD countries (especially Western Europe). The target size of the fund is equal to €1.0 billion, subdivided among 12-18 positions.

The integrated investment process adopted by the fund managers is composed by the sourcing, structuring and monitoring phases. Each phase is in turn subdivided in two steps. Along the process, allegedly eligible deals are scrutinized deeper and deeper, so that the tens of deals identified in the sourcing phase are reduced to the 12-18 investments actually pursued by the fund. The process is undertaken by a group of dedicated experienced professionals, composing the Investment Committee.

The UBS Archmore Infrastructure Debt Fund wants to represent, investment by investment, a Solvency II compliant solution for insurance companies willing to gain exposure to qualifying infrastructure assets. The eligibility of each investment is ascertained by the Investment Team through a purposely created checklist. The analysis carried out takes part of the Investment Memorandum, and is successively validated by independent members of the Investment Committee, consistently with the provisions included in Article 261a of the EU Delegated Regulation 2015/35. To address the requirements imposed specifically by the look-through approach, the mentioned Investment Committee Memorandum is drafted with the view to ensure full transparency and thoroughly report the outcome of the analyses performed by the Investment Committee. In addition, the look-through reporting and the Solvency II analysis are realized and quarterly updated. The former is a complete set of relevant data about each of the fund's investments. The Solvency II analysis, instead, aims at quantifying the Solvency Capital Requirement that regulated insurance companies are expected to face for each of the fund's investments. From this documentation, insurance companies can take all the data required to demonstrate the eligibility of underlying exposures to national supervisors.

The EIB Infrastructure Aggregation Platform

The Infrastructure Aggregation Platform is going to be an open-ended investment vehicle sponsored by the European Investment Bank. The associated initiative has been approved by the EIB Board at the begin of December 2017 and further developments are to come in the closest future. Its goal is to enable small and mid-sized investors to co-invest in new selected infrastructure projects by providing senior debt alongside the European Investment Bank itself. This can emerge as a particularly advantageous tool for insurance companies missing in-house skills for the construction of an own project finance desk but still willing to invest in infrastructure assets.

The EIB is going to be responsible for the sourcing of projects but the Infrastructure Aggregation Platform will be a separate legal entity with no recourse to the former. Indeed, investments will be taken on the basis on the vehicle's own policies and guidelines. Once projects are selected, an interested third party Asset Manager will underwrite the IAP tranche of senior debt, which will be *pari passu* with respect to the tranches of debt provided by other lenders and by the European Investment Bank on its own. The Asset Manager will then issue investment grade project bonds for the sale to institutional investors. The bonds issued by the Asset Manager for each selected project will convey toward the platform, which will be monitored and managed by the Asset Manager itself.

The EIB will provide a further (unfunded) credit rating enhancement facility for these bonds, for a value amounting up to the 20% of the overall value of the IAP tranche. While being part of the same

platform, each project's bonds will be ring fenced and different investors will be able to participate in each of the bonds issued.

The IFC Managed Co-Lending Portfolio Program Infra

The International Finance Corporation is a member of the World Bank Group. It is the first global development institution focused on the private sector in emerging markets. The Managed Co-Lending Portfolio Program is an initiative of its, having the goal to allow institutional investors to allocate debt capital to the IFC on a portfolio basis. It is meant to represent an efficient and cost-effective syndication process. The capital raised is conveyed by the IFC toward several regions and sectors, consistently with its strategy and processes, then a portion of new debt investments is offered to MCPP investors, according to a passive rule-based process.

The Managed Co-Lending Portfolio Program Infrastructure of the International Finance Corporation is a spin-off of the MCPP and is aimed at addressing the challenges related to the financing of infrastructure in emerging countries through the improvement of institutional investors' access to the related infrastructure markets. Through it, the IFC is supporting the creation of new private sector infrastructure debt vehicles with the purpose of having them investing in infrastructure loans originated by the IFC itself and syndicated through the MCPP platform. Each vehicle is designed to meet the regulatory and commercial requirements of large institutional investors. The IFC also backs up the exposures of institutional investors in the platform by providing first loss capital, hence granting their loans an investment grade status.

The provision of the guarantees is performed in co-operation with the Swedish International Development Cooperation Agency (SIDA), which aims to share risk by guaranteeing coverage on a portion of the first loss of the portfolio of loans. It is estimated that the collaboration between IFC and SIDA unlocks $8-$10 of third party capital for each dollar of capital invested.

Through the MCPPI, institutional investors are expected to leverage the IFC capacity to originate and manage a portfolio of bankable infrastructure project, in exchange for the possibility to gain exposure to a sufficiently sized and diversified portfolio of investment-grade-like infrastructure debt.

Conclusions

Infrastructure assets are essential for the socio-economic development of countries, but there are significant infrastructure shortages around the World. Fortunately, the annual number of global infrastructure deals is slowly increasing, year after year, with special reference to the sector of renewable sources of energy. The deployed financial resources are growing as well, at a faster pace than the number of deals, indicating that plentiful (private) capital is still available to accommodate

further increases in the number of new infrastructure deals. A very valuable contribution is expected to come from institutional investors, interested in the remarkable benefits that low-risk high-quality infrastructure investments can provide for them if the regulatory, institutional and market environment of referral is favorable. The Solvency II framework for European insurance companies has hence been adapted to accommodate the interest of insurance companies for core infrastructure investments by allowing them a favorable treatment, subordinately to their ability to demonstrate that the infrastructure exposures they are gaining, either directly or indirectly, actually fulfil the criteria set by the regulator. While at a first glance the stated requirements may appear as heavy and restrictive, they simply impose to regulated companies the adoption of best practices concerning the sourcing and assessment of investment opportunities and are indeed inclusive for most infrastructure initiatives, be them in the form of project or corporate finance initiatives. The favorable treatment is likely to represent a significant incentive for insurance companies to invest in infrastructure assets.

Given the new infrastructure-friendly regulatory environment, the next step to be taken is the enhancement of European insurers' access to the infrastructure markets. If bankable projects are lacking and insurance companies do not get able to actually access the favorable treatment dedicated to qualifying infrastructure investments, the positive contribution of the amendments to the Solvency II regulation is likely not to be fully captured. To address this problem, an important contribution is arising from market-based and institutional initiatives taken to stimulate long term investments in infrastructure facilities, whose number and breadth is expected to increase. The EIB's Infrastructure Aggregation Platform that will be started in 2018, the IFC's Managed Co-Lending Portfolio Program and the UBS Archmore Infrastructure Debt Platform represent excellent examples of public and private initiatives taken to pursue the goal of enabling and stimulating insurance companies' investments in infrastructure assets. [I]

[I] For bibliography and referencing, please refer to the full version of the thesis