SDA Bocconi

Bocconi School of Management

EMPOWERING LIVES THROUGH KNOWLEDGE AND IMAGINATION

MILANO | ITALY

STARBEI

EU Financing Policy in the Social Infrastructure Sectors

Implications for the EIB's sector and lending policy

European Investment Bank

Final research report

SDA Bocconi

European Investment Bank

This report is the results of a research project carried out by **SDA Bocconi School of Management** and financed by the European Investment Bank under **STAREBEI – Programme for Financing of University Research**.

The research draws from previous studies carried out by the EIB, most notably: the EIB Investment Report; the EIB Group Survey on Investment and Investment Finance; the EIBIS Municipal Infrastructure European Union Overview; the work by Hubert Strauss and Michael Koch about Capital stocks and (physical) Investment needs in the Education sector of the EU-28; the Economic Appraisal of Investment Projects at the EIB; EPEC's Non-Financial Benefits of PPP.

The research aims at adding further evidences to the results exposed in the 2017 Report of the High-Level Task Force on investing in Social Infrastructure in Europe chaired by Romano Prodi and Christian Sautter by developing an econometric model.

Errors remain those of the author. The findings, interpretations and conclusions presented in this research are entirely those of the authors and should not be attributed in any manner to the European Investment Bank.

SDA Bocconi

European Investment Bank

Researchers

Niccolo Cusumano is Associate Professor of Practice at SDA Bocconi School of Management. His research activities focus, among others, on public-private interactions, in particular in the context of public contracts, public private partnerships, impact investing. His work has been published on EGEA, Greenleaf Publishing, Palgrave Mcmillan, Environmental Science & Policy and Energy Policy.

Francesca Casalini is Research Fellow at SDA Bocconi School of Management. Her research activities focus, among others, on business-government relations for infrastructure and business development, impact investment and social innovation. She is PhD Candidate at the University of St. Gallen.

Filippo Maria D'Arcangelo is PhD Student at Toulouse School of Economics. He is an applied microeconomist with a research interest in environmental economics. He holds a Masters degree from Bocconi University.

Academic Tutor

Prof. Veronica Vecchi, SDA Bocconi School of Management

EIB Tutors

Andreas Kappeler, Guido Bichisao, Gunnart Muent and Olivier Debande

SDA Bocconi

European Investment Bank

Structure of the report

SDA Bocconi

European Investment Bank

OBJECTIVES AND PHASES OF THE RESEARCH PROJECT

Objectives of the research project

The main objectives of the research project are to explore:

The likely outlook for the main social sectors to be investigated in terms of:

a. Existing capital stock (intangible and tangible)
b. Financing and governance models used by EU governments to develop social infrastructure
c. Future capital stock requirements based on social needs

Explore existing methodologies for investment appraisal in the social sectors with identification of public value metrics reflecting project externalities

Develop different modalities to mobilise private sector resources in combination with public resources looking at existing experience (and notably in the PPP area);

Explore the availability of investment finance from different sources, with particular reference to private financing coming from commercial banks, Long-Term Institutions (such as pension funds, life insurers, endowments, sovereign wealth funds) and impact investors; the financial instruments to be used (equity, commercial bank debt, bonds etc.); the capability in the capital markets to arrange projects in these sensitive social sectors.

The concept of Infrastructure

There is still little consent among academics and researchers on a unanimous definition of infrastructure. The International Finance Corporation (IFC) refer to it "*as electricity, gas, telecoms, transport and water supply, sanitation and sewerage*". In an Economic Note, the African Development Bank (ADB) defines it "*as a country's physical facilities, such as roads, power plants, and bridges*". The Organization of Economic Co-operation and Development (OECD), in its Statistical Term Glossary, defines infrastructure as "*The system of public works in a country, state or region, including roads, utility lines and public buildings*.".

At the same time, there is wider consensus and formalization regarding its categorizations, divided in (1) **hard infrastructure**, i.e. physical structures or facilities that support society and economy (Bhattacharyay, 2008, World Bank Group 2010, UN Habitat 2011); (2) **personal infrastructure**, i.e. the human capital, the stock of knowledge and skills embodied in the workforce; and (3) **institutional infrastructure**, i.e. the social and institutional capital related to the system of rules that govern a country, such as policy, regulatory, and institutional frameworks, governance mechanisms, etc. (Howes and Robinson, 2006).

Within hard infrastructure, **economic infrastructure** is an economy's capital stock used to facilitate economic production, or serve as inputs to production (e.g. electricity, roads, and ports) or input to consumption by households (e.g. water, sanitation and electricity) (Fay 2000, UN Habitat 2011), while **social infrastructure is defined as that class of infrastructure that promote health, education and cultural standards of the population** (Bhattcharayay, 2008, WEF 2012, Bottini et al. Forthcoming)

How we define Social Infrastructure

Social infrastructure is recognized for its positive externalities in society; the World Bank refers to social infrastructure as the '**glue which holds communities together**' (World Bank, 1998).

With a more technical definition, in this research, **we refer to social infrastructure as the long-term physical assets that facilitate social services** (Preqin 2014, Fransen et al. 2017) **and encompasses municipal structures (e.g. parks, lightings and recreational spaces), housing (e.g. social dwellings), education (e.g. school buildings, education equipment, ICT), health (e.g. hospital structures, medical equipment)**, which ameliorate human development, quality of life and living standards (Howes and Robinson, 2006).

Among social infrastructure, within this work the following sub categories have been considered:

Education infrastructure: physical resources necessary to develop and deliver educational programs, ranging from primary school to tertiary education, as well as vocational and cultural secondary education, and adult education.

Healthcare infrastructure: physical resources necessary for hospital activities, general medical practices, specialist medical practice activities, nursing care activities and residential care activities for mental retardation, mental health and substance abuse as well as the elderly and disabled.

Affordable housing infrastructure: land needed for construction of dwelling; construction or purchase and remodelling of dwelling units for the general public or for people with special needs.

Phases of the research project

Phase A

Data acquisition on investment trends and governance models for social infrastructure in Europe

We have created a database of past and current capital investment in EU countries and regions across the three principal sectors, distinguishing between tangible "Gross Fixed Capital formation" and intangible investment (student lending, R&D etc.). In this phase, we have analyzed also the dominant financing and governance models used by EU Governments to develop social infrastructure.

Phase B1

Sector scenarios in healthcare and education

We have outlined likely future trends for social infrastructure investments, split between "Business As Usual" and "Maximizing Benefit" scenario. This phase mainly focuses on the healthcare and education. Social housing was not investigated in depth because, according to available data, EU Member States recur to subsidies/social transfers, thus limiting the scope of public investments.

Phase B2

The public value of social infrastructure

We have reviewed the extensive literature on project appraisal, the current project appraisal methodology used by the EIB, as well as by other institutions, to assess social infrastructure investment projects, and provided recommendations on how to incorporate public value into evaluation and monitoring.

Phase C

A review of PPP models applied in healthcare and education

We have reviewed existing PPP models in terms of their appropriateness in infrastructure and service delivery in healthcare and education.

Phase D

A review of PPP models applied in healthcare and education

We have mapped out ways of satisfying investment demand over and beyond what public sectors will likely fund via various additional private sector sources, mainly long-term institutional investors. We have analyzed the risk and return profile of these investors and discussed the policies that could be implemented to attract them to social infrastructure.

SDA Bocconi

European Investment Bank

PHASE A
INVESTMENT TRENDS AND GOVERNANCE MODELS FOR SOCIAL INFRASTRUCTURE IN EUROPE

Trends in social infrastructure investments

There is a **growing need for investments in social infrastructure to improve the productive efficiency and quality of publics services**.

Across the EU, services are delivered in facilities that are:

- too large (Posnett 2002);
- in the wrong place (Thomson et al 2009);
- generating excessive maintenance and utility costs (Thompson & McKee, 2004); and
- failing to exploit the efficiency- and quality-enhancing opportunities afforded by change in technology (Thompson & McKee, 2004).

Policy-makers in most EU are in the process of consolidating the public estate. However, the process of consolidation itself requires new capital investments (e.g. the replacement of large general hospitals with community facilities)

Such **investments often require external capital, which can be accessed from a variety of different institutions. In most EU countries, capital can be sourced by governments at a lower cost than is available to local-level service providers**. Consequently, raising finance through national or sub-national governments has often been the most efficient source of funds for social infrastructure, regardless of whether their assets are owned by the state.

However, **in an era of tight fiscal constraints, many local-level service providers are engaging with providers of external capital**. The use of external capital - both equity and debt - is becoming more widespread. Historically, its role has been important in decentralised states such as Germany and the Netherlands. However, now, even highly centralised states such as England and France have undertaken large social infrastructure rebuilding programmes through public private partnerships (PPPs) that leverage private finance.

…in Europe

Between 2000 and 2008, major social infrastructure investment programmes were underway in England, France, Italy, Scotland and Spain. Reflecting this, the priority afforded to capital in the allocation of government expenditure increased in these countries.

For example, capital expenditure in the public healthcare system in Spain saw the highest growth over the period - of some 130% in nominal terms. Similarly, in France, two successive hospital building programmes (Hôpital 2007 and Hôpital 2012) increased the rate of capital expenditure above trend. The European Observatory (2010) estimates that Hópital 2007 induced €16bn of additional investment and Hópital 2012 a further €7bn.

However, **all of these programmes were underpinned by project finance contracts. These programmes witnessed a sharp slowdown in 2008, when the financial crisis led to constraints among banks and other senior lenders, which diminished the availability of capital and increased its cost**. Subsequently, these programmes were also curtailed by constraints on the demand side (i.e. tighter control of government budgets) and political criticism.

Conversely, this period was characterised by historically low levels of capital spending on social infrastructure in The Netherlands and Germany. For example, since 2000, major changes have been made to the health care system in The Netherlands, including a shift from full reimbursement of hospital capital costs to a system in which hospitals are expected to fund capital costs through their activity-based payments. The uncertainty generated by the changes in investment funding has resulted in delayed initiatives for new buildings and the cancellation of some projects.

…and in Germany

In Germany, the pattern of investment has differed between regions.

In the former West Germany, there has been significant over-capacity in some areas of the social sector. For example, both the number of hospitals and the number of beds has fallen steeply over the last 20 years. Most new large capital projects take place in the new Länder (i.e. in the former East Germany) in order to bring public service facilities up to Western standards.

In the healthcare sector, historically, financing for hospitals in Germany operated on a dual principle, in which recurrent expenditures were financed by health insurers or out-of-pocket payments while support for capital is the task of the Länder. However, concerns have been expressed by some stakeholders that in a period of fiscal constraints, the dual financing system leads to serious under-funding for capital needs, and this is in review.

For example, the national federation of hospitals, the Deutsche Krankenhausgesellschaft, estimates that there is an investment shortfall among German hospitals (public and private) of some €50 billion. It has been suggested that at least €4-5 billion of additional investment per year will be needed in the next decade to ensure the hospital stock is fit-for-purpose. Against this background, from 2009, there has been an incremental move towards a diagnosis-related group (DRG) regime in which capital costs and operating costs will be remunerated within a single tariff.

However, in general, the move to activity-based remuneration for hospitals is associated with certain anomalies in respect of capital costs. As shown by Hellowell and Pollock (2010), hospitals with new estate can be under-funded for their capital costs, leading to solvency problems.

Capital investment planning

Approaches to capital investment planning strongly reflect the institutional, legislative and regulatory framework of a country's welfare state.

Major capital investments in social infrastructure are usually regulated and planned separately from service budgets. Hence, there is significant variety on how this process works.

- In some countries, **process is regionalised** (e.g. in Denmark, Finland, Germany and Italy, new hospital developments are planned and funded at regional level).
- In others, such as France, the Netherlands and the United Kingdom, **large new social developments require the approval of central government authorities.**
- In most countries, **regional (and sometimes national) authorities are also involved in financing (and sometimes guaranteeing) major capita investments**.

Capital financing options for new investments

Summary of major capital financing sources used, or being considered for future use		
Capital source	**Countries in which capital source is currently used**	**Countries in which capital source is being considered in the social infrastructure sector**
Municipal Bonds	Non currently (in contrast to the United States)	England
Loans – commercial banks	England, France, Germany, Italy (heavily restricted), The Netherlands, United States	
Loans – development banks	England, France, Germany, Italy, The Netherlands, Spain	
Loans – other financial services companies (e.g. pension funds, insurance companies)	England, The Netherlands	France, Germany
Internally-generated capital (e.g. accumulated savings)	England, France, Germany, Italy, The Netherlands, Spain	
Asset sales	England, France, The Netherlands	
Leases	Italy, Germany, The Netherlands (focus on equipment, rare to use this for the estate)	
Private philanthropy	England, Scotland, The Netherlands	
Public grants (central/ regional government or sickness fund)	England, France, Germany, Italy, Spain, Scotland	
Public loans	England, France	
Project finance (PFI or public-private partnerships)	England, France, Italy, Scotland, Spain	Germany

Capital financing options for new investments

As previous slide shows, **social infrastructure projects in most countries have access to public grants in some form, whether from central or regional governments** (who may pass on the proceeds of sub-sovereign bond issuance), **or from social insurance institutions** (in the case of France and Germany). It should be noted that public grants are not always a "free good" for public service organisations. For example, in England and Scotland, grants are provided to hospital organisations from central government in the form of 'Public Dividend Capital', on which an annual interest charge (equal to 3.5% of net assets) is paid.

In addition, **some governments have established direct loan facilities in order to provide public service organisations with a low-cost source of capital, with interest rates set at a small premium to domestic sovereign bond yields**. For example, in England, the West London Mental Health Trust procured a £260 million redevelopment of the high security hospital at Broadmoor, to be funded partly through Public Dividend Capital and partly through central government loans. Similarly, in France, the Hôpital 2012 programme included the provision of €2bn in public loans at low interest rates, with €5bn in grants.

The table also shows that private finance can come in a variety of instruments and be sourced from many different types of institution. In the EU, most external capital is sourced from commercial banks in the form of loans. Loans are especially prevalent in France, Germany and The Netherlands, particular for health investments. In these countries, public service organisations may be able to borrow funds directly from the private sector subject to regulation. For example, in Germany, such loans are subject to approval by the regional Länder.

Capital financing options for new investments

In terms of development funds, entities such as the EIB have become important. The EIB has been an important provider of relatively low-cost loans, provided directly to public sector organisations or through private sector intermediaries in project finance contracts. Indeed, the EIB has been one of the principal lenders in the EU's project finance market, providing around 10% of loans to the UK's PFI programme

However, **most countries with PPP programmes have relied on commercial loans to finance investments**. Bank loans have, for example, financed most transactions signed under the *contrat de partenariat* programme in France, and have thus constituted an important source of capital finance for the Hôpital 2007 and 2012 programmes, though new loans to projects under these initiatives have been infrequent since the financial crisis in 2008.

In contrast, in the UK, a large proportion of PFI contracts have been financed (or refinanced) by 'wrapped' bonds. This market collapsed in the wake of the US sub-prime crisis in 2007, as many of the monoline insurance companies lost their triple-A credit ratings. Only in North America, where there is strong demand for 'unwrapped' bonds from public sector pension funds, does bond financing of PPP transactions continue at scale.

Finally**, finance can be raised via the bond markets directly by regional governments and municipalities accessing the capital markets on their behalf**. Currently, this form of financing is mainstream only in the United States. However, there are agencies in the local government sector in some EU countries that borrow in the markets and on-lend to members, reflecting triple-A rating of their bonds – a trend which may be due to increase.

SDA Bocconi

European Investment Bank

PHASE B1
SECTOR SCENARIOS
IN HEALTHCARE AND EDUCATION

SDA Bocconi

European Investment Bank

PHASE B1 - SECTOR SCENARIOS IN HEALTHCARE AND EDUCATION

Researchers: Niccolò Cusumano, Filippo Maria D'Arcangelo

Table of contents

SDA Bocconi

European Investment Bank

B1.1. Summary of Results

Healthcare – Investment trends

Healthcare expenditure rose almost uninterruptedly during the last 50 years in OECD countries. After 2008, growth stabilized in relation to GDP. Existing literature identifies several factors affecting healthcare expenditure growth. However, only national income is found to be statistically significant, at least according to available data. Making things more complex there is scant evidence of a direct relation between expenditure and health outcomes (such as living expectations).

Healthcare capital investments (measured as gross fixed capital formation), due to their relatively small importance in terms of absorption of financial resources (2%-3% of healthcare expenditure) and the lack of data, have been less analysed in terms of impacts and determinants.

Looking at data it seems that investments do not follow the same trend of ”general” health expenditure, rather reflecting public sector investment patterns where resources are allocated on the basis of budgetary and broad economic considerations. For example, investments rose in 2009, in line with economic stimuli launched by governments, and a decreased in the following years due to austerity policies (whereas healthcare expenditure kept growing) in order to rein in deficits.

This pattern can be explained by several considerations:

- it is easier to cut investments instead of current expenditure;
- the large majority of healthcare expenditure nowadays is related to chronic diseases which tend to be threated pharmaceutically;
- thanks to medical advances and for budgetary reasons there is a trend towards reduction of acute care expenditure (i.e. de-hospitalization) which is less capital intensive, even tough in the short term additional investments would be needed to reconfigure the systems of care;
- a governance system which may lead to gaps in long term investment planning and prevent an efficient allocation of resources.

Healthcare – Sector Scenarios

Starting from these considerations we defined a forecasts country-specific investment model. Main results are expressed hereby. It is worth noting that in the business as usual scenario (BAU) forecasts are based on projections of investment trends according to the evolution of economic and demographic variables, no policy considerations have been defined in terms of public health goals, nor resource allocation towards specific assets or efficiency increases in the use of assets and resources because of the lack of consistent evidences (Varabyova & Muller, 2015, Hollingsworth, 2008).

We compare the BAU scenario with an alternative one, a “maximising benefit” scenario, in which investments are set to evolve in order to reduce unmet needs, such as photographed by EU-SILC survey. In this counterfactual scenario, investments are increased until the marginal return in terms of unmet need reduction is zero; that is, until additional investments per capita would not have a sizeable influence on quality of service.

Key results of the study are:

- In the next 20 years investments are set at least to double under a business as usual scenario and almost triple under a benefit maximising scenario.
- By 2040 an investment gap, measured as the difference between two scenarios, of EUR 477 billions is set to arise.
- By early 30’s private investments are going to overtake public ones. That said if the system wouldn’t be able to actually attract private resources it will be impossible to meet forecasted investment needs, therefore leading to an increase in investment gap beyond our estimates.
- Under the BAU scenario only 25 cents for 1 euro invested are devoted to additional assets, the rest being devoted to renovate existing ones.

Education – Investment Trends

Like in the healthcare sector, also education expenditure experienced a huge growth in the past. Outcomes, evaluated in terms of academic achievements, of this increase have been questionable. According to existing measures, such as those made by OECD PISA study, pupils and students are not learning more compared to the past. According to OECD, the relation between expenditure and learning outcomes break down after a certain threshold is passed, meaning that after reaching a minimum level of inputs more resources do not necessarily imply an improvement.

Physical resources, albeit seldom considered, seems to influence learning processes. The magnitude of their effect is still debated, moreover the majority of existing studies have been carried out in the United States and take into consideration only building facilities. Nowadays the majority of capital expenditure in the education sector is devoted to digital technologies. Knowledge about impact of ICT and its interplay with the physical learning environment is still scarce. We need, therefore, to collect more data and evidences in order to better employ resources and understand the real return on such investments.

According to the European Commission (SWD(2017) 165 final):
"Evidence shows that investment in education can lead to very different outcomes. Therefore the quality of investment in education is just as important as its volume. Three main lessons seem particularly relevant for policy development:

- *The costs of investing in education are largely offset by the individual and collective benefits generated by education, particularly but not only in the longer-term. Education can be one of the most profitable areas for Europe to invest in.*
- *Investments in education do not result automatically in higher economic growth and other economic benefits. Making the economic case for education means striving for higher efficiency in spending and for a strong policy focus on the key factors that determine effective outcomes, such as good quality teachers or school accountability and autonomy.*
- *Knowledge about what works best in education — and what is efficient — is still limited. This is partly due to the lack of data, and to the long-time lags that are typical of education. An improved evidence base and mutual learning can support policy- making and help design policies that make the provision of education more efficient without jeopardising the goals of effectiveness and equity."*

Education – Sector Scenarios

Like in the healthcare sector, education expenditure is mostly driven by income. Holding all else constant, a given change in personal income in a state will lead to an increase in spending on education of an equal percentage (Fernandez and Rogerson, 2001). As confirmed by our model other demographic variables play a minor role in spending per pupil/student.

Education systems are confronted with the double challenge of ensuring equity and quality, despite learners' socio-economic background, and providing learners with adequate skills and competencies for their professional life. Digitalization is both a driver of change and a tool for addressing education challenges. On one hand Digitalization, by reshaping the workplace, requires a new set of skills, on the other hand the adoption of new services, technologies, competences by education organisations, can help to improve learning outcomes, enhance equity and improve efficiency. Education systems shall therefore prove more flexible, adaptable, relevant and open to the wider society according to a whole-school approach. Learning environments, in their physical and digital dimensions, play an important role to address such challenges.

Key results of the study are:

- In the next 20 years investments are set to increase by 24% under a business as usual scenario and 62% under a policy scenario despite the number of students is set to decrease. With decreasing student population this means that the capital intensity per pupil/student is set to increase significantly.
- By 2040 an investment gap, measured as the difference between two scenarios, of EUR 509 billions is set to arise.
- The ratio of public and private investments is set to remain constant meaning that public resources available could cope with the increase and that the system is set to remain strongly public. It is important to note that these figures refer to formal education and do not capture potential investment effort made in informal and non formal education contexts.
- Under the BAU scenario only 7 cents for 1 euro invested are devoted to additional assets, the rest being devoted to renovate existing ones. This result is explained by the fact that investments are mainly directed towards intellectual property products which enjoy a short lifespan and higher depreciation rates.

Main Implications

Based on the results of our study, we draw the following implication:

1. In the healthcare sector public resources alone will not be able to address future investment needs even under a BAU scenario. This gap could be filled by private resources. PPPs could be a way to attract private resources while keeping the governance of healthcare systems public and increase public acceptance. The situation of the education sector is different probably because of the nature of investments and the education systems.

2. The impact of social infrastructures on outcomes is still unclear. In healthcare common measures, such as amenable mortality, despite being a step forward in our understanding, have been mainly related to aggregate healthcare expenditure and still present some issues in their interpretation (Vladescu & Ciutan, 2017, Mackenbach et al., 2013). In education international studies, such as OECD Pisa, shows that the impact of investments tend to plateau after a certain endowment is reached. Further evidences are needed to asses the impact of new kind of investment on technology which are under way. Therefore, more studies are needed in order to define consistent methodologies to evaluate investments effectiveness in both sectors.

3. Demographic changes are leading towards a deep reconfiguration of healthcare and education systems. This could be a be a game-changer in terms of investment needs. In order to direct resources towards most effective uses it is important to strengthen the governance of the system and improve long term planning. The huge variety, in terms of institutional arrangements, financing modes and asset allocation, constitute of course a major obstacle towards the definition of pan European investment approaches.

4. Policy makers and financing institutions shall ensure that, in the future, resources are allocated towards the most effective uses in terms of value creation. It is important to note that the investment gap mostly arises by a lack of additional investments compared to the asset replacement. This could mean that the healthcare and education systems could fall short of investing in real innovation or in more efficient ways to address emerging needs and continue to dedicate resources to legacy assets.

How to interpret data and limitations

In this section of the report, results are presented as punctual estimates. Indeed, when forecasting, estimation errors compound each year and the noise proportionally increases. This problem is exacerbated by the fact that future values for GDP and population, used to produce forecasts, are in turn estimated (and therefore imprecise) values. Yet, although no formal confidence interval is provided, the figures presented here should nevertheless be interpreted as imprecise and approximated. Therefore, the most relevant element of this analysis is not the precise quantification of total and public investments in 2040, but rather the outlining of their growth path (relative to each other, and to population and GDP growth).

This study, as any exercise of forecasting, is based on a set of assumptions and simplifications. The main limitations can be synthesized here:

- *Role of the financial crisis*: the empirical model proposed does not deliberately control for the financial crisis, started in 2008. One reason is that data limitation and shortness of the time series. The other is that, not removing the (negative) crisis' effects on investments, we implicitly avoid assuming that a similar scenario could take place again.
- *Affordability*: albeit we control for (lagged) public finance budget constraints in the model, the forecasts proposed herein do not explicitly model the investments' affordability. We provide instead investments forecast as percentage of GDP, as a proxy for affordability.
- *Normative content*: estimating an "investment gap" involves defining what is the first best investment level. This definition should in turn follow a precise cost-benefit analysis. Albeit we obtain an estimation of benefits in terms of reduced unmet needs, our approach necessarily disregards many other elements. In this sense our "maximizing benefit" scenario should be interpreted as a mere comparison or benchmark and not in a normative way.
- *Top down approach*: the model follow a top down/ macro approach, investment needed are therefore a projection based of evolution of a defined set of variable. Due to the lack of data, and the absence of standards it is not possible right now to follow a bottom up approach, thus defining a demand function based on real world needs (like for example status of equipment and facilities, or evolution in technology). Estimates provided by the model capture the growth trajectory of investments and the level of economic effort that might be requested.

SDA Bocconi

European Investment Bank

B1.2. Deatiled results
Investment needs in the healthcare sector

Healthcare expenditure trends

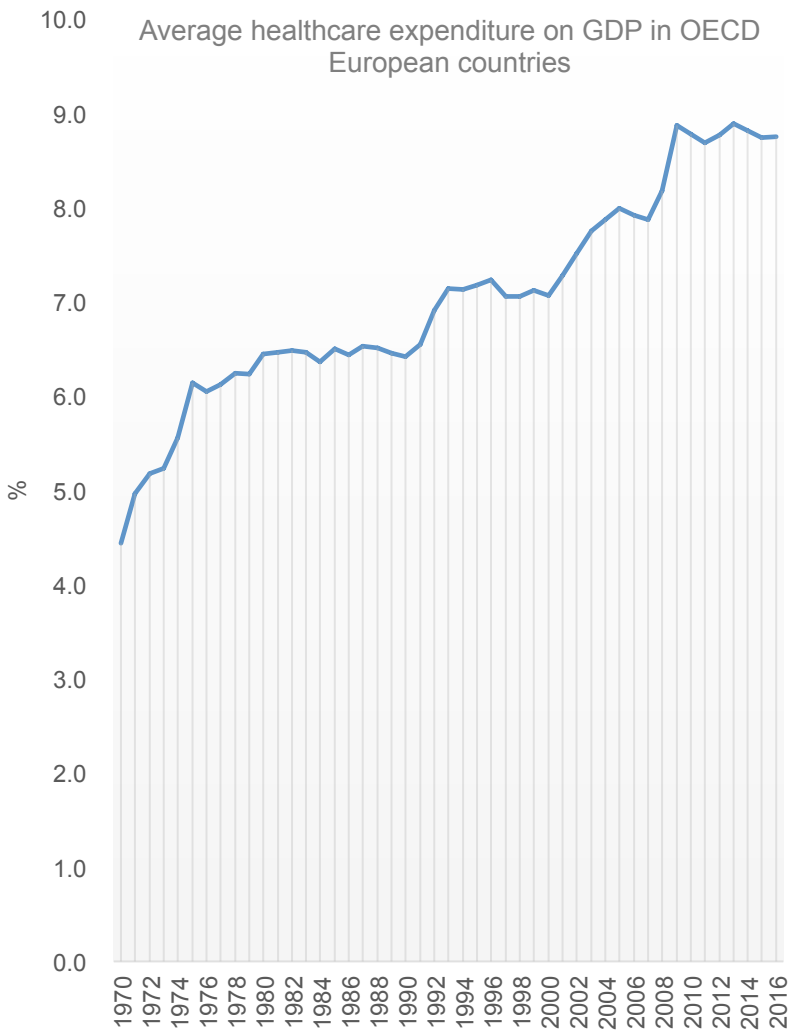
Healthcare expenditure, measured as a percentage of GDP, till the economic crisis in 2008, register a almost constant growth. Meaning that the growth of resources devoted to healthcare outstripped the general economic growth.

The determinants of growth in health expenditures have been widely analysed. WHO (2011) listed:

- income, measured as per capita GDP;
- population age structure;
- technological progress;
- variation in medical practice;
- health system characteristics;
- Baumol effect due to a relative lower productivity of healthcare sector and equalization of wages across sectors.

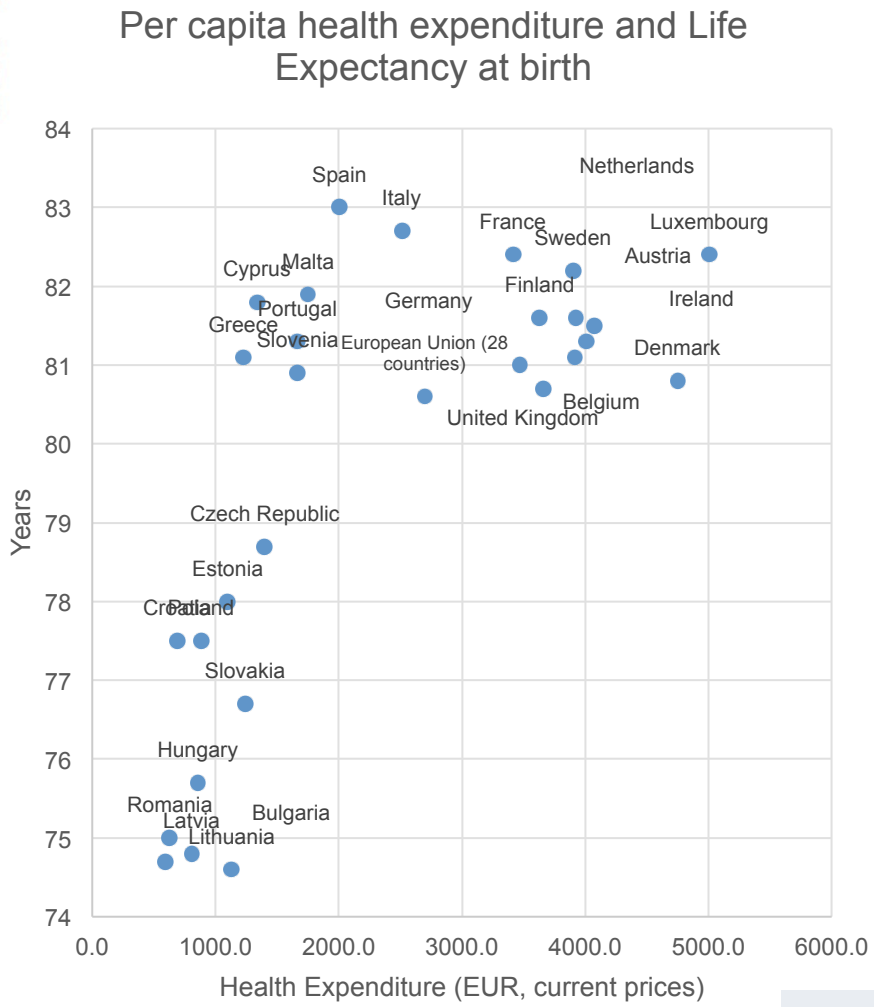
WHO, in line with previous literature, concluded that income is associated with healthcare expenditure, whereas population variables are not statistically significant and we do not have sufficient data to test the other determinants.

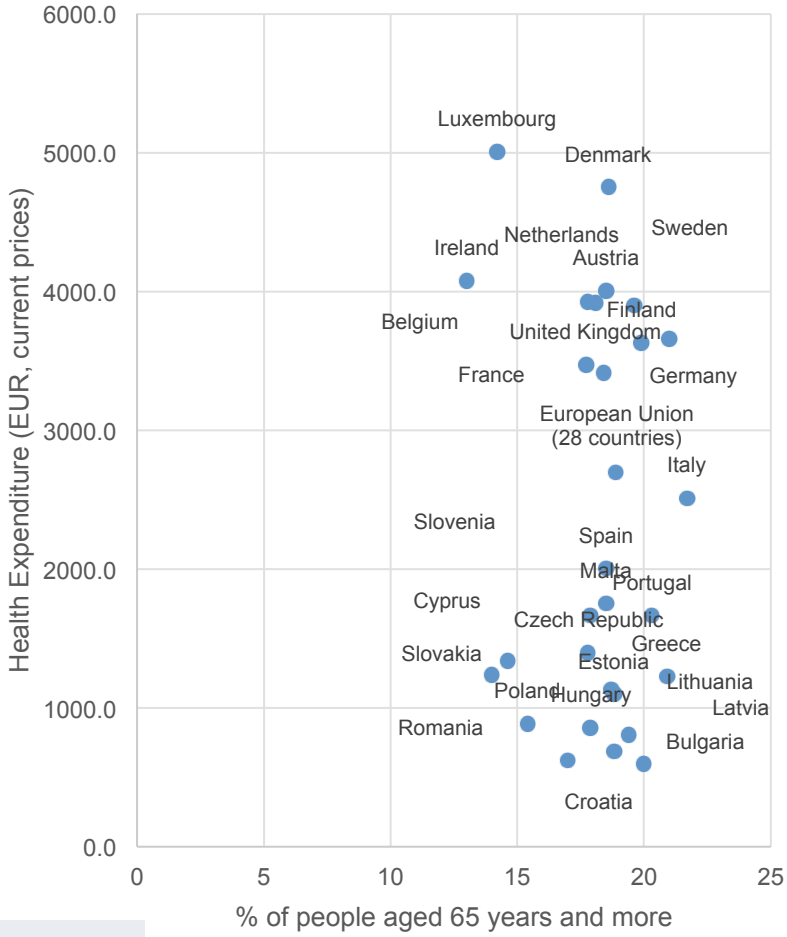
Scholars attempting to analyse the relation between healthcare expenditure and income, however, have not reached a consensus if elasticity is below or above 1 (WHO, 2011). Moreover, some studies (Wang, 2011, Amiri & Ventelou, 2012) underline that relation between income and healtcare expenditure changes across countries.



Source of data: OECD (2017)

Expenditures and social outcomes





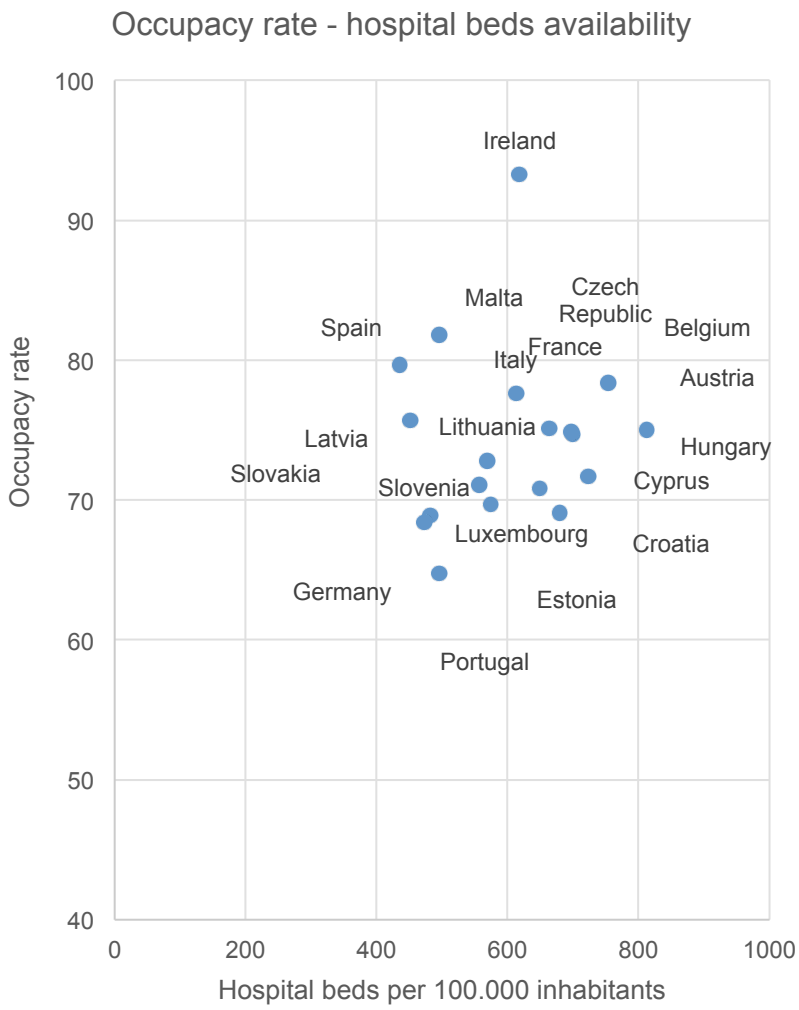
Source of data: Eurostat

Effectiveness of asset allocation

Data on physical resources are sparse with a focus on the number healthcare technological resources (see table in the following slide) and hospital beds per 100,000 people.

However, these measures are not representative of the actual conditions of these assets, nor “appropriateness” in their use.

When looking at these data it is evident that there are huge variations among countries which underline the lack of international equipment standards. For example Wunsch et al. (2008), analysing the distribution of critical care hospital beds, reached the conclusion that there are wide differences in both numbers of beds and volume of admissions. Moreover, they add that the number of intensive care unit beds per capita is not strongly correlated with overall health expenditure. The absence of standards or references (with the exception for hospital beds where there’s a wide literature) could be explained on one hand by the lack of available data, on the other hand to the difficulty at assessing demand for health services.



Source of data: Eurostat, 2015

Effectiveness of asset allocation

	Average	Median	Max	Min	St Dev
Computed Tomography Scanners	1,79	1,76	3,77	0,84	1,13
Magnetic Resonance Imaging Units	1,09	1,12	3,36	0,36	0,85
Gamma cameras	0,5	0,46	1,4	0,22	0,42
Angiography units	0,59	0,57	1,58	0,36	0,54
Lithotriptor	0,24	0,18	0,98	0,05	0,27
Mammographs	1,46	1,41	5,07	0,77	1,31
PET scanners	0,12	0,1	0,46	0,03	0,12
Radiation therapy equipment	0,51	0,49	1,37	0,37	0,4
Operation theatres in hospital	6,25	8,63	14,77	3,44	5,02

The definition of “needs” in healthcare sector

Any evaluation of the adequacy of infrastructure stock (and service provision) shall start from the definition of “need”. The difference between what is needed and what is available – the unmet need – may act as a proxy of an existing infrastructure gap. In the healthcare sector assessing needs is particularly tricky.

The European Commission’s Expert Panel on effective ways of investing in Health (EXPH) concluded that this task is “challenging” for the following reasons (p.16):

1. in many cases, the individual concerned may not realise that they need health care, as is the case with someone who has undiagnosed high blood pressure.
2. even when their condition is symptomatic, it may be necessary to undertake complex, and in some cases, painful or uncomfortable investigations to make a precise diagnosis, and therefore determine whether there is an effective treatment for the condition, and which, by extension, they have a need for.
3. there is the potential for supplier-induced demand, in which an individual may not actually need care, but is advised by a health worker that they do. This situation may arise where that health worker can profit from the administration of unnecessary treatment.

At the moment of writing, the primary source of comparative data on unmet need for health care is the European Union Survey of Income and Living Conditions (EU-SILC). In particular, the survey asks respondents if in the past 12 months they didn’t receive a medical treatment or examination and, in case of a positive answer, the main reason. Reasons are therefore grouped in three main categories: affordability, availability and acceptability. According to EXPH (p.38) “Availability encompasses accessibility to acceptable, well-equipped facilities within easy reach and adequate provision of health services, staffed by health workers with the right skills in the right place, who have access to quality medicines and devices are available at fair prices.”

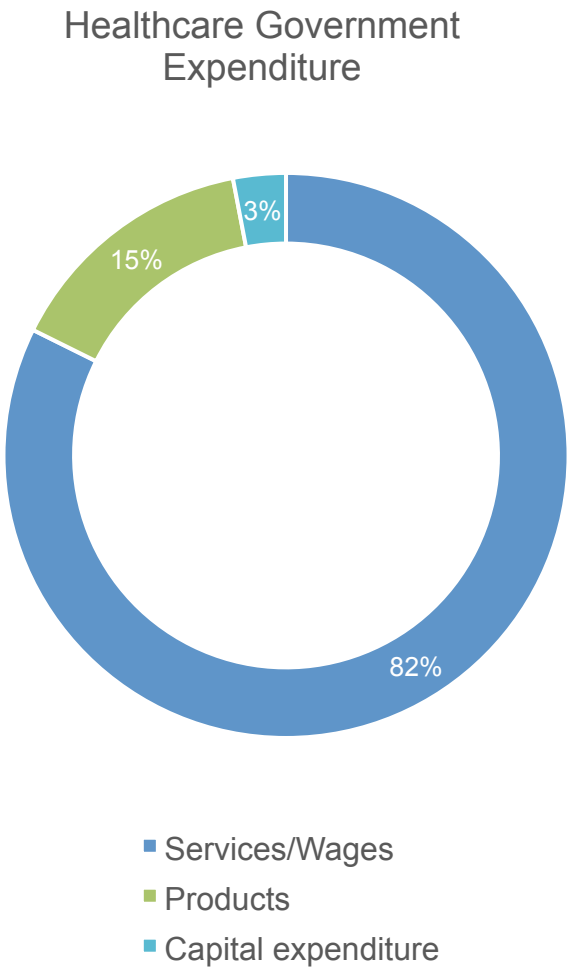
Capital expenditure in the healthcare sector

In 2016 27 EU countries (Data for Malta are not available) spent EUR 1.459 trillion in healthcare. Government expenditure represented 70% of that figure (i.e. EUR 1 trillion).

Looking at government expenditure, whom breakdown is available: 15% of resources, on average, goes into medical products (medicines and medical devices), the rest into wages, medical services and other current expenditures. Just 3% of public resources are dedicated to acquisition of fixed assets (on average 2% for the broad economy for those countries where data are available).

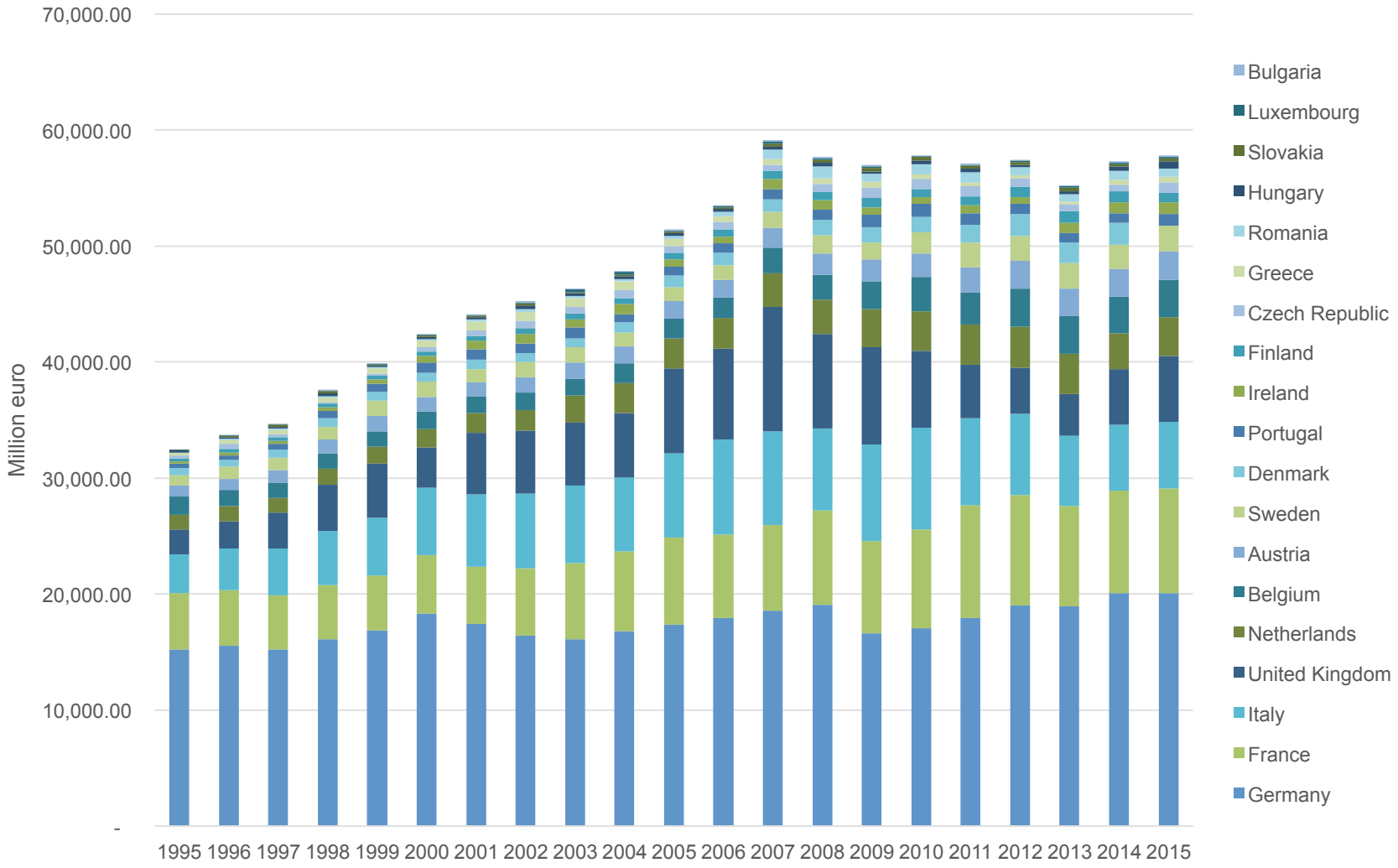
In absolute terms in 2016 EU governments directly invested EUR 31.8 billions in healthcare assets. We shall, then, add other EUR 4.3 billions of investment grants, meaning private sector investment in healthcare financed in part by the government.

Data for the whole economy (i.e. gross fixed capital formation in the healthcare sector) are more sparse: in 2015, 18 out of 28 countries where data are available, EUR 57.8 billions were invested by public and private sector combined. Germany alone contributed with EUR 20 billions: twice the amount invested by France (EUR 9 billions), and almost 4 times the amount invested by Italy and the UK (5.7 and 5.6 billions respectively).



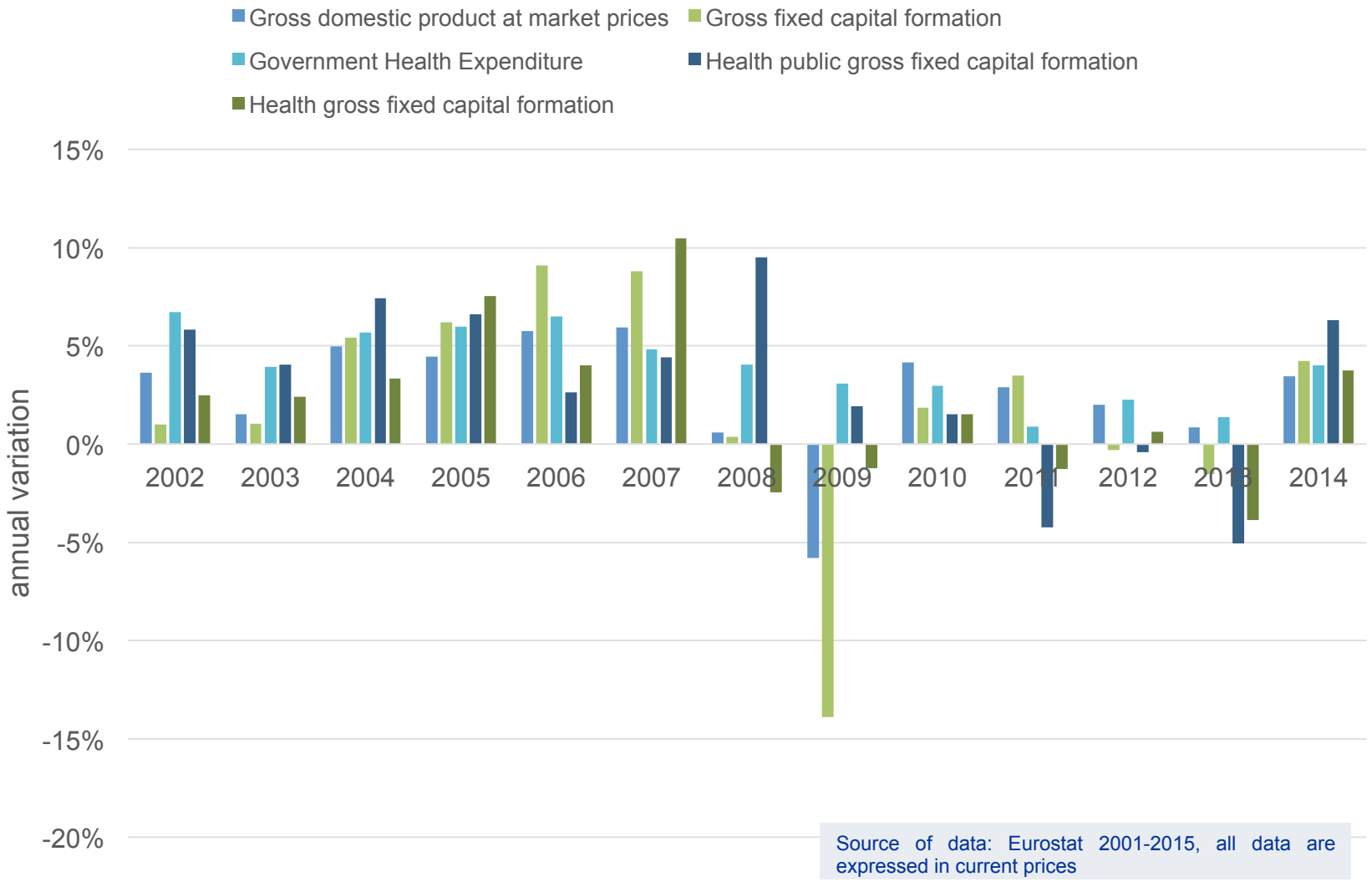
Source of data: Eurostat, General Government Expenditure in 2016

Capital expenditure in the healthcare sector 1995-2015 by country



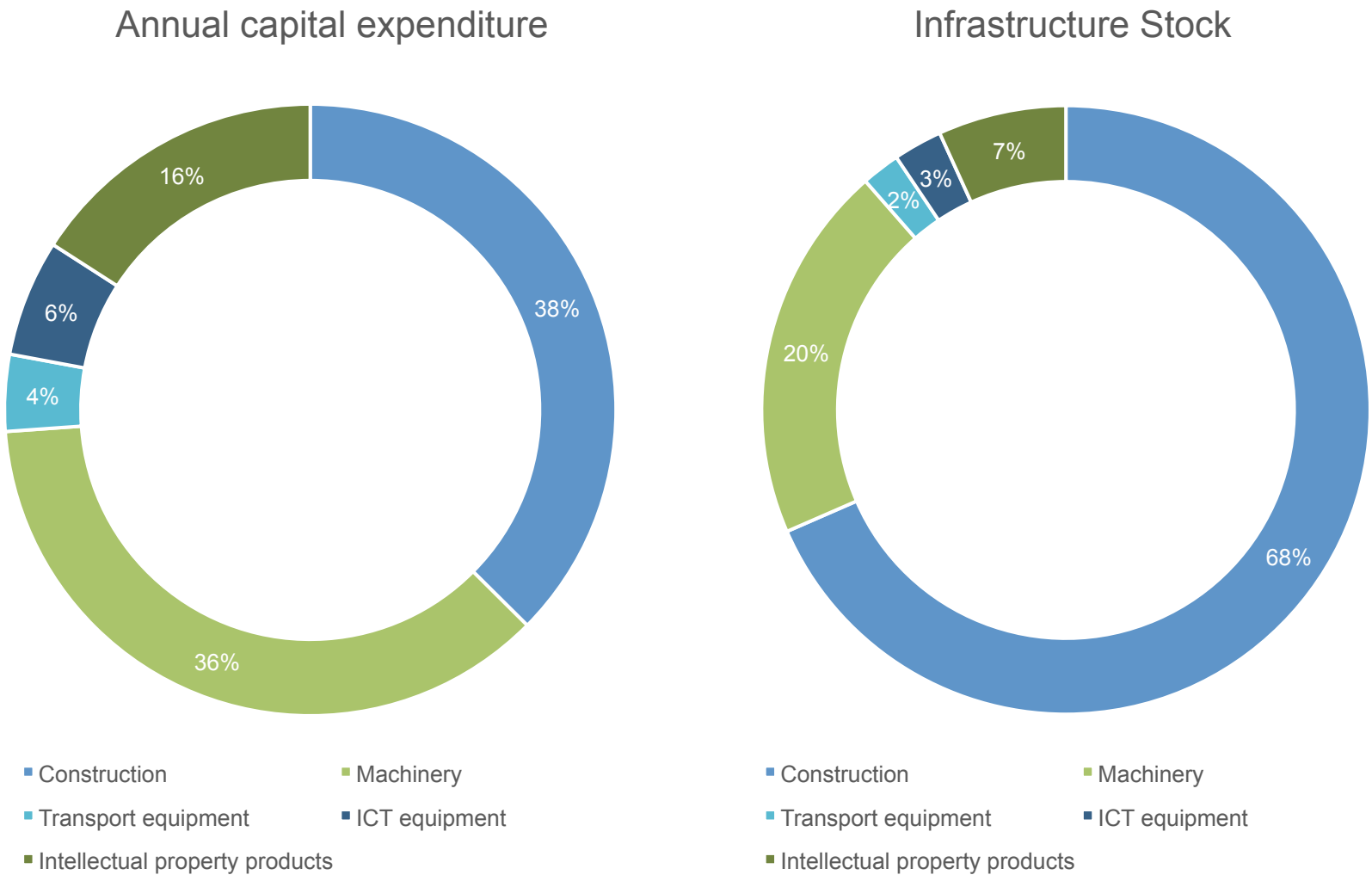
Source of data: Eurostat 1995-2015, all data are expressed in current prices

Investment in healthcare put into perspective



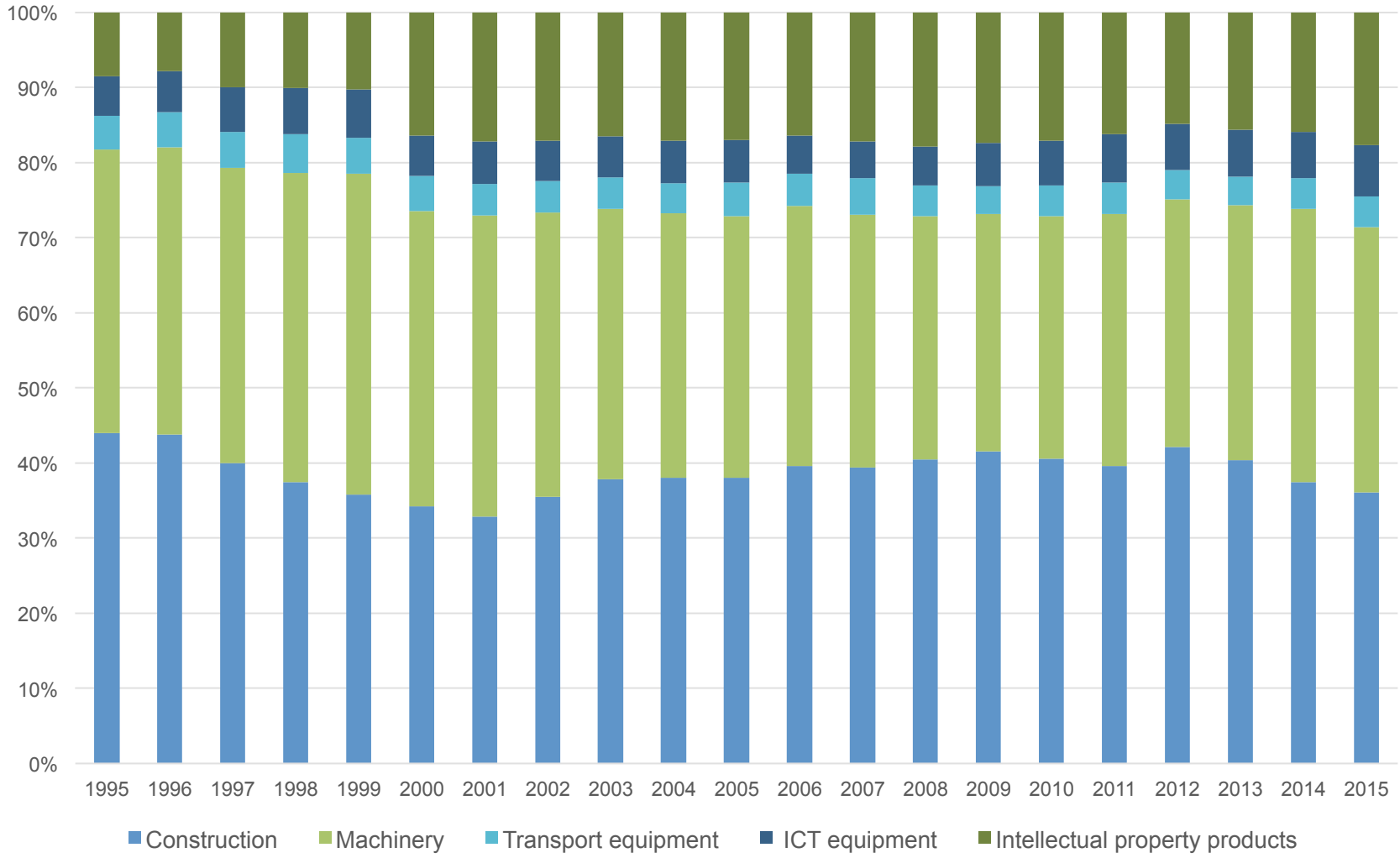
Source of data: Eurostat 2001-2015, all data are expressed in current prices

Healthcare annual capital expenditure and infrastructure stock by category in the EU



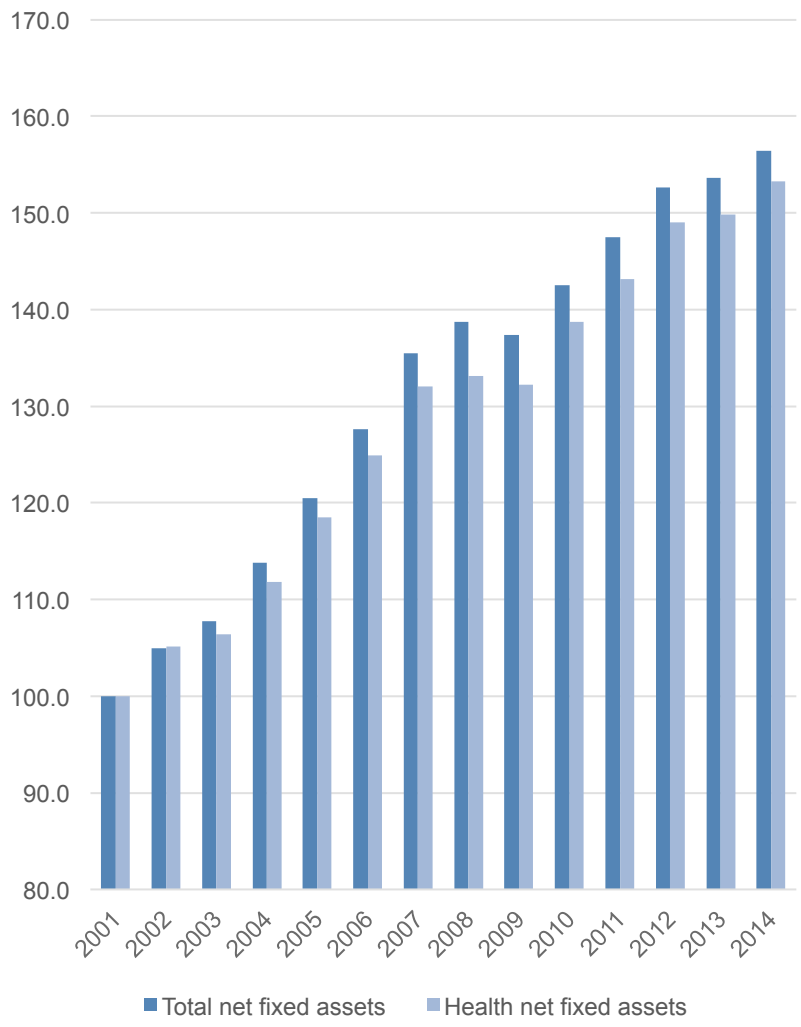
Source of data: Eurostat, data are referred to 2014 EU level

Evolution of healthcare annual capital expenditure



Source of data: Eurostat 1995-2015

Health infrastructure stock (2001 = 100)



The previous slide showed that the growth rate of investments in healthcare generally trailed not only the growth of healthcare expenditure (85% of the time), but also fixed capital formation of general economy (54% of the time) and GDP (62% of the years).

This trend is reflected when looking at infrastructure stock evolution in countries where data are available (Austria, Belgium, Czech Republic, Denmark, Finland, France, Greece, Italy, Luxembourg, Netherlands, Portugal, Sweden, United Kingdom).

It is interesting to notice that fixed capital formation seems to not follow the evolution of broad health expenditure and also lagging behind broad fixed capital formation in the economy.

This gap seems to widen after 2008. Main cutbacks in healthcare investments have been made in particular by two countries, UK and Italy, while other countries maintained their investment level pretty much unchanged.

SDA Bocconi

European Investment Bank

B1.3. Deatiled results
Investment needs in the education sector

Linking education expenditure to outcomes

Till 2008 per pupil/student expenditure kept increasing. Since then, growth stalled, albeit less than in healthcare growth.

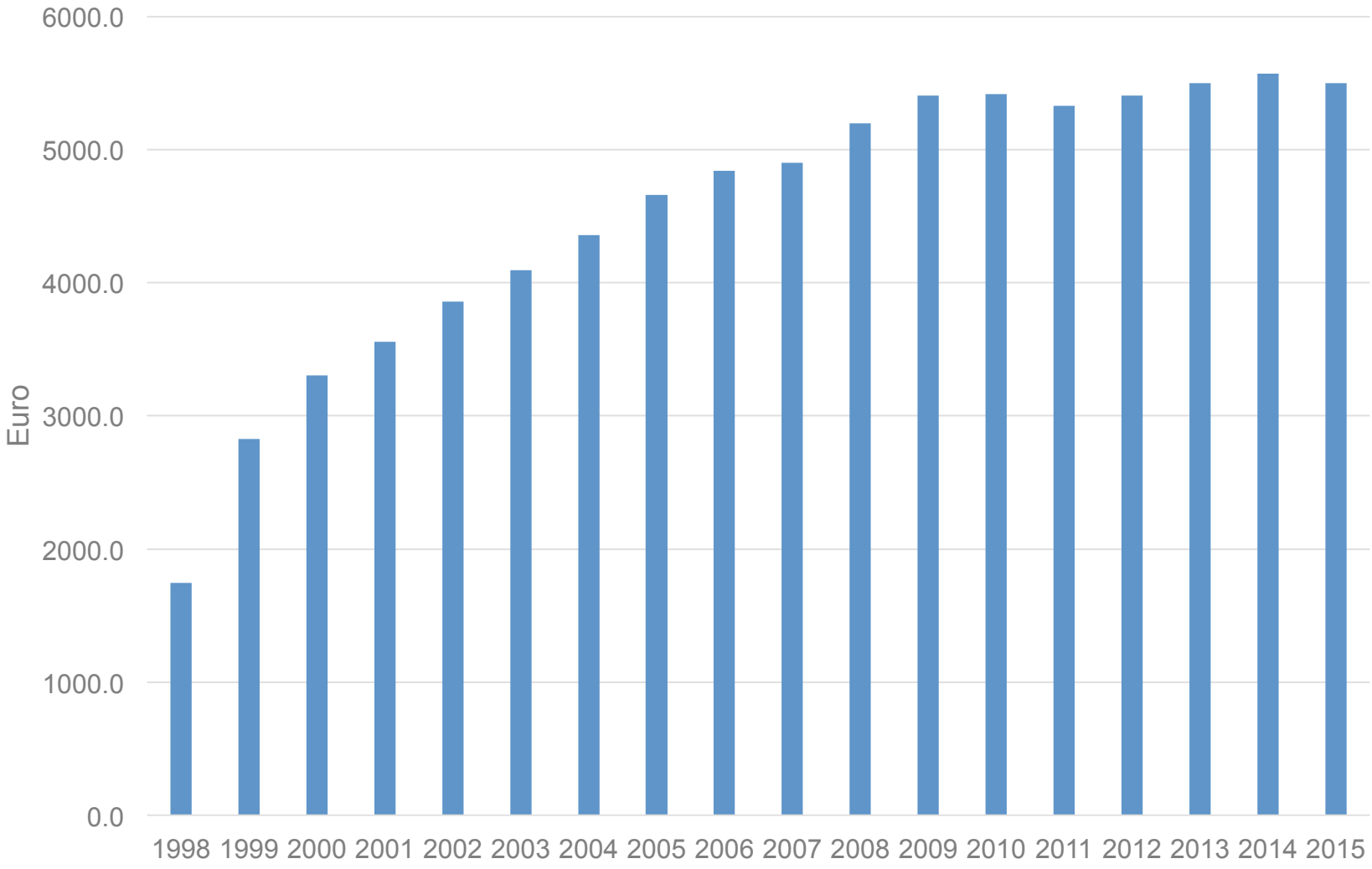
The relation between educational resources and outcome is far from being obvious. In its seminal work Hanushek (1981) noted that “the available evidence suggests that there is no relationship between expenditures and the achievement of students”.

OECD (2016) in its PISA 2015 report reaffirmed this concept by stating that “despite the widely accepted idea that more resources improve student performance, previous research on education has generally shown that, once an adequate level of resources is reached, additional resources may not necessarily contribute to better learning outcome”.This is particularly true for more developed countries “whose cumulative expenditure per student is more than USD 50 000, the relationship between spending per student and performance is no longer observed”.

Since student population in many EU Member States is shrinking, per pupil/student expenditure is growing even if total expenditure is kept constant. The relative stickiness of expenditure can be explained by the fact that in the last ten years average 62% of EU Governments expenditure in education was made by salaries.

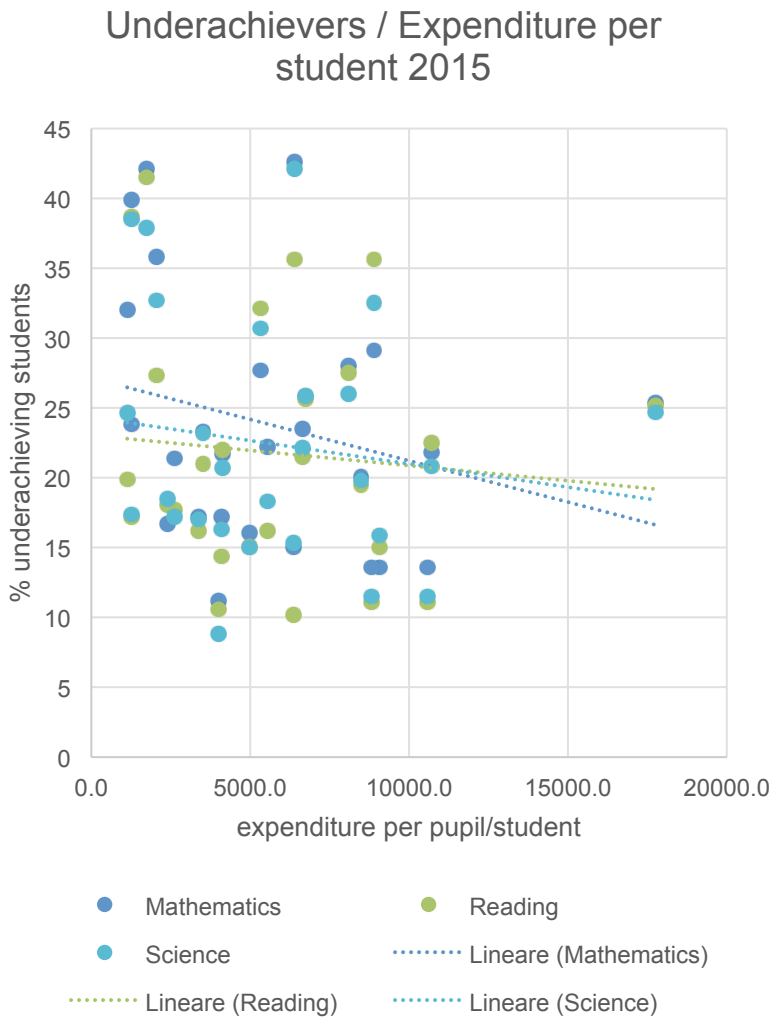
Economists have studied the relation between education inputs and outcomes according to the so called “education production function” (Hanushek and Woessmann, 2017). This model put in relation educational achievement with family background, school resources, institutional features and individual ability. Among educational resources there are also material infrastructures which are the object of this study.

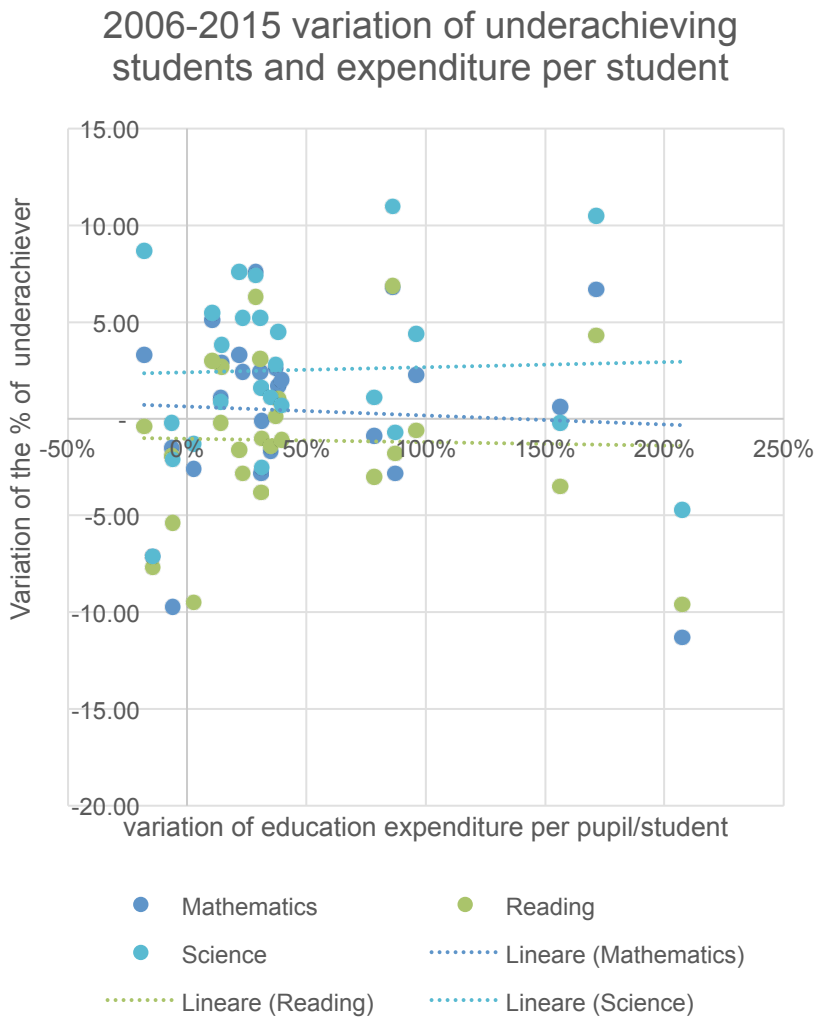
EU median public expenditure per pupil/student



Source: Eurostat, government expenditure for education ISCED 0-8

There's no evident relation between education resources and student's academic achievements

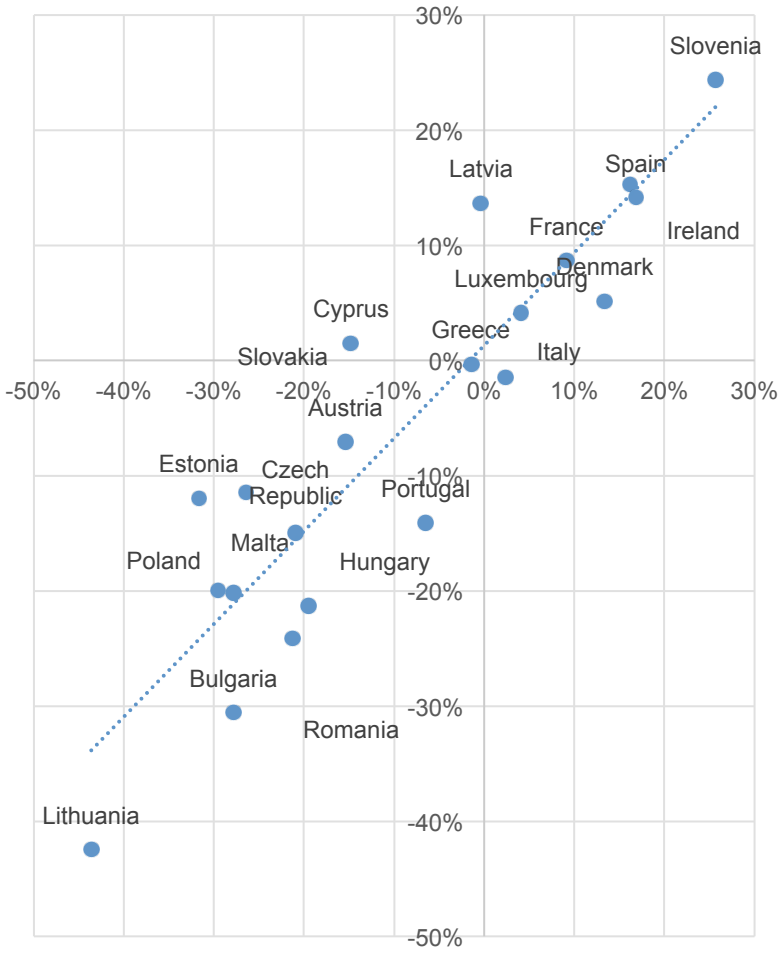




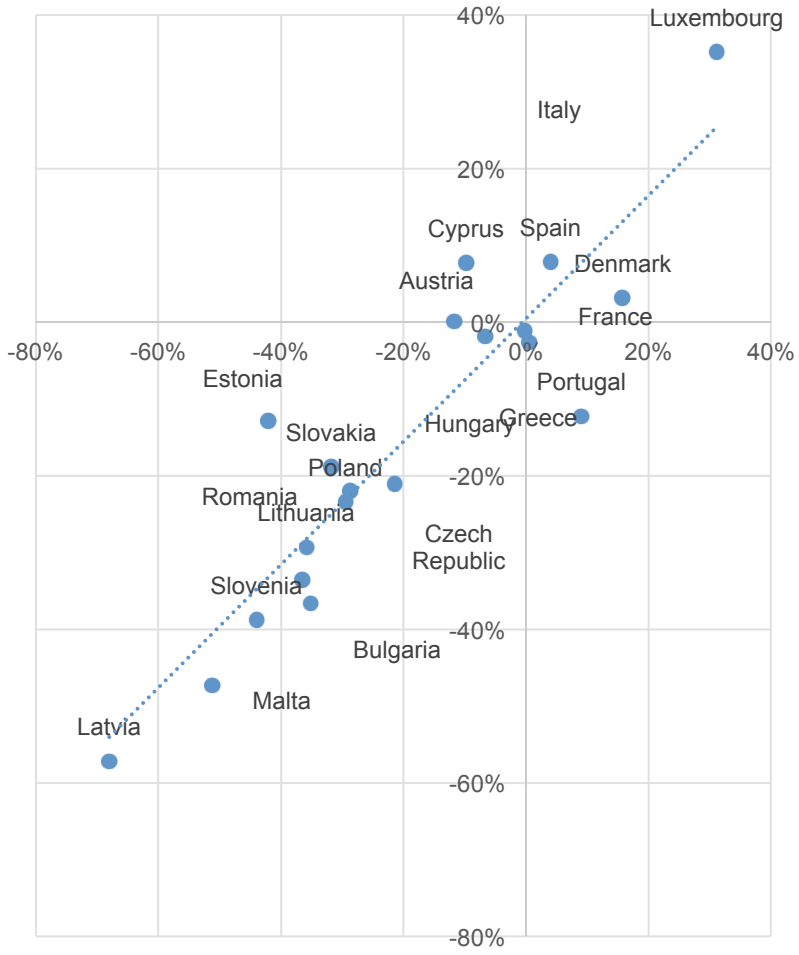
Source of data: Eurostat, Underachieving 15-year-old students by sex and field - PISA survey (source: OECD), Eurostat ISCED 2-3 education expenditure

The number of classes varies according to the variation of the number of pupils/students

Pupils/Classes ISCED 1

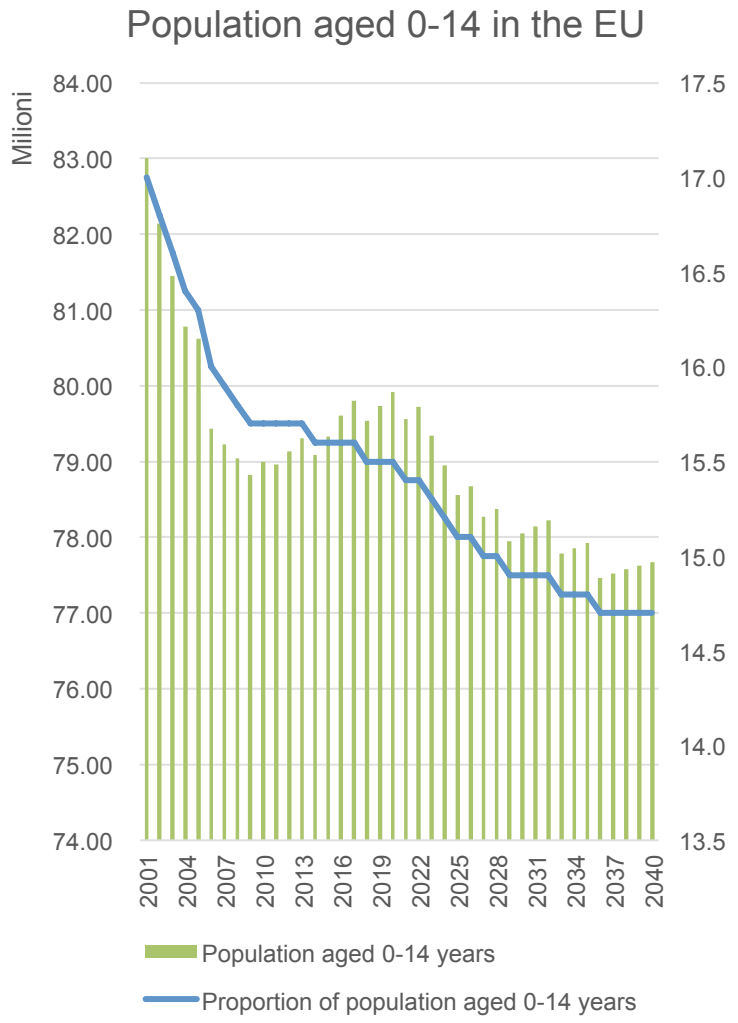


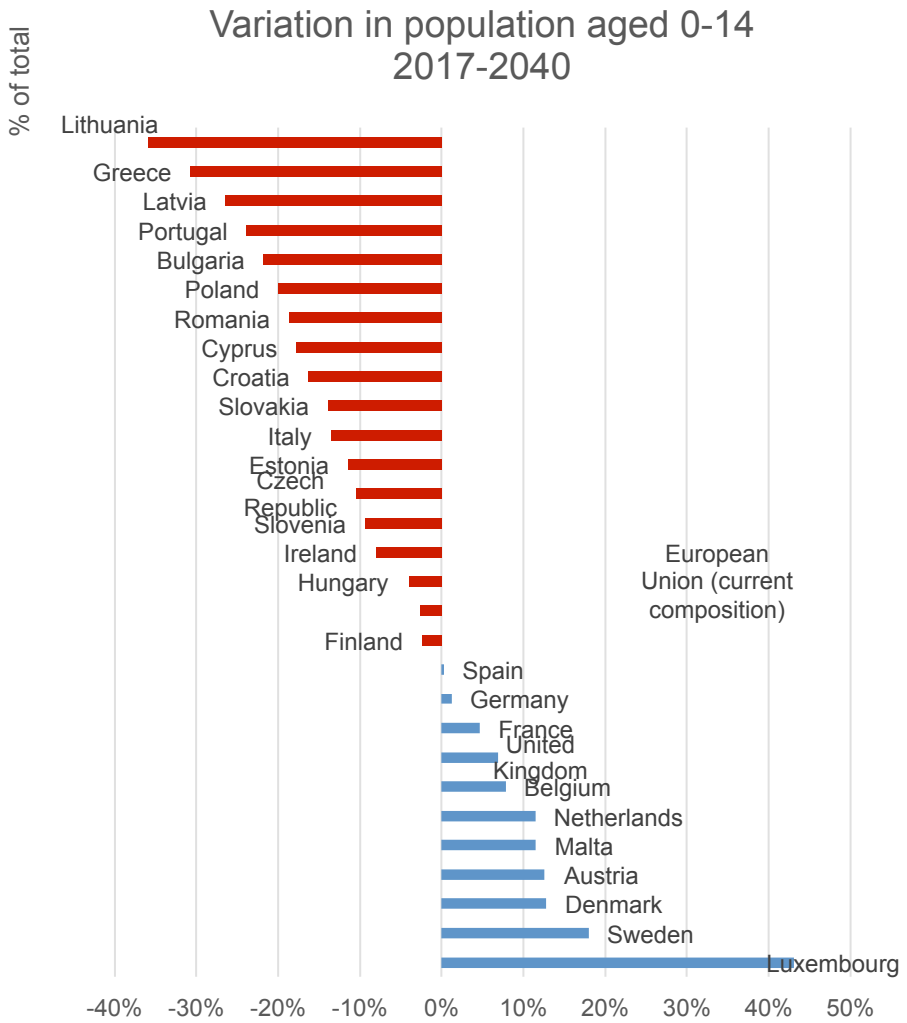
Pupils/Classes ISCED 2



Source of data: Eurostat, Average class size at ISCED 1-2, years 2002-2012; Pupils at ISCED 1-2 years 2002-2012

An ageing continent: population aged 0-14 in the EU up to 2040





Source of projections: Eurostat

Challenges in the education sector

In its 2018 Policy Outlook OECD identifies three main challenges to the education systems:

1. Addressing inequalities: providing all learners, independently of their socio-economic, immigrant, minority, special education needs (SEN) and gender-specific background, the same opportunities;
2. Improving quality of education.
3. Providing learners with adequate skills and competencies for their professional life.

In its New Skills Agenda for Europe (COM(2016) 381 final) the European Commission identifies other specific challenges:

1. Variance in the quality and relevance of education and training provision;
2. Digital transformation;
3. Ageing of population;
4. Increase in non formal and informal learning experiences.

Challenges in the education sector

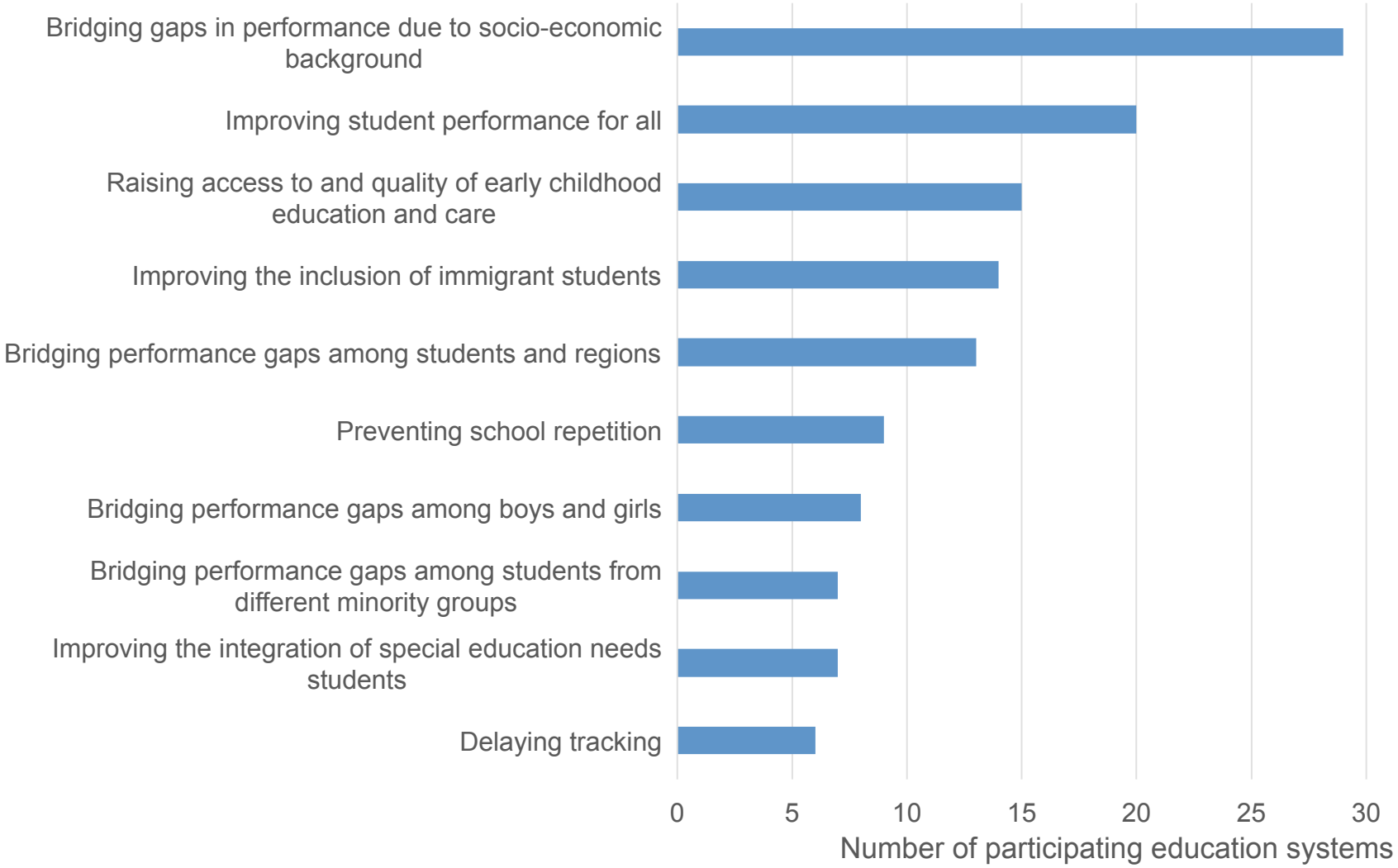
In other terms European education systems are confronted with external forces – demographic changes, shifts in the required skill mix – and internal forces – ageing of educators, relevance of contents and teaching methods. Since 2001 younger population, the cohort aged between 0 and 14 years old, is declining in many member states, especially in Eastern and South Europe.

This is pushing towards a reconfiguration of the education systems by merging classes and eventually shutting down schools. School size policies varies a lot across countries and regions (OECD, 2014). Globalization, automation and digitalization are reshaping the workplace and skills needed (Cedefop, 2016, McKinsey, 2017).

According to the OECD (2012) "*quality in education refers to providing students with high-level skills adapted to their individual interests and needs, building the foundation to succeed later in their lives*". Bad education systems produce skills mismatches, early leaving, youth unemployment and inequality. According to OECD (2010) even a modest improvement in the education system could have very large implications of improved cognitive skills and human capital. Economic gains for society could easily outstrip costs.

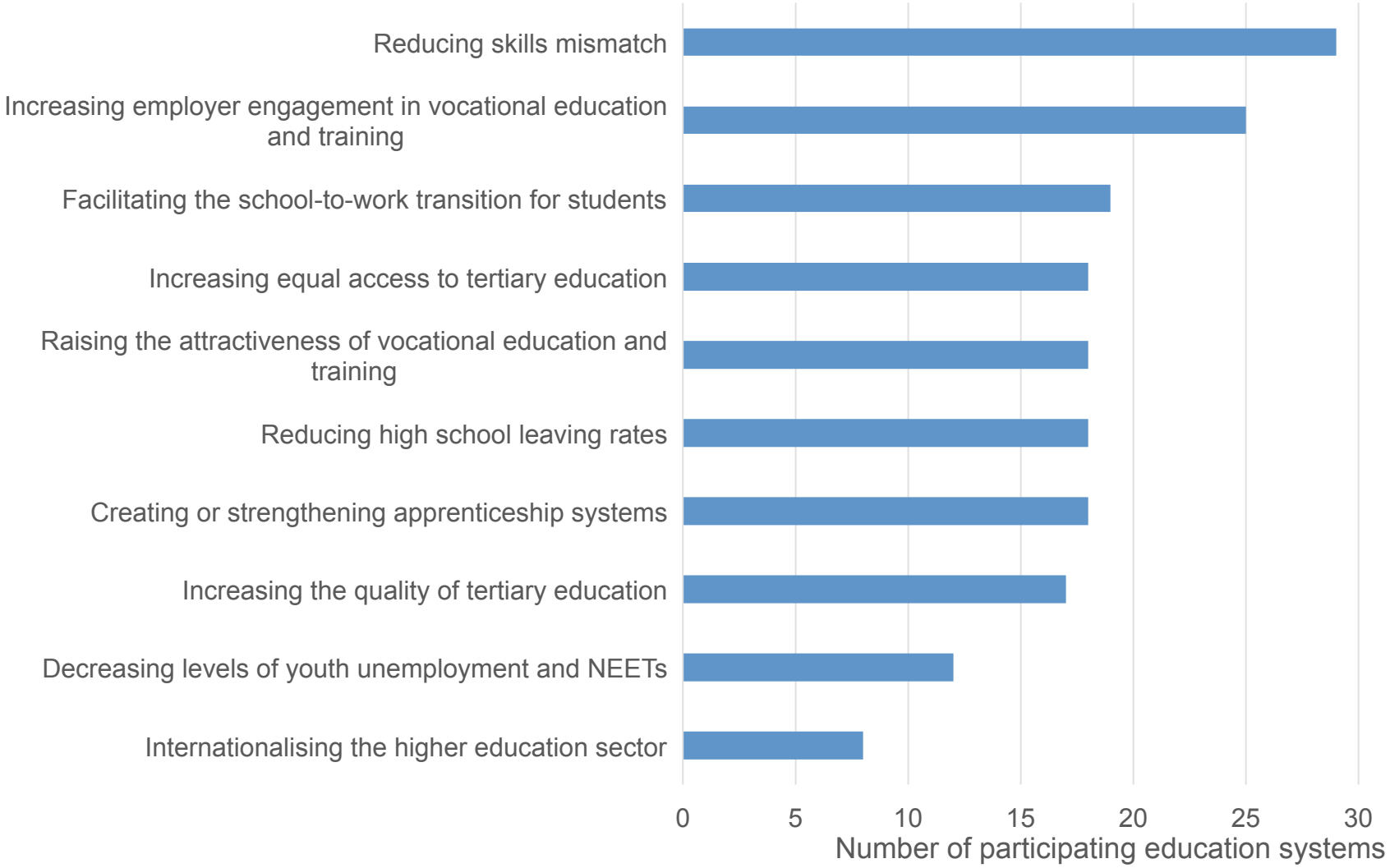
Education systems should, therefore, be able to engage people throughout their entire active life in education and training in order to help them to continuously reconfigure and update their skills. It is widely recognized that there cannot be one-size-fits-all solutions to these problems. At individual level personalized approaches are required to meet different learning styles. At system level it is required to foster decentralization and school autonomy; adopt a "whole-school approach" where educational institutions collaborate with families, businesses and the wider community in order to help learners succeed (ET2020 (2018), COM(2017) 248).

OECD members' policy priorities: EQUITY AND QUALITY of the education systems



Source: OECD, Education Policy Outlook, 2018

OECD members' policy priorities: PREPARING LEARNERS FOR THE FUTURE



Source: OECD, Education Policy Outlook, 2018

Challenges in the education sector

Digitalization is both a driver of change and tool for addressing new challenges. On one hand Digitalization, by reshaping the workplace, requires a new set of skills. On the other hand the adoption of new services, technologies, competences by education organisations, can help to improve learning outcomes, enhance equity and improve efficiency (COM(2018) 22 final). Effective use of ICT in education requires, however, that teachers are able to change their practices to be more student centred, to give over control, and that students are capable of self-regulated learning in the classroom and on line (Crook and Light,1999; Luckin,2010; Marjanovic, 1999; Moulds and Harper, 2008).

In January 2018 The European Union adopted a Digital Education Action Plan. The plan is based on other European initiatives: “A renewed EU Agenda for Higher Education” and “School development and excellent teaching for a great start in life”. It also supports the work on the Digital Single Market and the New Skills Agenda for Europe. National education systems are already investing in digital resources. According to Eurostat in 2015 more than 50% of capital expenditure was represented by “intellectual property products” (such as software) and IT systems (such as computer hardware). This trend could, in principle, further accelerate in future.

OECD (2018) and EU Commission communications analysed (COM(2011) 567, COM(2012) 669, COM(2016) 381, COM(2017) 206, COM(2017) 247, COM(2017) 248, COM(2018) 22)) do not include any reference to educational physical infrastructures. However, we may assume that in order to improve education system outcomes we shall improve students’ learning environment and the pedagogical setting where learning takes place.

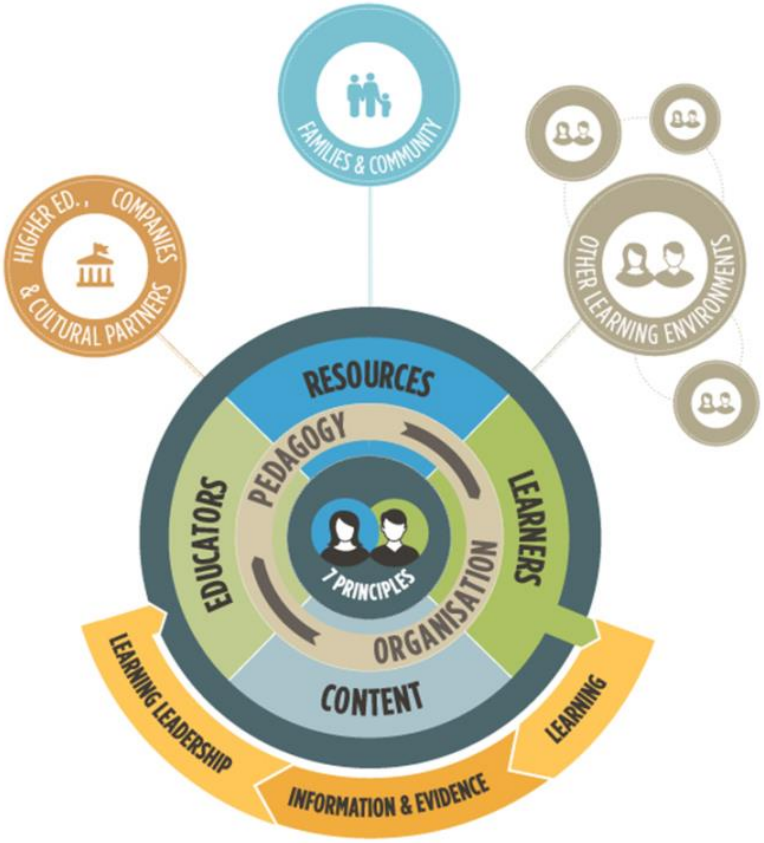
The impact of physical resources in education

Goodyear (2001) defines learning environment as "the physical and digital setting in which learners carry out their activities, including all the tools, documents and other artefacts to be found in that setting. Besides the physical and digital setting, it includes the socio-cultural setting for such activities".

OECD (2013) provides a broader definition of learning environment "an organisational form that covers the particular learning arrangements for a group of learners in context over time, in which the learning taking place is an integral part".

Physical learning environment, meant as the result of interactions between physical resources – learning spaces, materials and technology – and learners, educators and contents, is an essential element of the learning environment since it is conducive to effective teaching and learning (OECD, 2017).

Teaching activities are actually affected by the built environment where they take place and resources available. It is worth noting that the built environment may also impact the way technology is used.



Source: OECD (2013), Innovative Learning Environments

The impact of physical resources in education

Health, wellbeing, emotional, social, cognitive and behavioural characteristics of individuals are pre-conditions that can enhance or impede learning. Indeed, they are also desirable learning outcomes in themselves (OECD, 2017). Looking from this perspective is clear that physical facilities play a role.

Several scholars investigated the relation between physical infrastructures and educational outcomes. Gunter and Shao (2016) in their meta-analysis of the literature reviewed 623 papers and found that "*on average, school building condition is positively related to academic achievement to a weak degree*". Nevertheless, Pritchett and Filmer (1999) argues that school infrastructures investments are 7.7 more cost-effective than increasing teacher salaries. Physical infrastructures seem to matter more on mathematic achievement and for elementary school students albeit is not perfectly clear why. A possibility could be that mathematics are learnt mostly at school whereas reading could be acquired also at home. Regarding the second aspect it has been argued that younger children are more influenced by the learning environment.

Infrastructures seem to have not only an impact on learning but also on school attendance. Branham (2004), for instance by studying 226 Houston District schools argues that "*the quality of school infrastructure has a significant effect on school attendance and drop-out rate*" … "*a 1,000-student school in need of structural repair can expect a loss of four to five students a day in attendance*".

Other scholar attempted to analyse the impact of specific features / conditions of spaces on learning processes. Duyar (2010) by analysing 1045 answers to the Public School Principals' Perceptions of Their Facilities: Fall 2005 survey, identified the following facility conditions to be statistically significant in relations to students achievement: natural lighting, air conditioning, acoustic, physical condition of building and size or configuration of classrooms. Artificial lightning, indoor air quality and cleanliness albeit positively correlated, proved not to be significant.

The impact of physical resources in education

The Head project (2015) by surveying 3,766 pupils from 27 primary schools in UK assessed the impact of individual classroom conditions on learning. It fund out that physical learning environment explains 16% of the variation of overall learning progress in a year, light, temperature and air quality accounting for half the impact.

Looking at different studies, it looks like, as concluded by OECD (2016) that what matters for student achievement and other education outcomes is not necessarily the amount of resources – at least once a minimum level has been reached – but the quality of those resources, how effectively they are used, and how equitably they are distributed across schools.

Further, Hanushek and Woessmann (2017) argue that e that differences in teacher quality and instruction time do matter suggests that what matters is not so much the amount of inputs that school systems are endowed with, but rather how they use them.

Defining “needs” in education sector

As every other input resource, also physical learning environment can be evaluated in terms of adequacy, effectiveness and efficiency. OECD (2017) provides the following definition of these dimensions:

- Adequate learning environment is the learning environment that meets the minimum requirements to ensure users’ comfort, access, health, safety and security.
- Effective learning environment is the learning environment that supports the varied demands of teaching and learning to enable a school to achieve its educational objectives.
- Efficient learning environment is the learning environment that maximises the use and management of space and resources to achieve maximum output in terms of student and teacher outcomes.

Further, we could add the dimension of environmental sustainability.

The question is, after the criterion of adequate learning environment is met (and what that means is context specific), is whether there is a limit to which the built environment may indirectly have impact on learning and other outcomes? The literature suggests that improvement could plateau but again there is little evidence (OECD, 2017).

Ideally in order to assess the investment need we should therefore know the status quo of existing physical resources and, based on best practices, measure the potential gap and action needed to fill it. However, there’s limited knowledge about the interplay between learning outcomes and physical learning environment. Few methodologies have included an outcome measure such as student performance to evaluate the physical learning environment (OECD, 2017).

Defining “needs” in education sector

Available information about existing building stock is rather limited. For example, based on our analysis of National Renovation Strategies drafted according to Directive 2012/27/EU, only 16 out 28 EU countries collect data about floor space and 13 the number of educational buildings. Contrary to healthcare no data are collected on schools/ universities equipment.

Like in the healthcare sector education expenditure is mostly driven by income: holding all else constant, a given change in personal income in a state will lead to an increase in spending on education of an equal percentage (Fernandez and Rogerson, 2001). As confirmed also by our model demographic variables play a minor role in spending per student. So defining a need in the education sector is a matter of policy decision.

In this case we chose, drawing also from EU 2020 policy objective, to focus in reducing the rate of early leavers. This is particularly important because leaving education early exposes people (Cedefop, 2016) to:

1. a higher risk of unemployment (incidence and duration), lower income, precarious work conditions, and lower job satisfaction;
2. worse health, lower life expectancy, and worse lifetime satisfaction;
3. lower participation in democratic institutions and other civil society initiatives and organisations.

Expenditure in the education sector

In 2016 28 EU governments spent EUR 703 billions in education. Public expenditure, where data are available (all EU countries bar Denmark, Greece, Estonia, Croatia, Hungary), represents on average 89% of total expenditure ranging from a minimum of 80% in the UK to 100% in Sweden. It is worth noting that as in the case of healthcare a service provided for free at point of delivery, meaning that citizens won't pay nothing, could still be delivered by private operators.

In 2016 62% of Government expenditure was directed towards salaries, 16% in intermediate consumption and only 6% for investments.

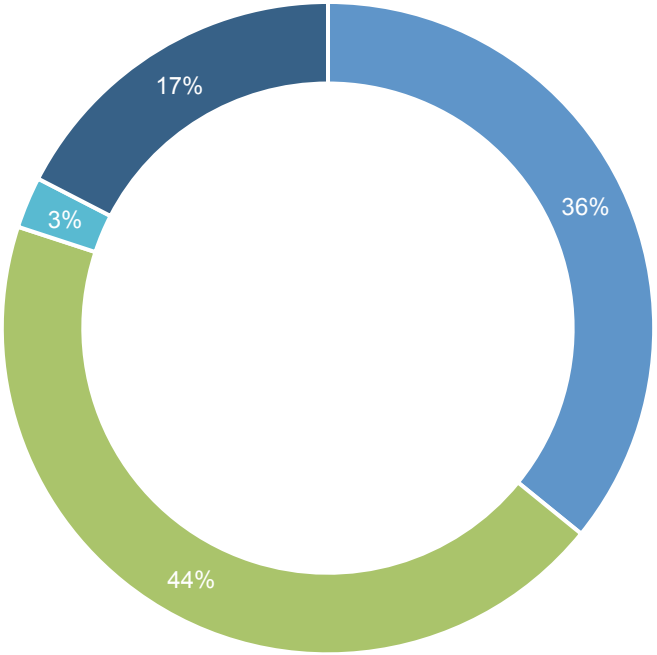
In absolute terms in 2016 EU governments directly invested EUR 45.2 billions in education assets. We shall, then, add other EUR 3.5 billions of investment grants, meaning private sector investment in education financed in part by the government.

Looking at data for the whole economy (i.e. gross fixed capital formation in the education sector): in 2015, 25 out of 28 countries where data are available, EUR 92 billions were invested by public and private sector combined. The UK invested almost a third of this figure (EUR 28 billions), followed by Germany (EUR 19 billions) and France (EUR 9 billions).

It is interesting to note that nowadays 50% of investments are related to intellectual property products up from 25% back in 1995. A fourfold increase in absolute terms whereas investments in constructions experienced a 50% growth. Taking a closer look: 77% percent of intellectual property products category is represented by the capitalization of research and development expenditure, 13% by computer software and databases.

Capital Expenditure in the education sector

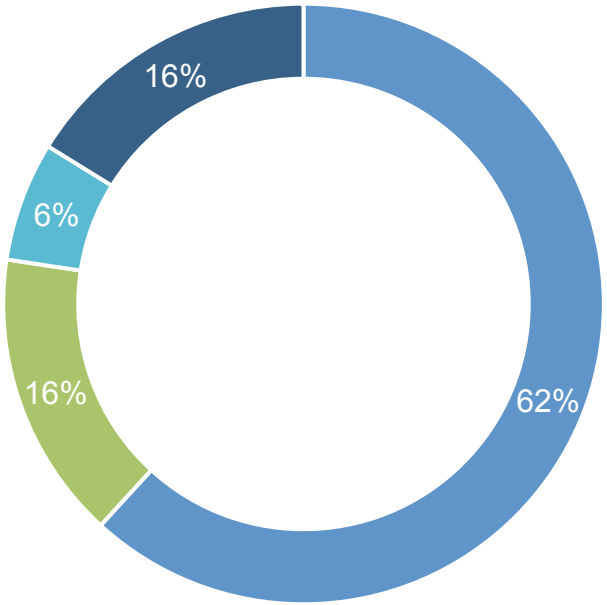
Education government expenditure per ISCED LEVEL



ISCED 0: Early childhood education
ISCED 1: primary school
ISCED 2: Lower secondary education
ISCED 3: Upper secondary education
ISCED 4: Post-secondary non-tertiary education
ISCED 5: Short-cycle tertiary education
ISCED 6: Bachelor's or equivalent level

ISCED 0-1 ISCED 2-3
ISCED 4 ISCED 5-6

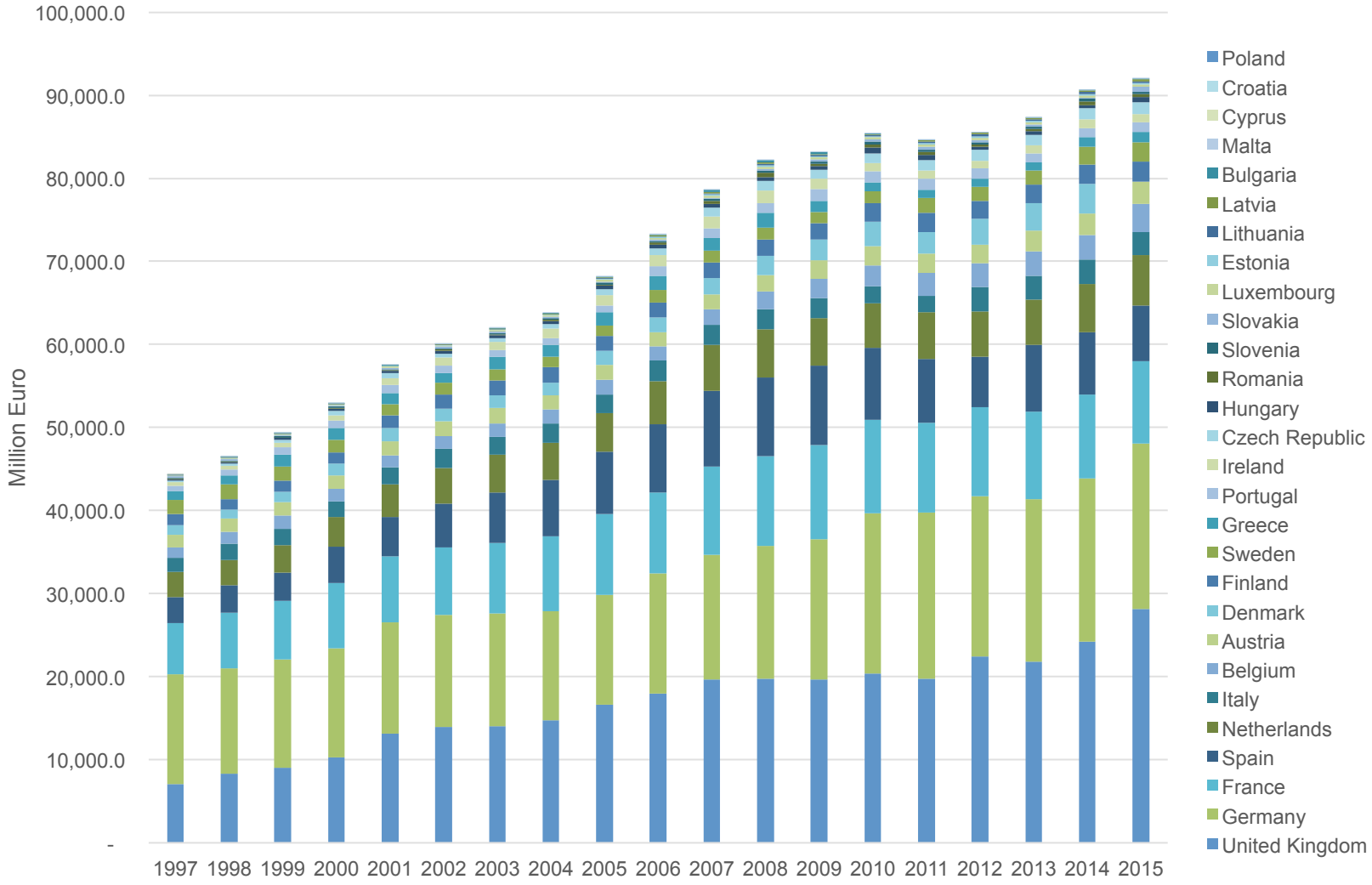
Education government expenditure



Compensation of employees
Intermediate consumption
Gross fixed capital formation
Other

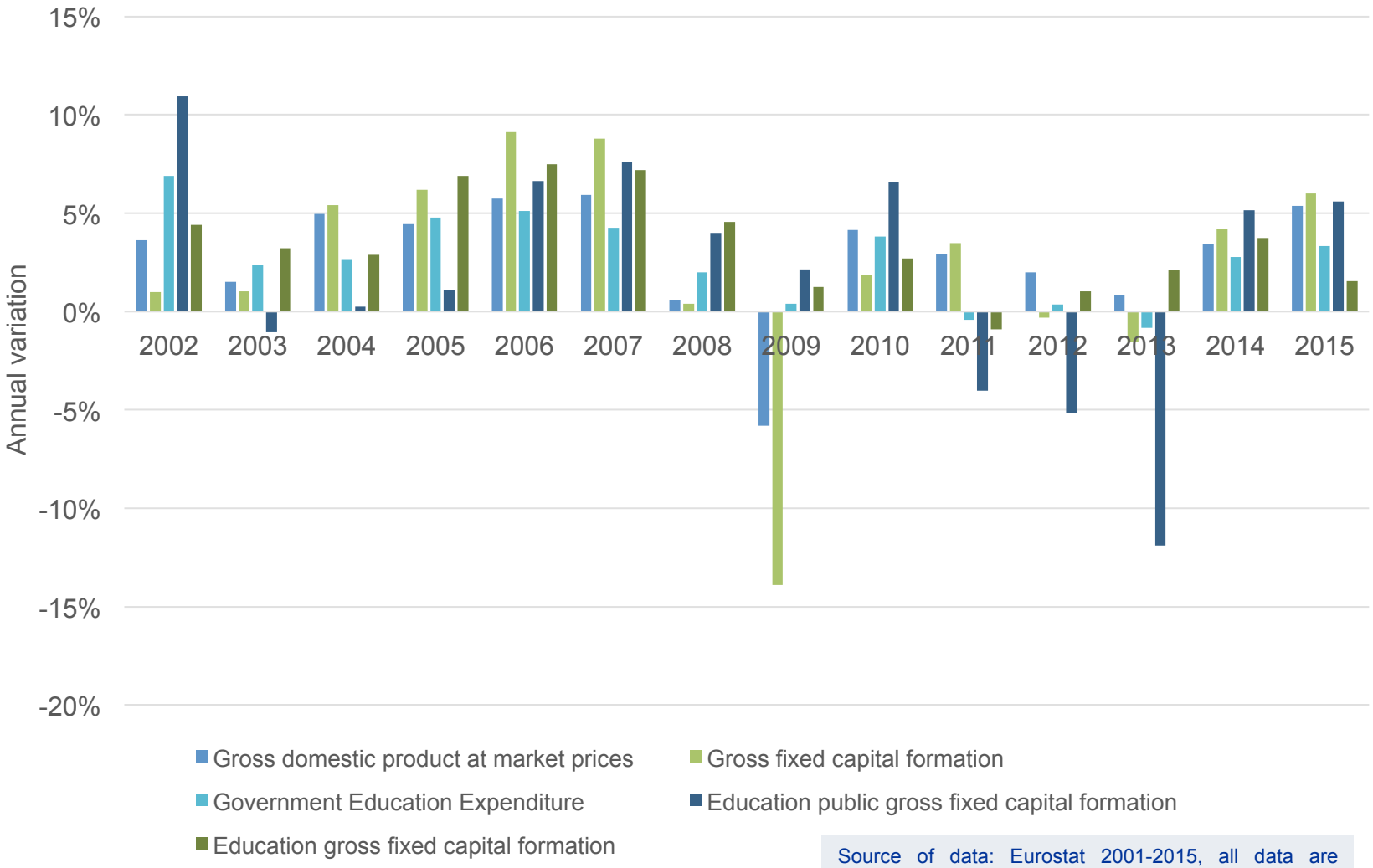
Source of data: Eurostat, General Government Expenditure in 2015, 2016

Capital expenditure in the education sector 1995-2015 by country



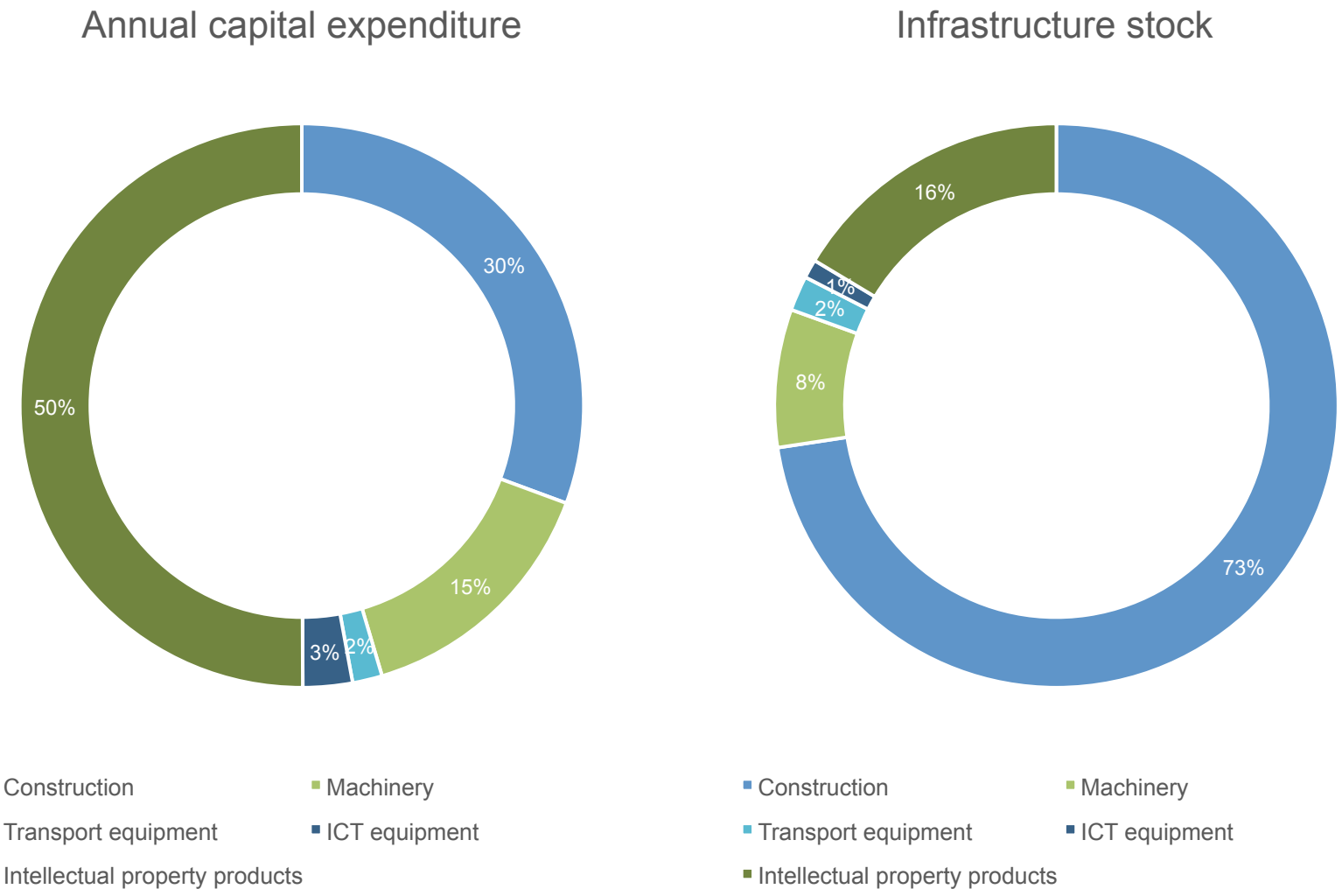
Source of data: Eurostat 1995-2015, all data are expressed in current prices

Investment in education put into perspective



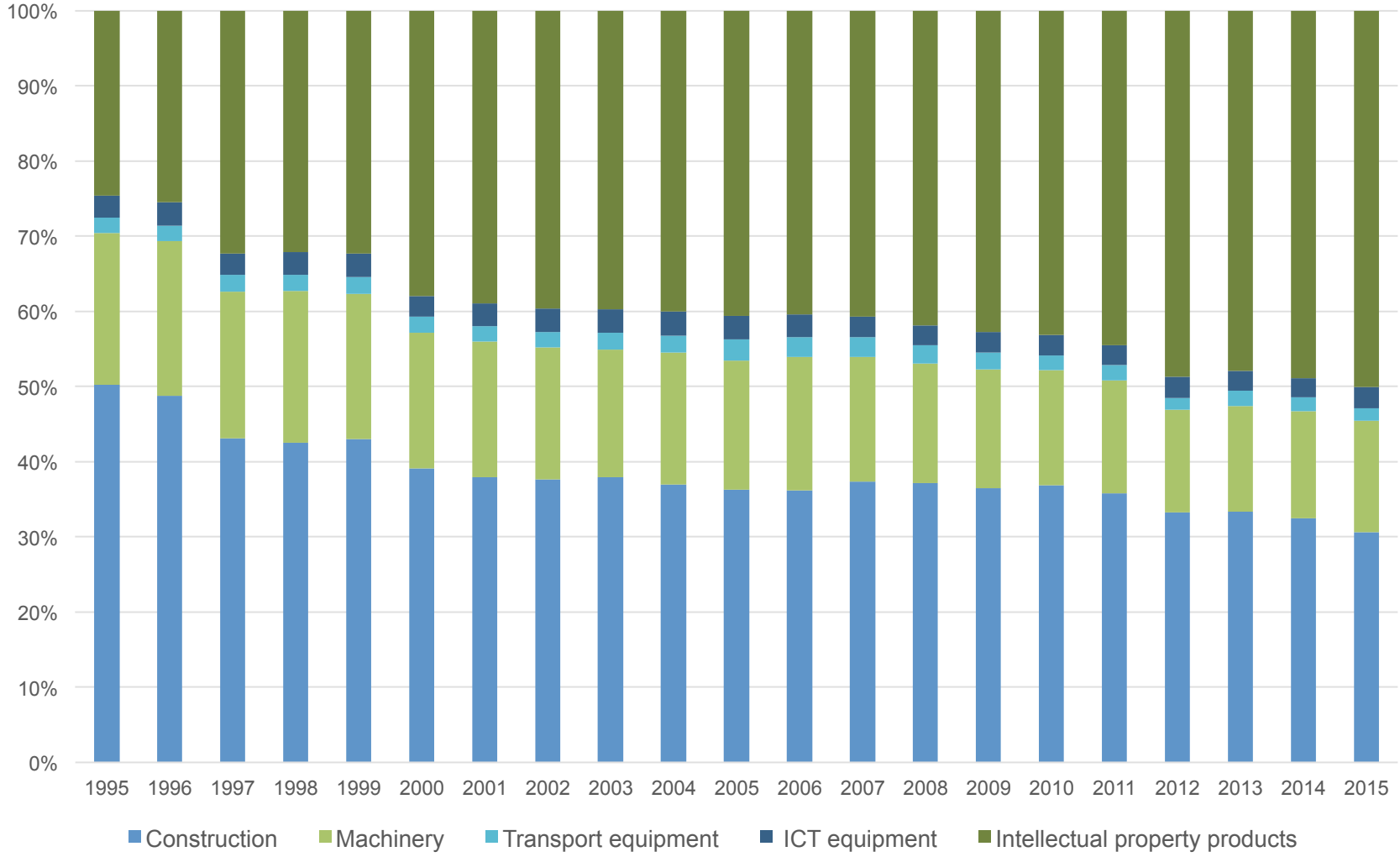
Source of data: Eurostat 2001-2015, all data are expressed in current prices

Education annual capital expenditure and infrastructure stock by category in the EU



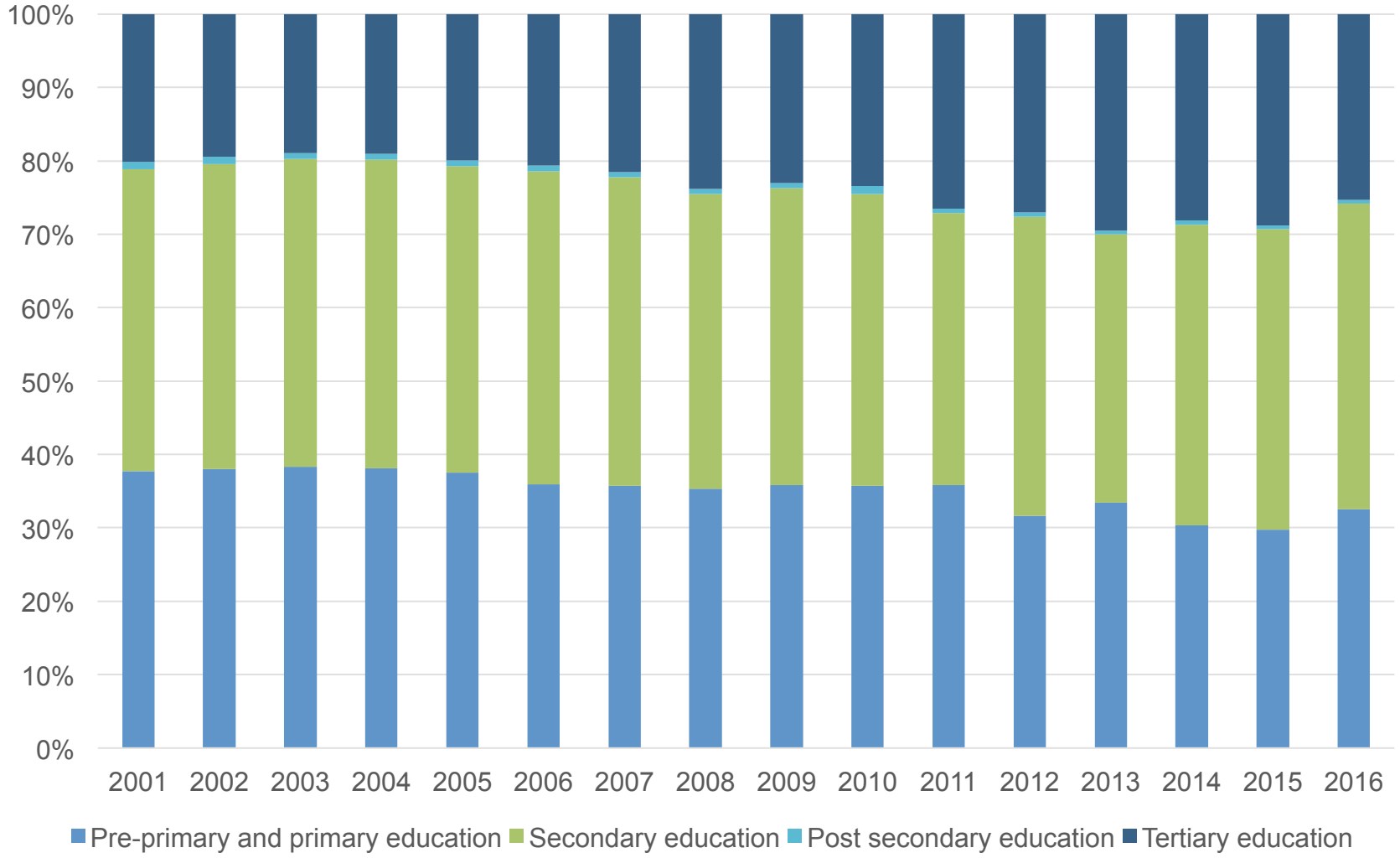
Source of data: Eurostat, data are referred to 2014 EU level

Evolution of education annual capital expenditure by asset



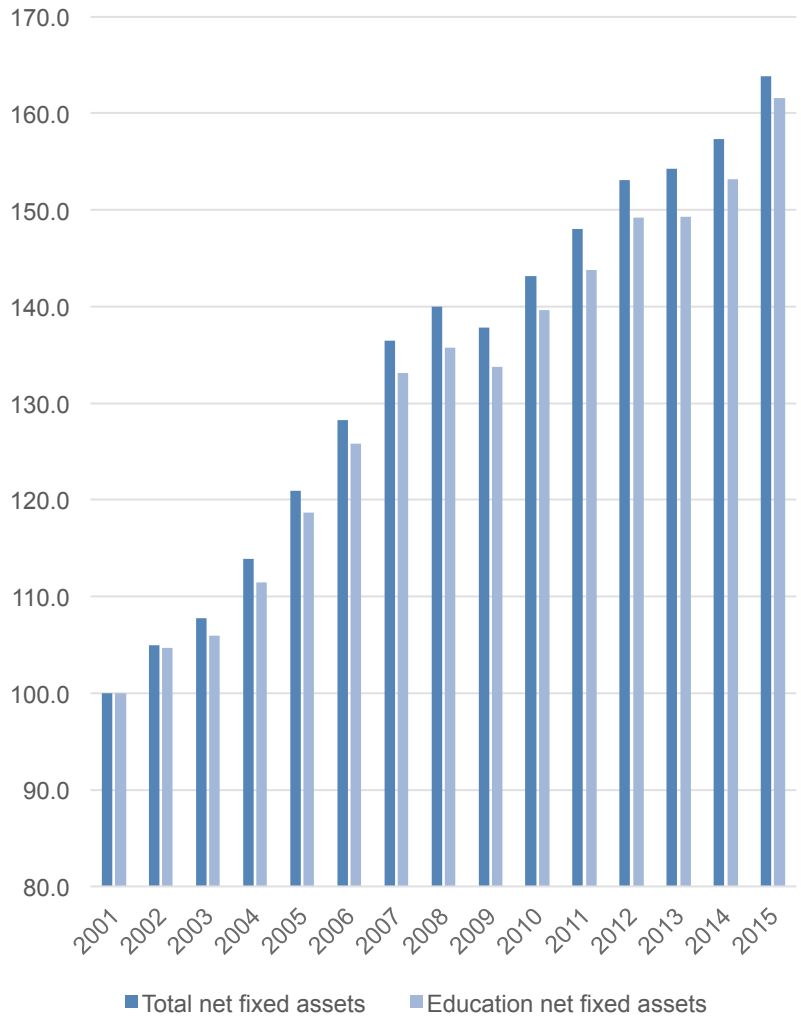
Source of data: Eurostat 1995-2015

Evolution of education annual capital expenditure by education level



Source of data: Eurostat 2001-2016

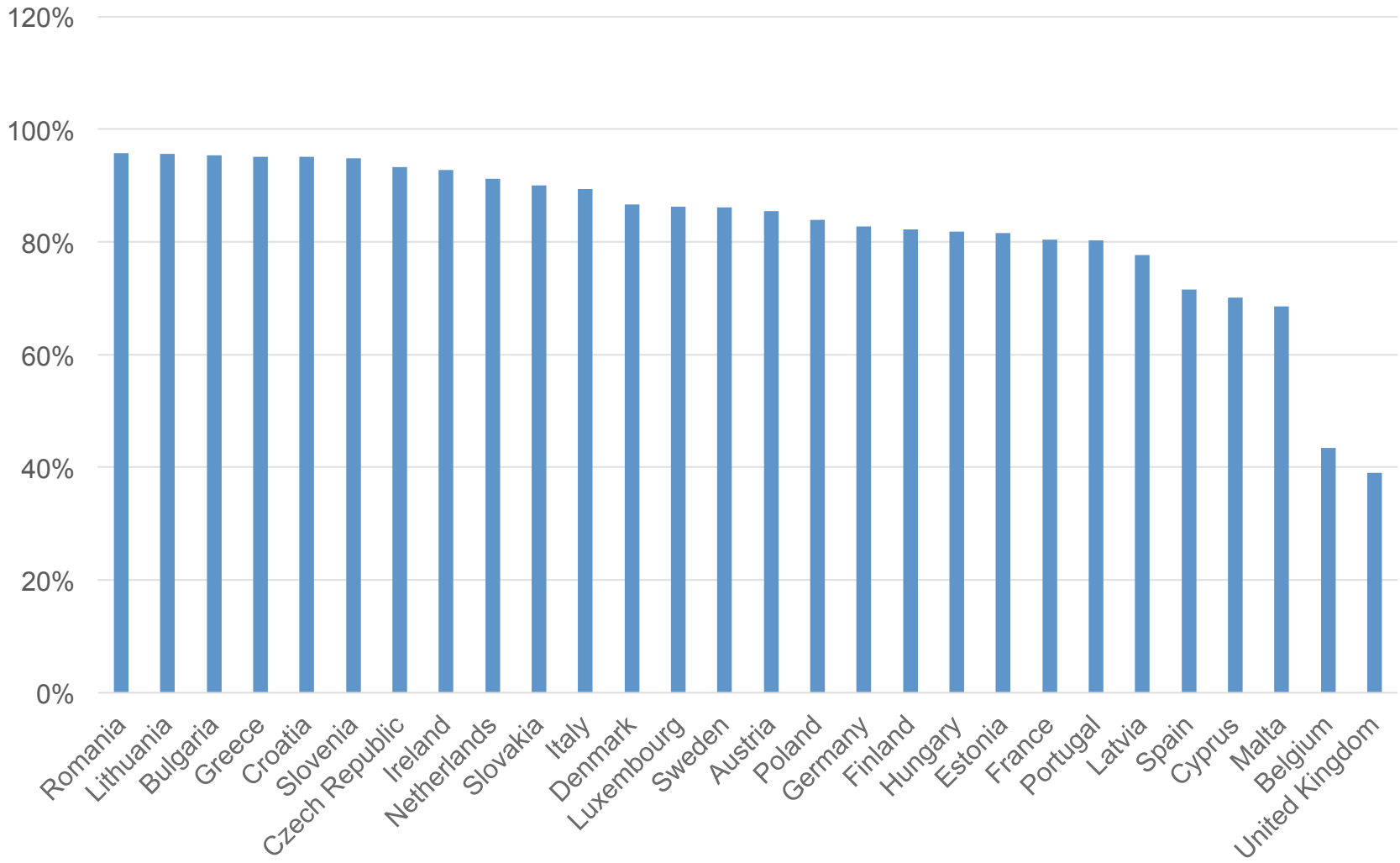
Education infrastructure stock (2001 = 100)



Contrary to the healthcare sector, the rate of growth of investment in education beat GDP, investments and also general education expenditure in the majority of the considered period (respectively 64%, 57% and 71% of the time). Also public investments in education enjoyed higher rate of growth then broad education expenditure (57% of the time).

Nevertheless when looking at the net stock of assets we can notice that it is trailing the evolution of broad asset stock of the economy (data refer to the following countries: Belgium,Czech Republic,Denmark,Estonia, Ireland, Greece, France, Italy, Lithuania, Luxembourg, Hungary, Netherlands, Austria, Poland, Portugal, Slovenia, Finland, Sweden, United Kingdom).

Proportion of pupils and students enrolled in public institutions in 2016



Source of projections: Eurostat, All ISCED 2011 levels excluding early childhood educational development (1-8 levels)

SDA Bocconi

European Investment Bank

B1.4. Deatiled results
Investment scenarios

Are we facing an investment gap?

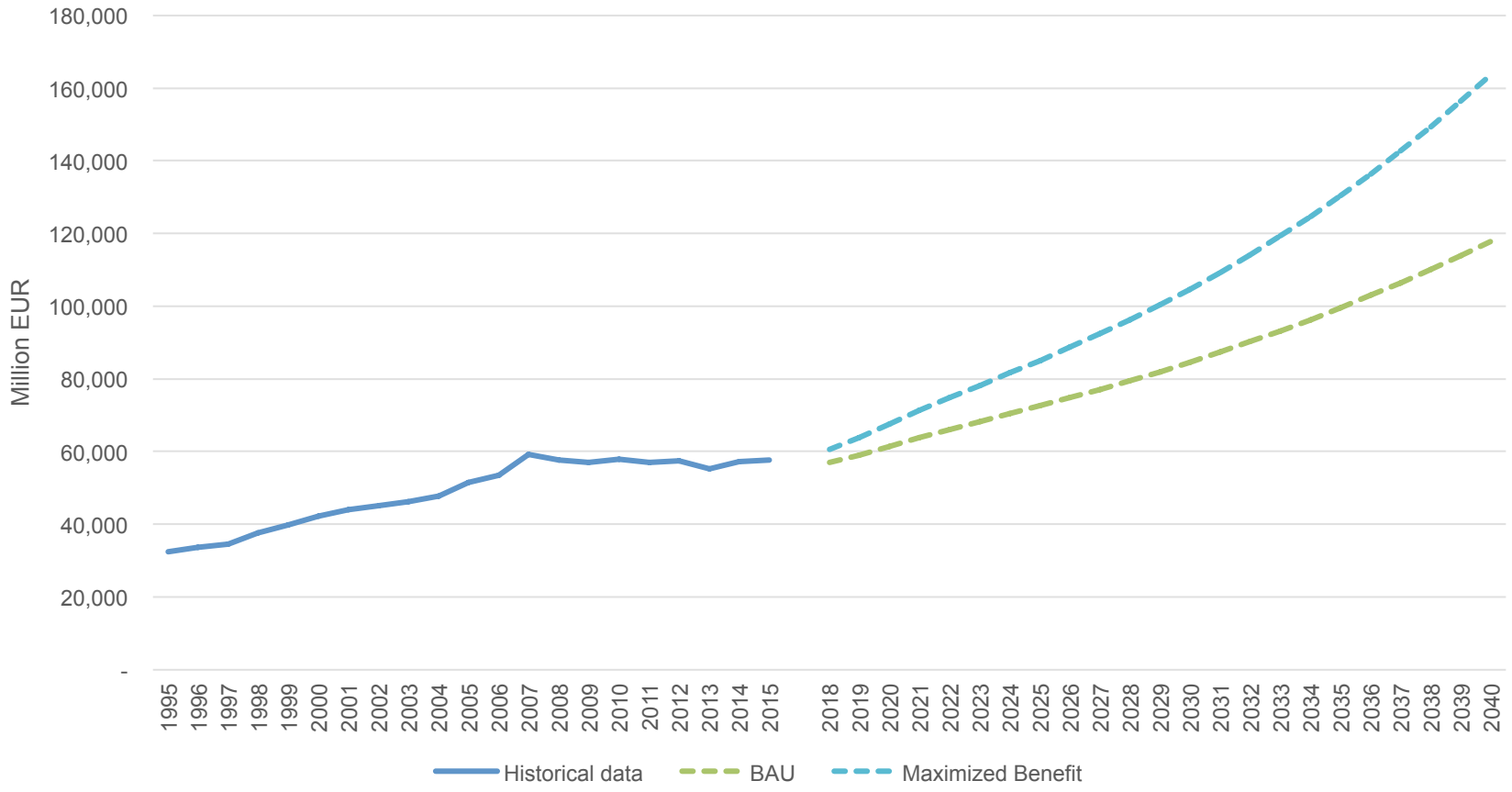
Starting from these considerations we we characterised a country-specific investment model and we estimate it by using panel data techniques to forecast future infrastructure investment in the 28 EU countries in the 2015-2040 period.

The model entails three equations:

- the first two equations capture the relation between fixed capital formation in the healthcare and education sector and economic and demographic variable.
- the last equation introduces a policy objective: for the healthcare sector, it puts in relationship the unmet needs with the infrastructural dimension; for education, it looks at the effect on school dropouts.

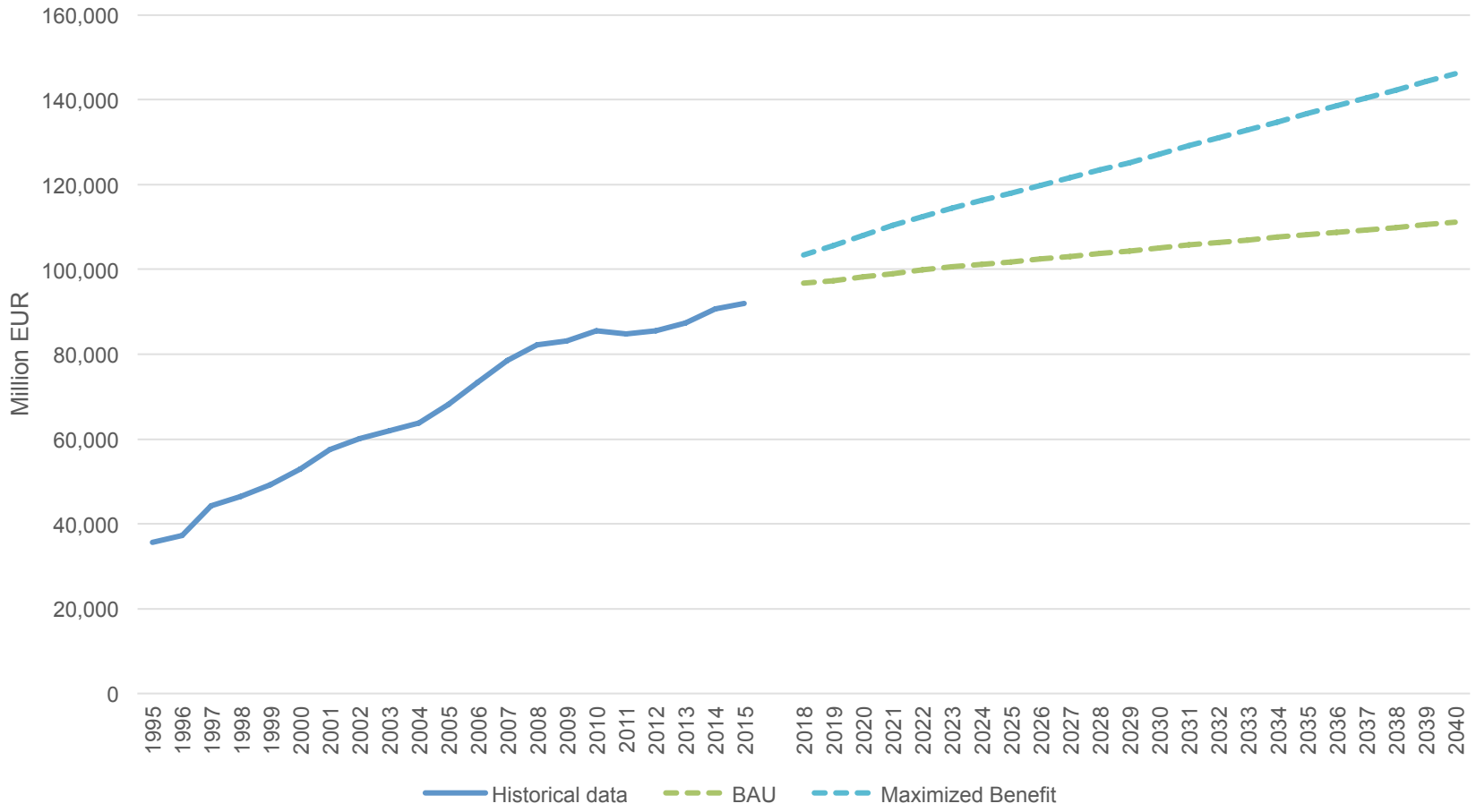
The model provides forecast infrastructure stock and flows (i.e. yearly investments) at aggregate European and Member States level (so called business as usual – BAU – scenario). The metric referenced is total investments and existent real assets, aggregated across the different asset classes.
The model provides an estimate of the investment gap at an aggregate European Level calculated as the difference between the BAU scenario and a counterfactual scenario. As we may see there's an investment gap gradually arises from the mid 2020's.

EU annual investment forecasted needs 2015-2040: healthcare



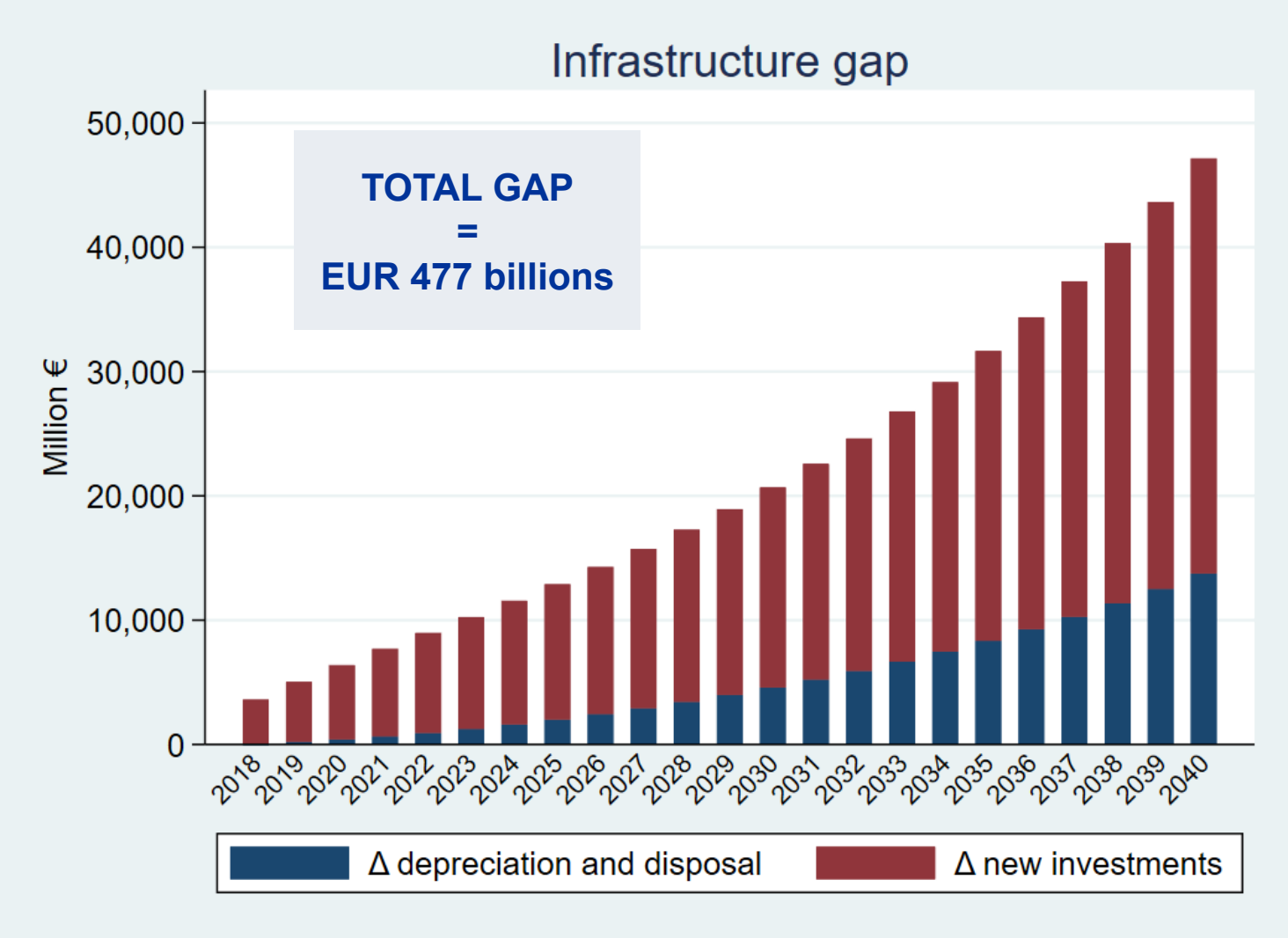
Note: Total Healthcare Investments. EU Total. Historical data as follows: (from 1995) Austria, Belgium, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Luxembourg, Sweden, United Kingdom; (from 2000) Estonia, Lithuania, Netherlands, Poland, Portugal, Slovenia; (from 2002) Bulgaria, Croatia, Malta, Romania, Spain; (from 2004) Slovakia.

EU annual investment forecasted needs 2015-2040: education

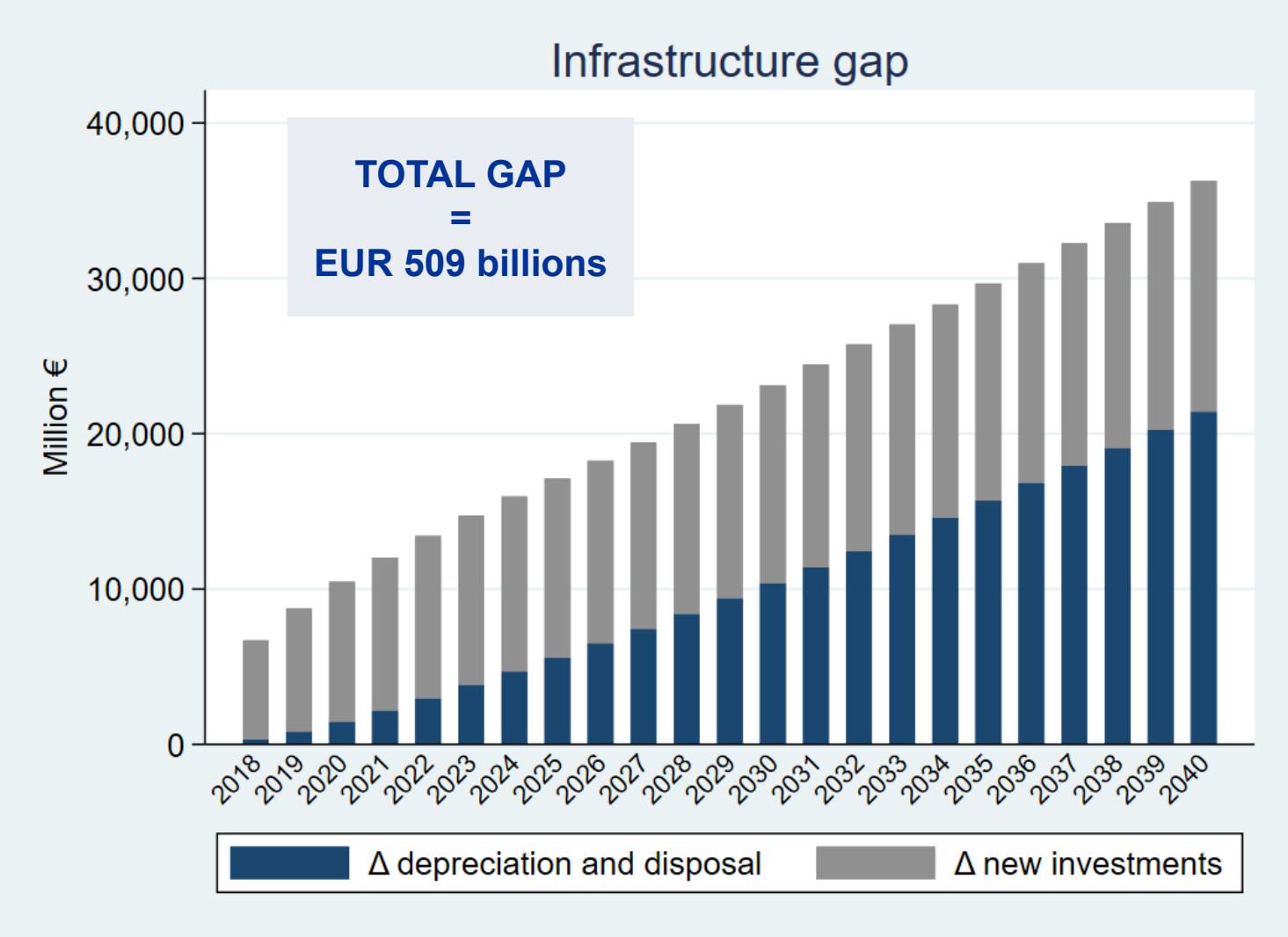


Note: : Total Education Investments. EU Total. Historical data as follows: (from 1995) Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, (from 1997), UK, (from 1998) Bulgaria,

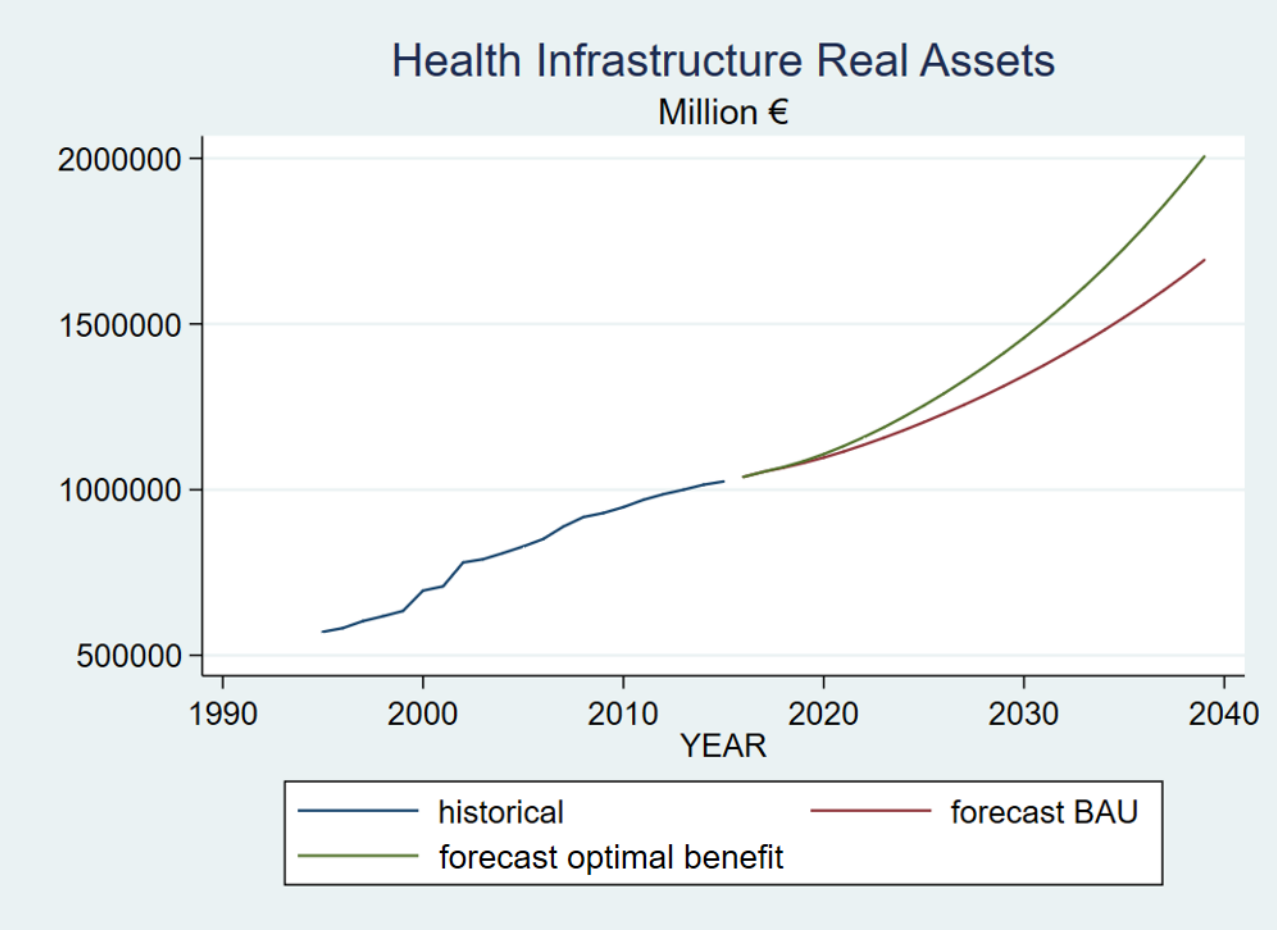
Main findings: health infrastructure investment gap



Main findings: Education infrastructure investment gap

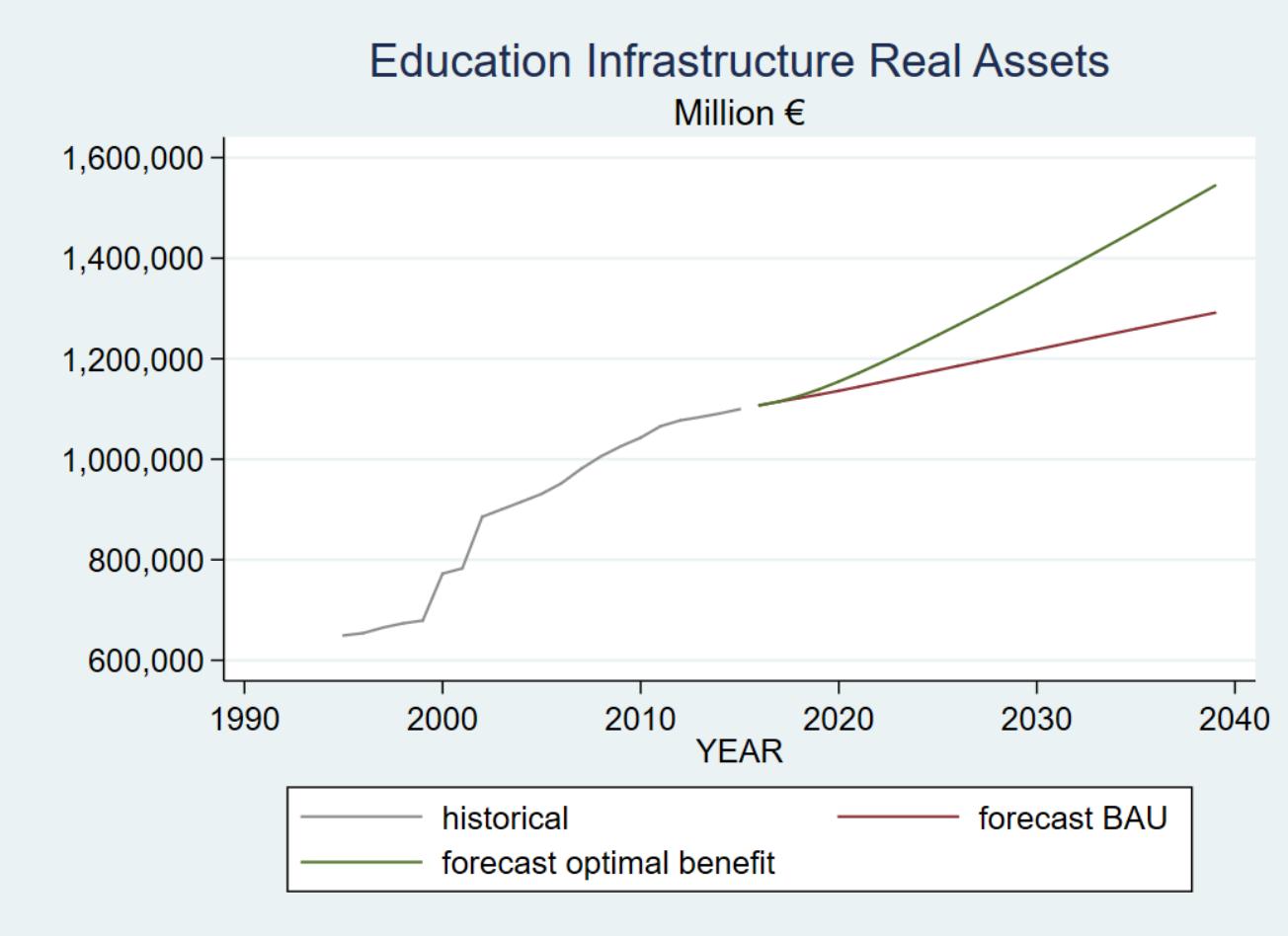


EU infrastructure stock evolution 2015-2040: healthcare



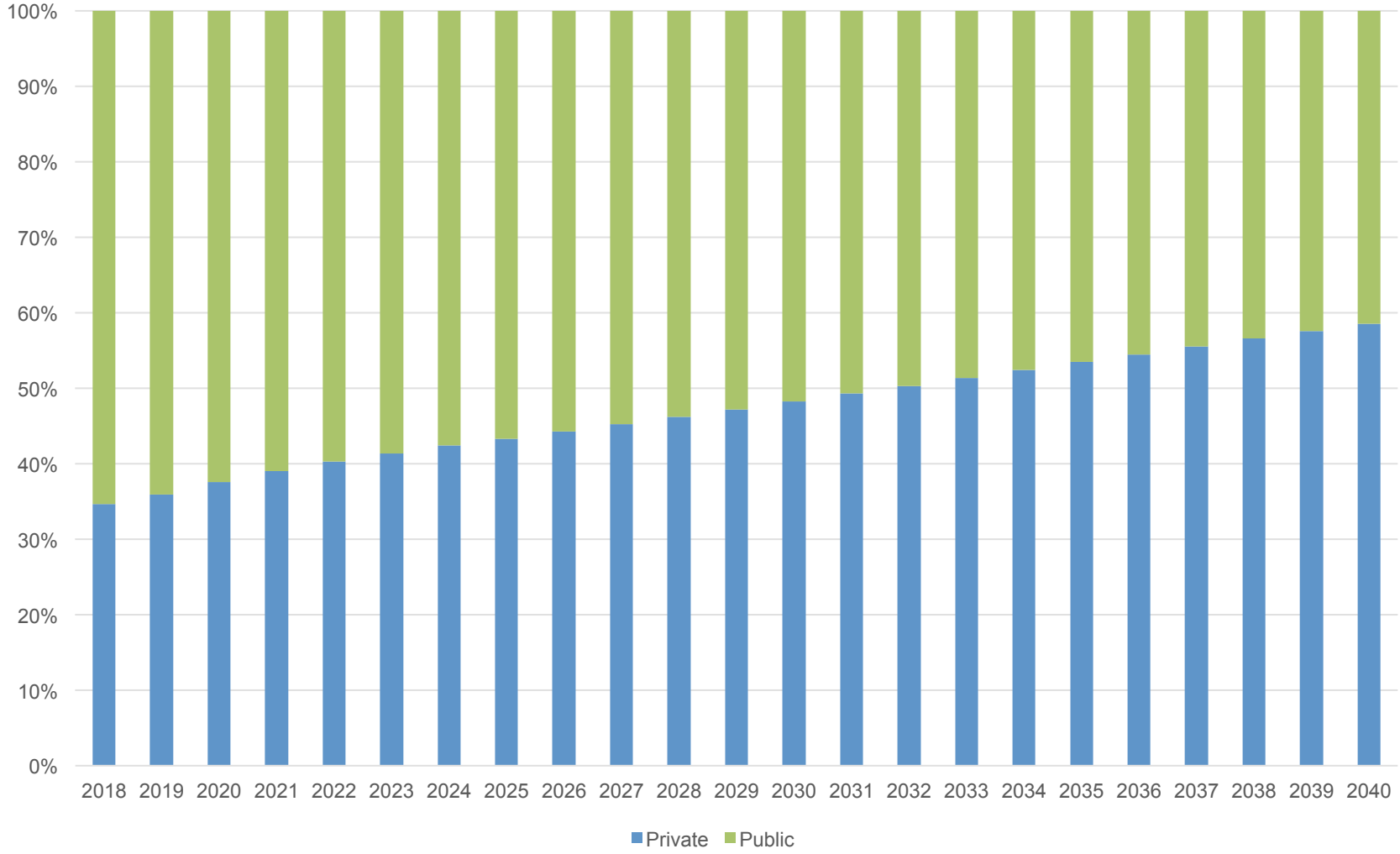
Note: : Total Healthcare Investments. EU Total. Historical data as follows: (from 1995) Austria, Belgium, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Luxembourg, Sweden, United Kingdom; (from 2000) Estonia, Lithuania, Netherlands, Poland, Portugal, Slovenia; (from 2002) Bulgaria, Croatia, Malta, Romania, Spain; (from 2004) Slovakia.

EU infrastructure stock evolution 2015-2040: education

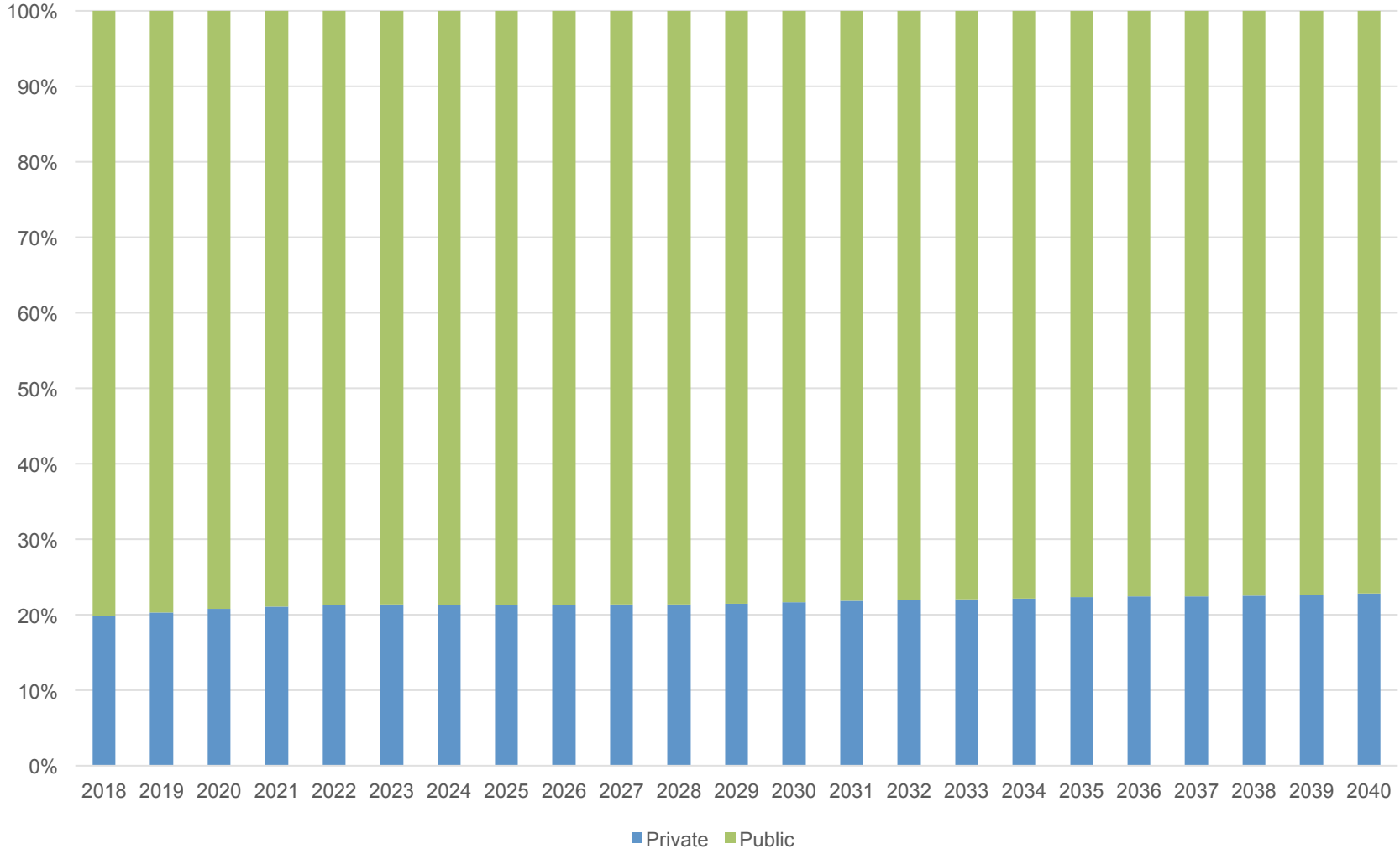


Note: Total Education Investments. EU Total. Historical data as follows: (from 1995) Austria, Belgium, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Luxembourg, Sweden, United Kingdom; (from 2000) Estonia, Lithuania, Netherlands, Poland, Portugal, Slovenia; (from 2002) Bulgaria, Croatia, Malta, Romania, Spain; (from 2004) Slovakia.

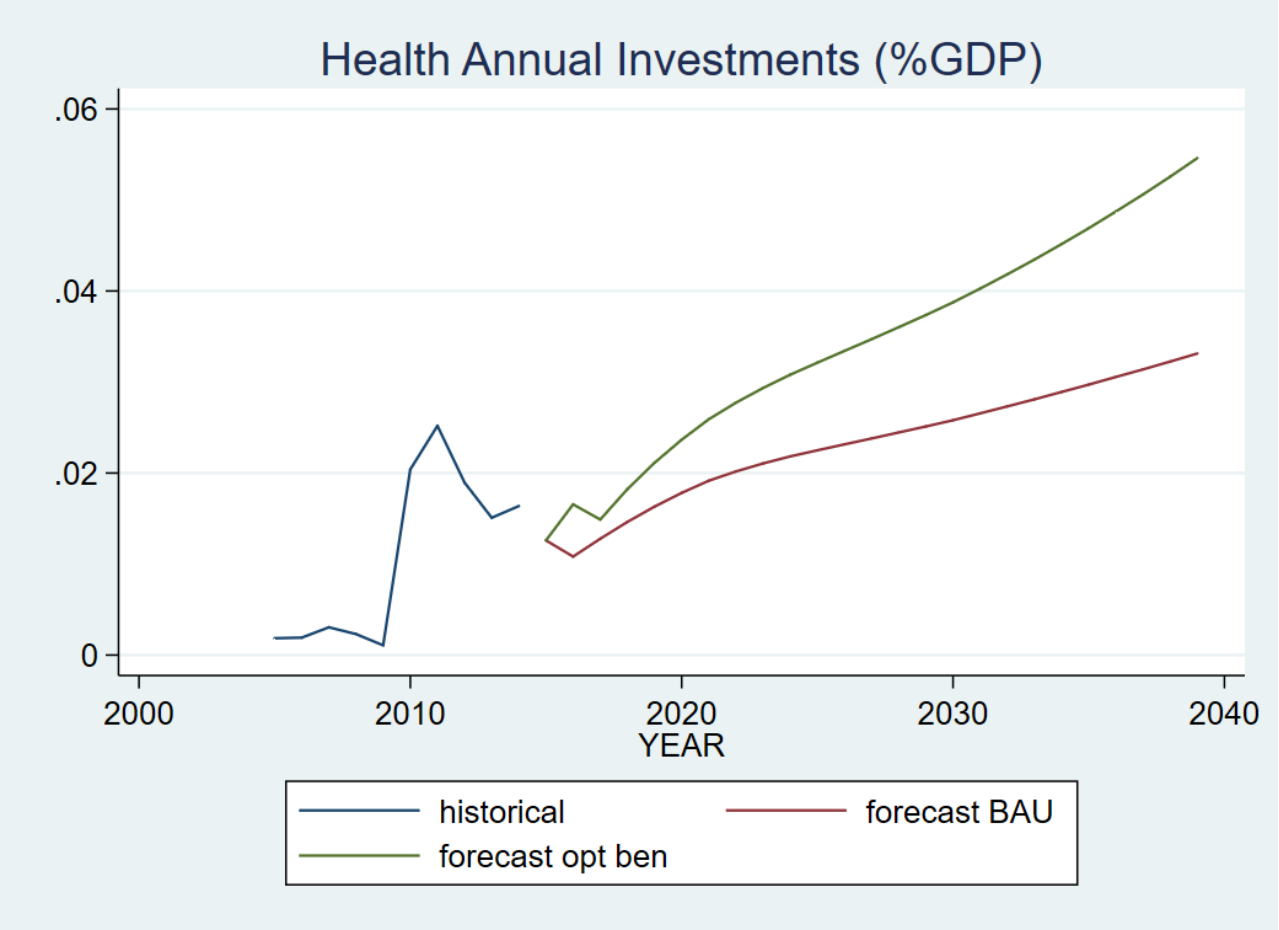
Share of public and private investment (BAU scenario): healthcare



Share of public and private investment (BAU scenario): education

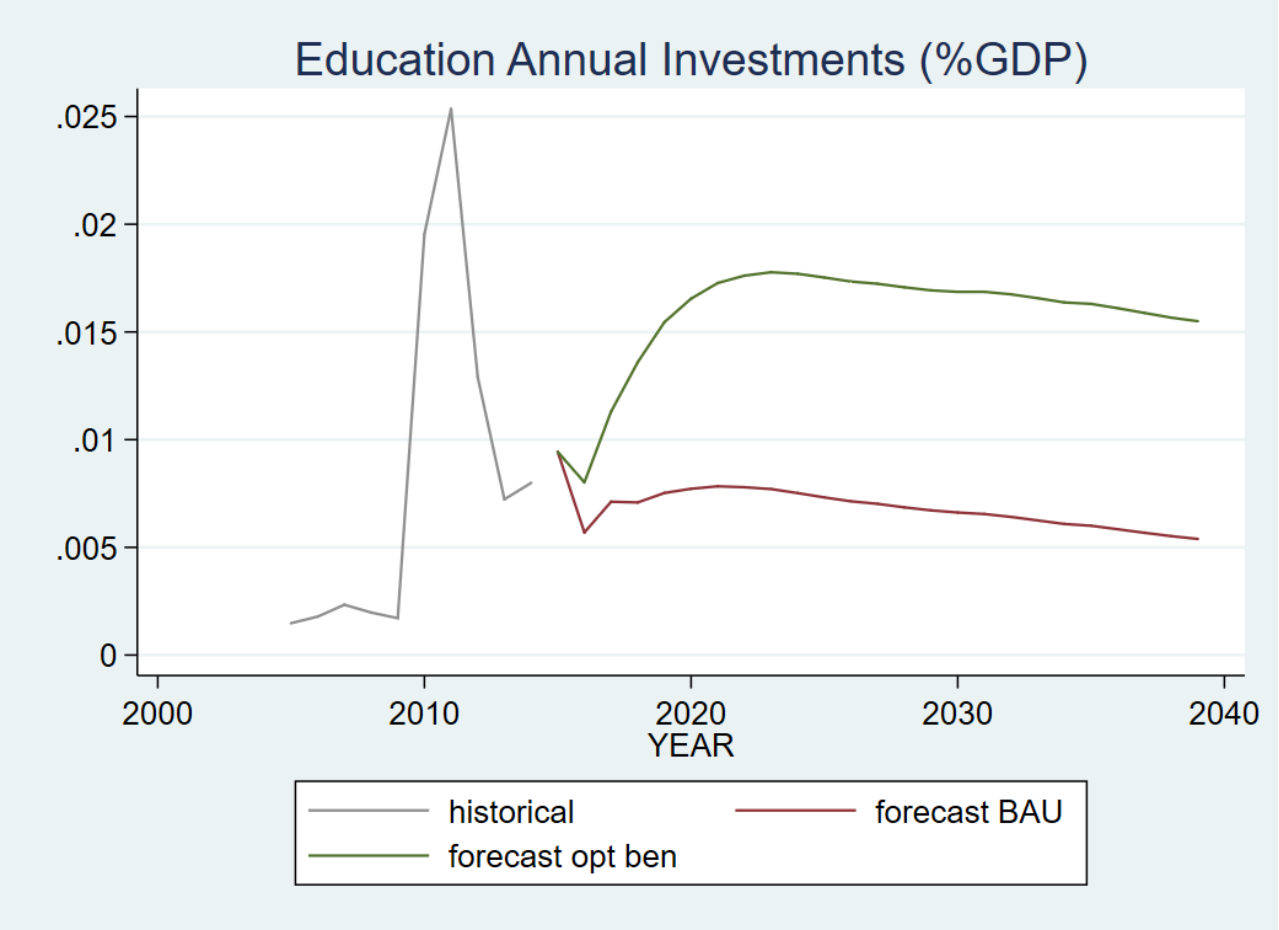


EU annual investment forecasted (% GDP) : healthcare



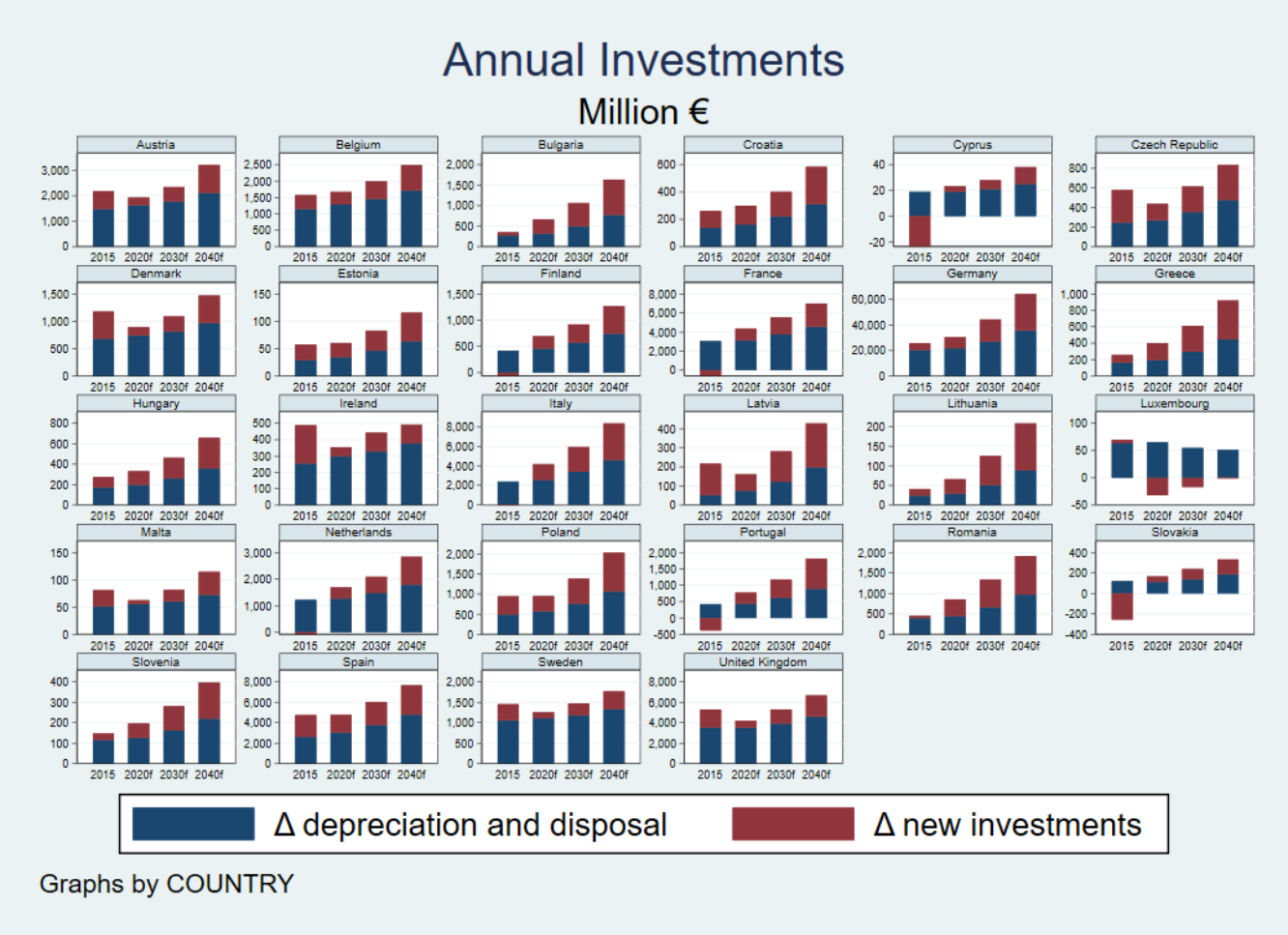
Note: Total Healthcare Investments. EU Total. Historical data as follows: (from 1995) Austria, Belgium, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Luxembourg, Sweden, United Kingdom; (from 2000) Estonia, Lithuania, Netherlands, Poland, Portugal, Slovenia; (from 2002) Bulgaria, Croatia, Malta, Romania, Spain; (from 2004) Slovakia.

EU annual investment forecasted (% GDP) : Education



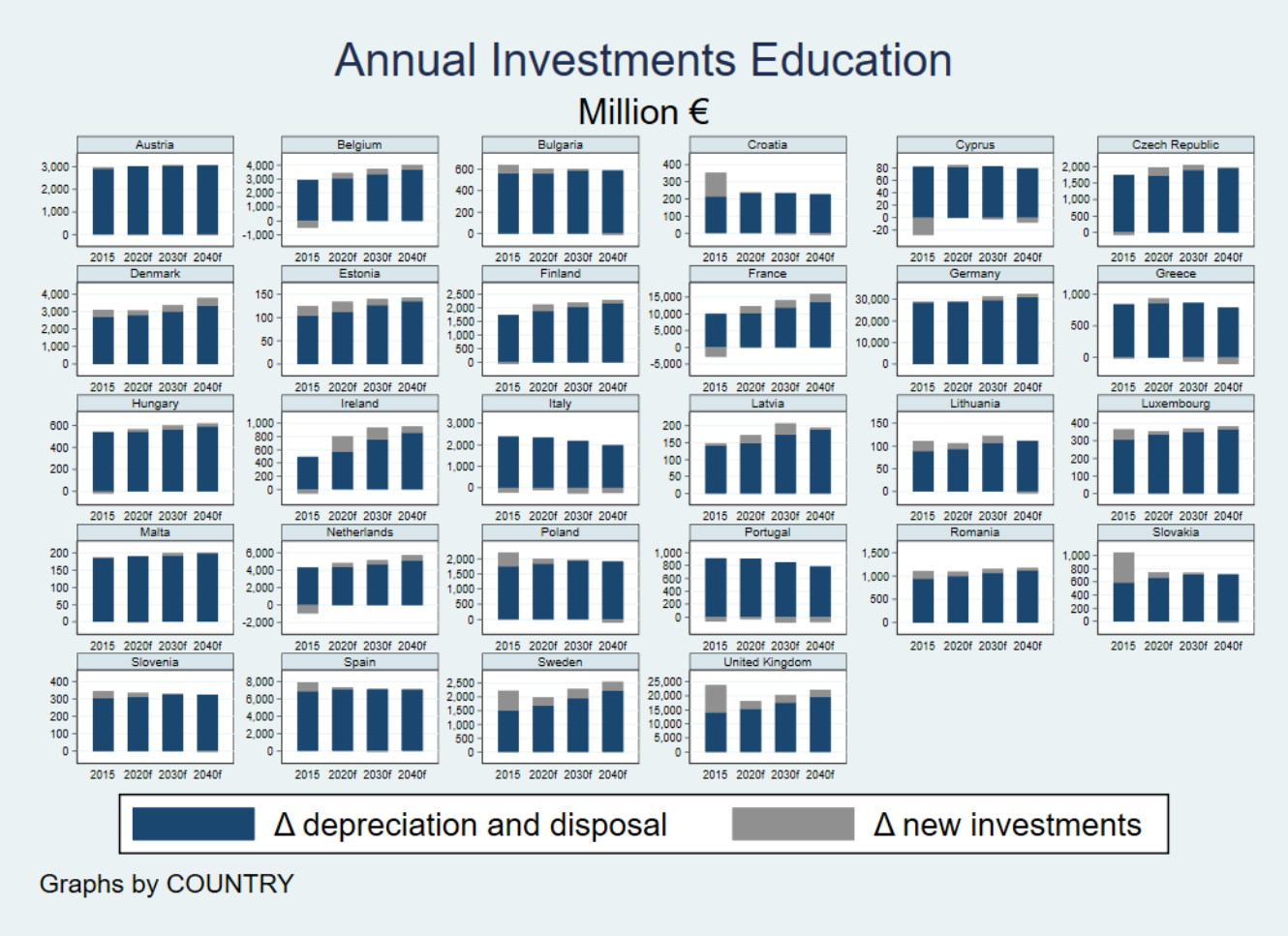
Note: : Total Education Investments. EU Total. Historical data as follows: (from 1995) Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, (from 1997), UK, (from 1998) Bulgaria,

Infrastructure net fixed capital formation investment evolution by country (BAU): healthcare



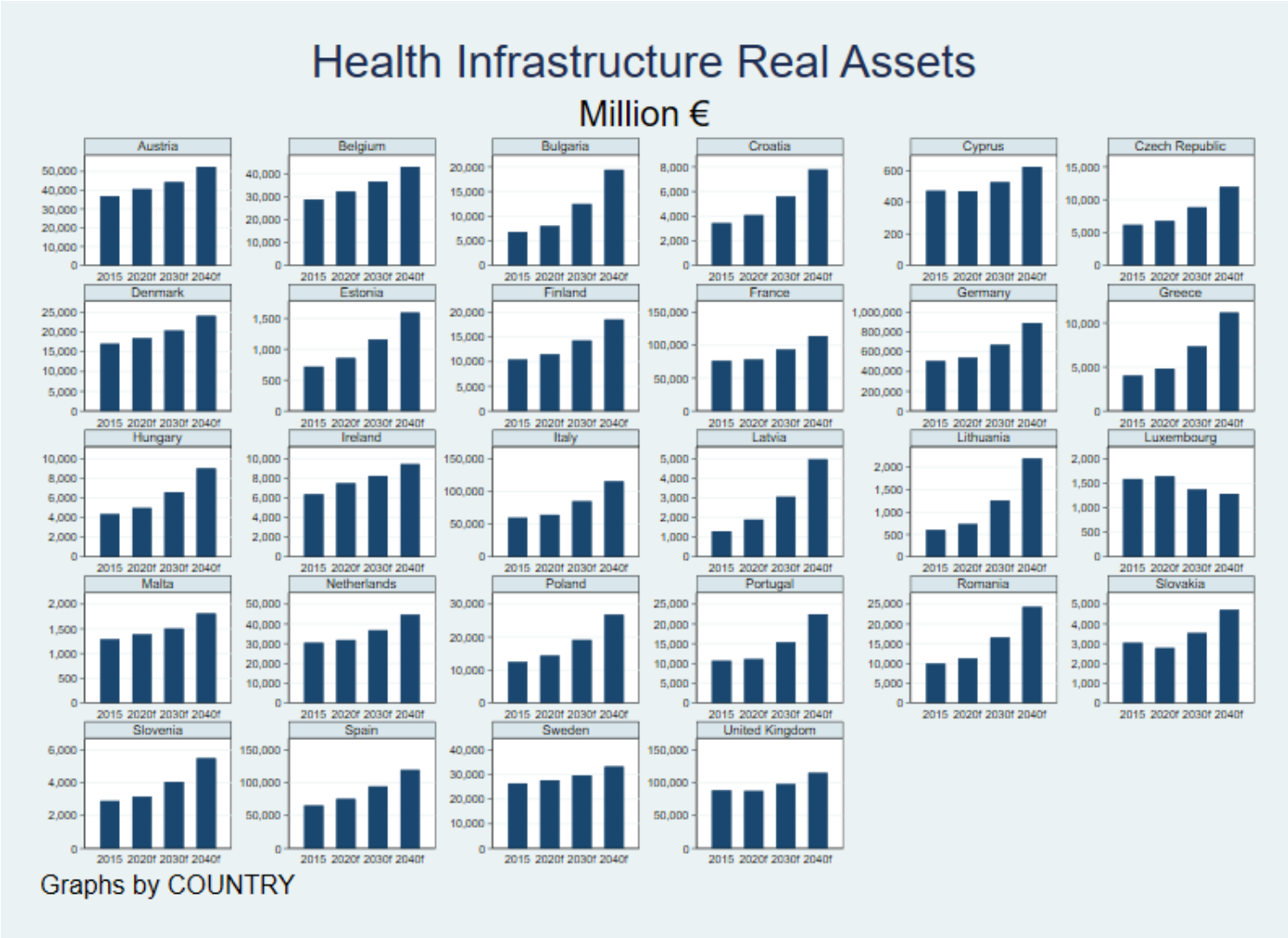
Data are historical for 2015 and forecasted for other years. Depreciation for 2015 are calculated as 4% of net real assets for consistency.

Infrastructure net fixed capital formation investment evolution by country (BAU): education

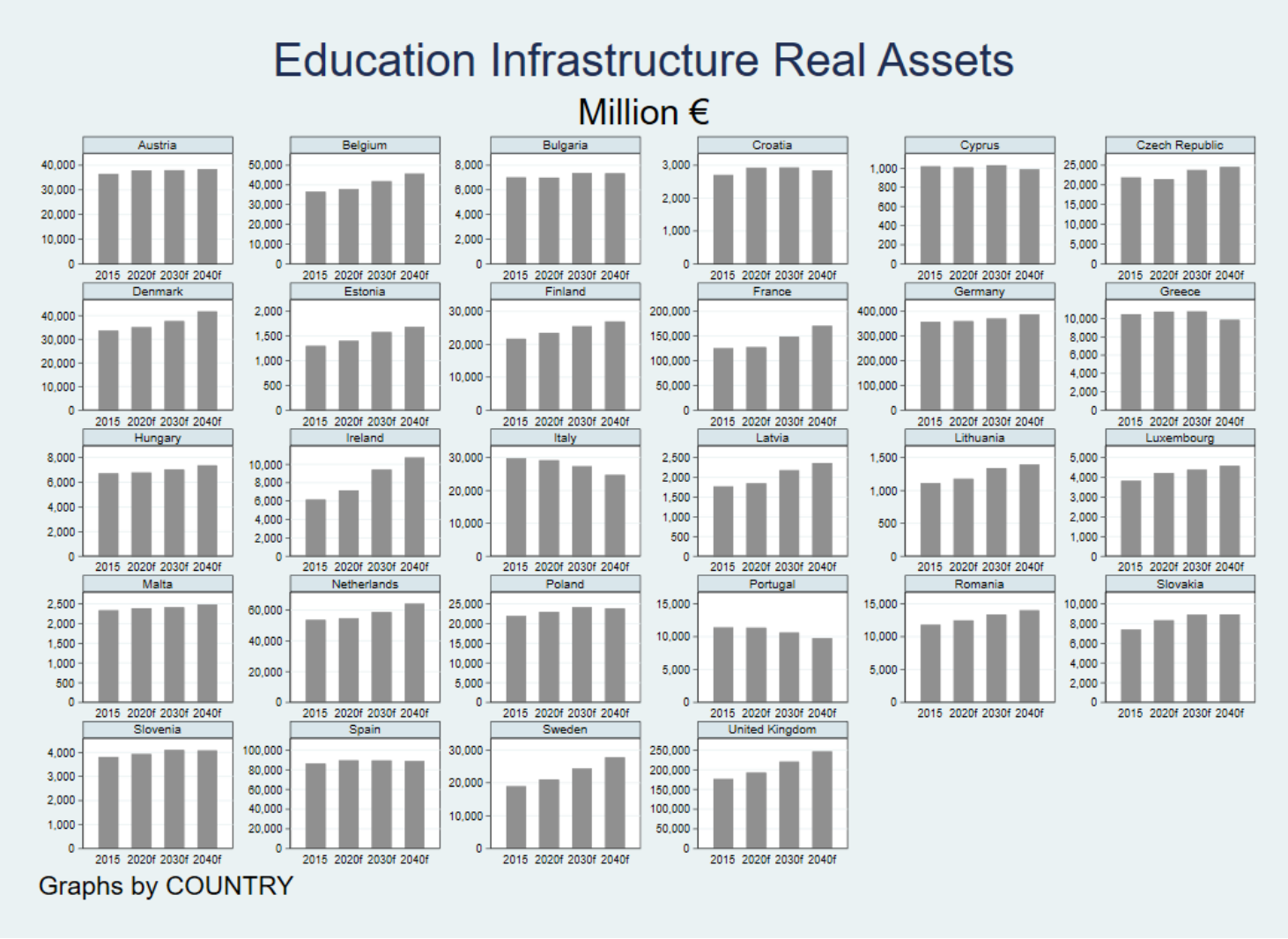


Data are historical for 2015 and forecasted for other years. Depreciation for 2015 are calculated as 4% of net real assets for consistency.

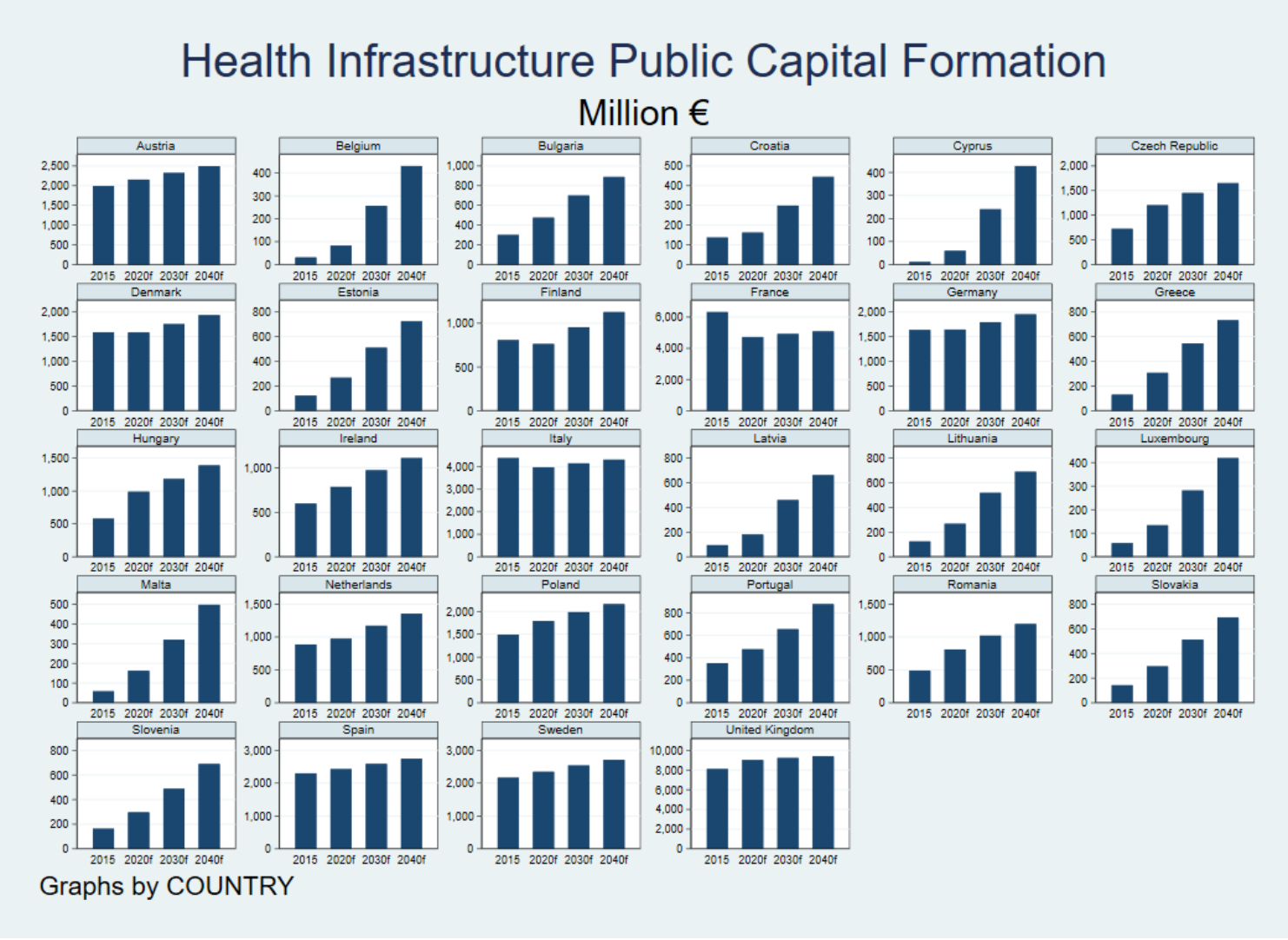
Net infrastructure stock evolution by country (BAU): healthcare



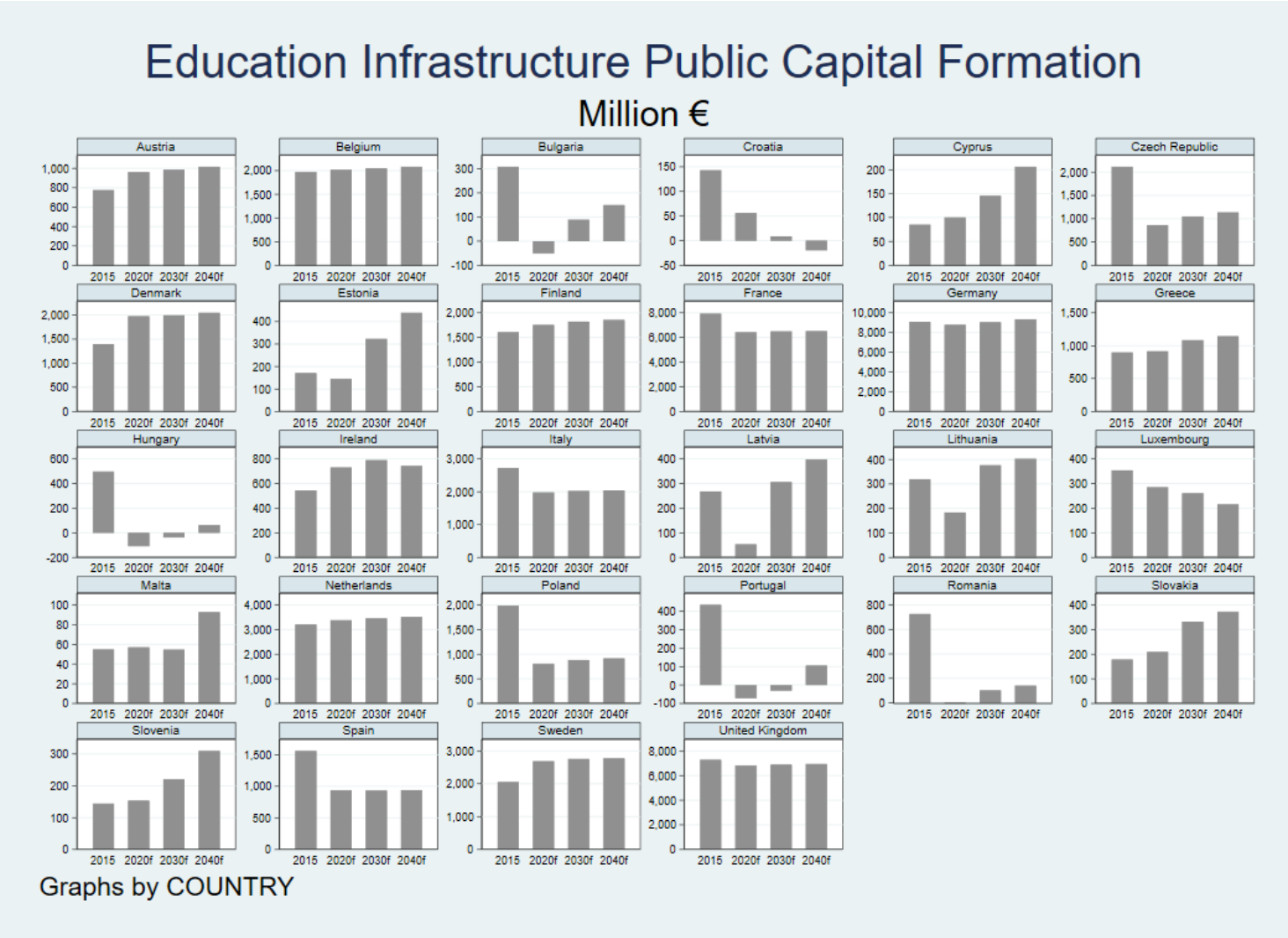
Net infrastructure stock evolution by country (BAU): education



Public investments by country (BAU): healthcare



Public investments by country (BAU): education



SDA Bocconi

European Investment Bank

B1.5. Focus
Affordable housing in Europe

Affordable housing

Compared to health and education, which are two defined sectors in the Statistical classification of economic activities in the European Community (respectively NACE rev.2 P and Q), the affordable housing sector falls within the construction, real estate and public administration. Therefore it is very difficult to get appropriate data. Government accounts classified by function (COFOG) can provide a useful source of information. Affordable housing may fall in two different classes: housing development (CS) and housing (IS) (please refer to annex 2 for their full description).

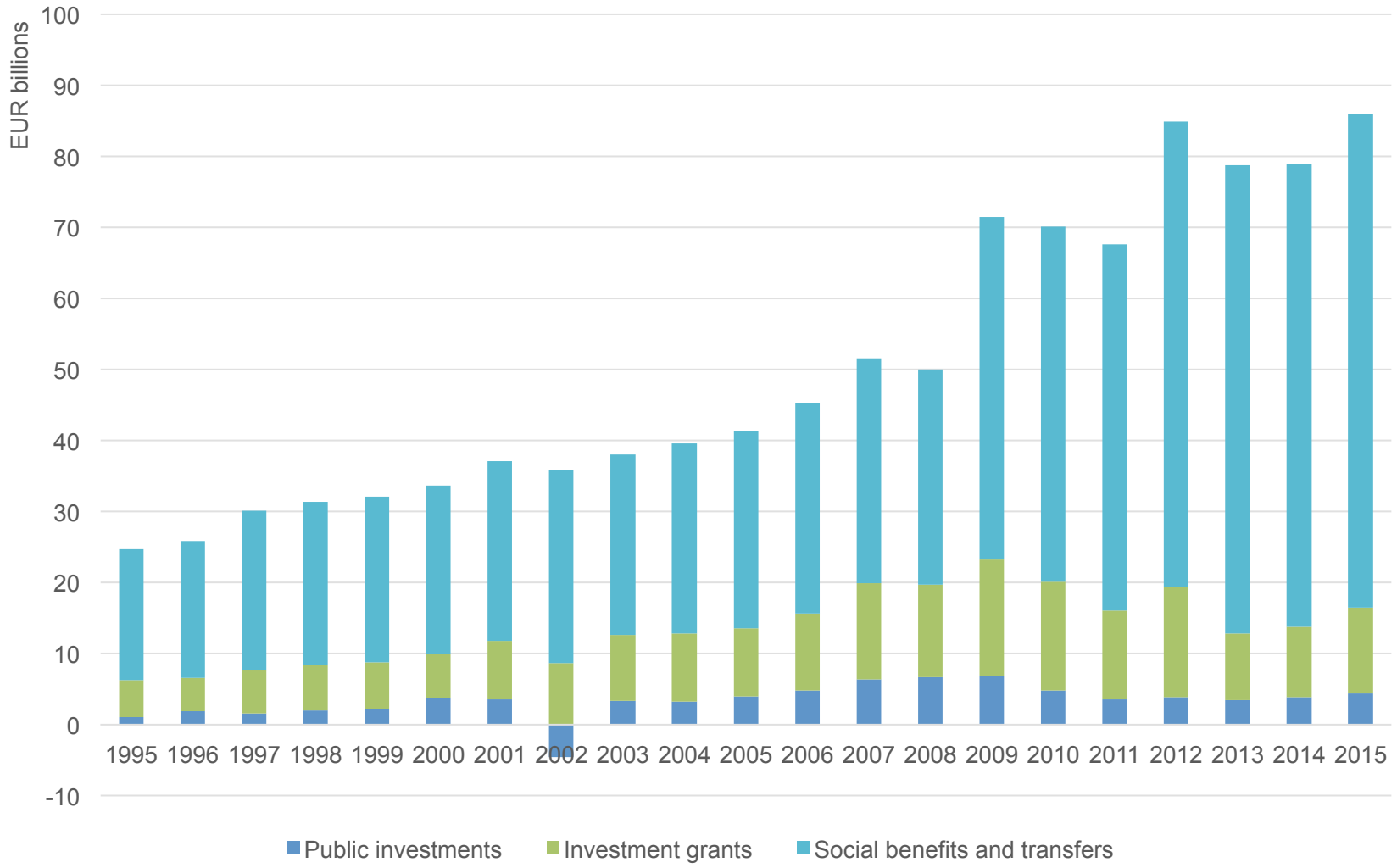
EU Governments support housing sector through:

- Direct public investment (i.e. fixed capital formation) for the construction, purchase and renovation of dwellings;
- Investment grants;
- Social benefits and transfers to households.

As we may see investments grants, which consist in capital transfer to other entities, outpace direct investments made by public authorities. In many European countries affordable housing is actually provided by the private sector (profit or non profit organizations).

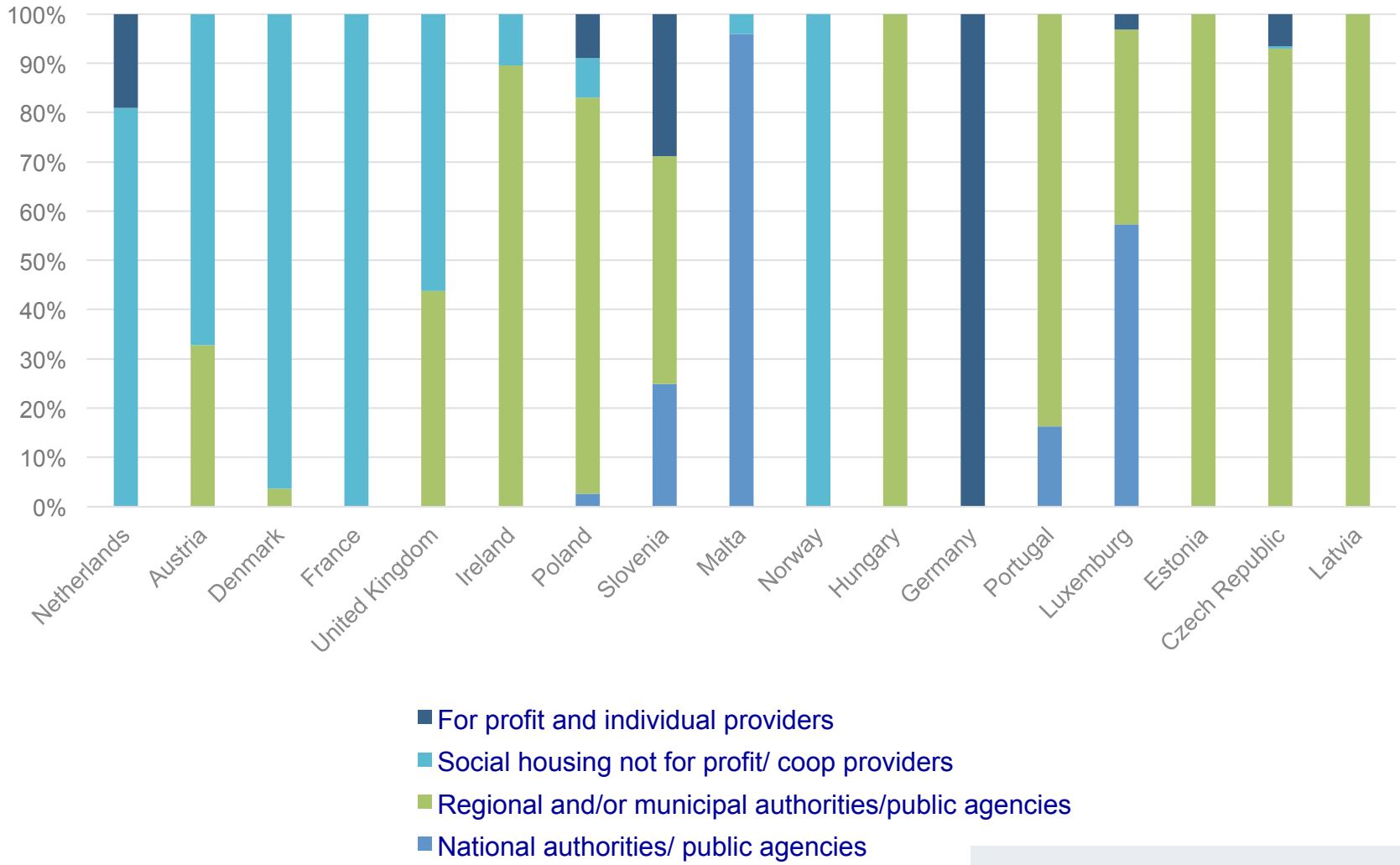
In 2015 five countries (UK, France, Germany, the Netherlands and Ireland) accounted for 90% of social protection expenditure for housing. France and the UK have by far the biggest budget (69% of the total), but whereas the UK mainly uses social benefits, France recurs to social transfer in kind. These two countries also accounts for 62% of investment grants.

Government housing expenditure



Source: Eurostat, Government annual account statistics

Providers of affordable housing



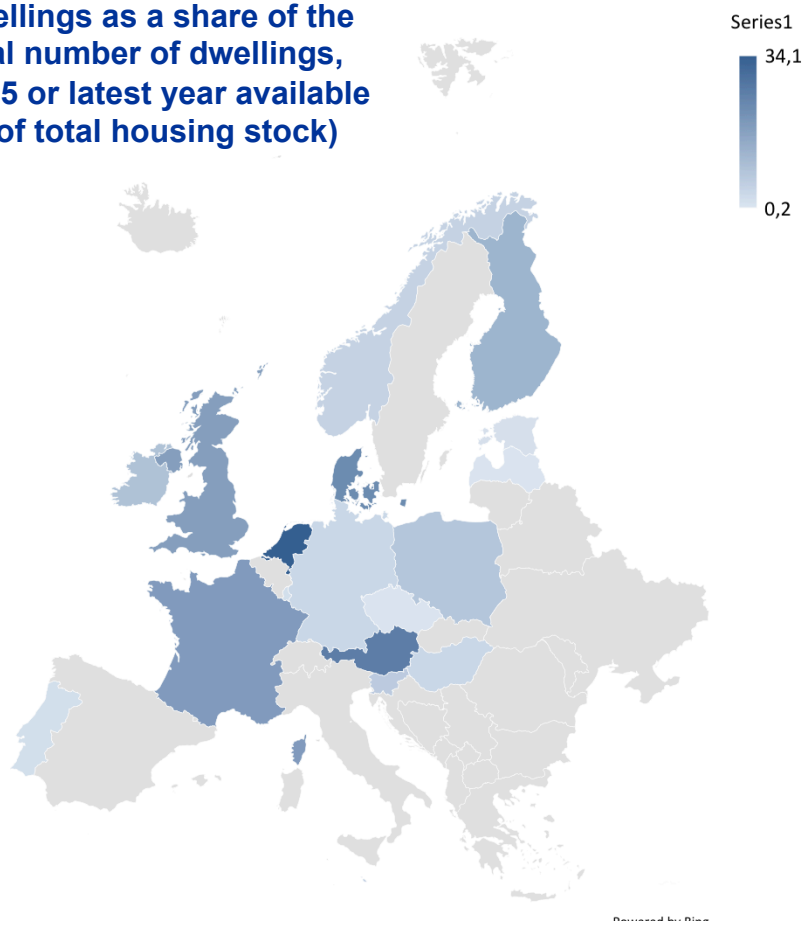
Source: OECD: Affordable Housing Database

Affordable housing market share

OECD collects data (through questionnaires sent to national Governments) about affordable housing. The international organisation was able for some states to get information about “social rental housing stock”. The indicator refers to the stock of residential rental accommodation provided at sub-market prices and allocated according to specific rules rather than according to market mechanisms.

OECD emphasizes that there are still significant gaps in the information collected that does not allow to include all countries, reference years of available information vary from country to country and available data only allow for limited comparison over time.

Number of social rental dwellings as a share of the total number of dwellings, 2015 or latest year available (% of total housing stock)



Source: OECD: Affordable Housing Database

SDA Bocconi

European Investment Bank

ANNEX B1.1. Methodology
The Forecasting Model

Introduction

Objectives

1. Provide forecasted estimates of future EU investments in health and education social infrastructures
2. Provide a measure of the «infrastructure gap», measured as the difference in investments business as usual and a counterfactual scenario where all investments with a sizeable effect on quality of service are realized

Strategy

We characterise a country-specific investment model and we estimate it by using panel data techniques. The model entails three equations: the first two equations capture the relation between fixed capital formation in the healthcare and education sector and economic and demographic variable. The last equation introduces a policy objective. For the healthcare sector, it puts in relationship the unmet needs with the infrastructural dimension. For education, it looks at the effect on school dropouts.

We proceed in the following way. First, we produce long-term forecasts of investments, both for the public and the private sector. Contextually, we produce forecasts for our outcome variable of interest as a function of the forecasted investments. For the healthcare sector, we interpret the unmet needs as proxy of the general availability and accessibility of the infrastructures and ultimately as level of service. Similarly, for education, we interpret dropouts as a function of quality of the service. Finally, we produce out-of-sample predictions of the infrastructure gap for a desired level of service.

Data

We estimate the model on annual country-level macroeconomic variables in the period 1995-2015. We provide forecasts up to 2040. Data for the main socio-demographic variables are took from Eurostat or from the OECD database. Imputed forecasted data for the years after 2016 are taken from the OECD long-term baseline projection. For non-OECD countries, PwC forecasts ("The World in 2050", 2017) have been imputed.

Exogenous variables	Endogenous variables
GDP (Y_{jt}) • Eurostat (1995-2016) • OECD (2017-2040) and EY (2017-2040) Population (P_{jt}) • Eurostat (1995-2016) • Eurostat (2017-2040) Deficit (D_{jt}) • OECD (2017-2040) Other variables (e.g. inflation)	Net real total assets (I_{jt}) • Eurostat (1995-2015) - National accounts Public gross capital formation (pub_{jt}) • Eurostat (1995-2015) - National accounts Unmet healthcare needs (out_{njt}^{0}) • Eurostat (2004-2015) - European health interview survey Dropouts and PISA results (out_{njt}^{0}) • Eurostat (2000-2017) and OECD (2000-2015)
g_{jt}^{I} change in health investment (%) g_{jt}^{Y} change in GDP (%) g_{jt}^{P} change in population (%) D_{jt} government budget surplus (% of GDP)	$age65_{jt}$ portion of the population aged >65 (%) Δpub_{jt} delta public gross K formation (M€ 2015 prices) out_{njt}^{0} Unmet needs in healthcare (% of population)

A model of infrastructure investments and demand

Let's first define in a nutshell the main macroeconomic variables of the investment model.

Let individual n's demand of social infrastructure in country j at time t be $I_{njt}^{d} = f(y_{njt}, q_{It}, x_{njt})$ where y_{njt} is individual's income, q_I the monetary price to purchase the service and x_{njt} are individual-specific characteristics, such as age.

Aggregating at the national level we have $I_{jt}^{d} = \sum_{n=1}^{P} I_{njt}^{d} = I^{d}(Y_{jt}, P_{jt}, W_{jt}, q_{It})$, so that aggregated demand in country j at time t is a function of aggregated income, number of individuals by class of age, country-specific households' characteristics and price.

In this economy, households supply infrastructures as a function of institutional, geographical and economical country-specific characteristics. They do so through the private or the public sector (taxes), under an intertemporal budget constraint.

Let the aggregate supply of infrastructure be $I_{jt}^{s} = I^{s}(Y_{jt}, P_{jt}, Z_{jt}, D_{jt}, q_{It})$ where Z_{jt} are country-specific supply determinants and D_{jt} are the determinants of the public sector's contribution.

(Intertemporal) demand is met by equilibrium investments (both public and private) I_{jt}^{*}, determined as a function of income, population, both demand and supply side country-specific characteristics and credit constraint. In what follows we will abstract from price determination considerations. In most of Europe, the price paid in healthcare and education is often not indicative of the service provided. Therefore, in absence of data on current and future price elasticities, we will assume that price determination will be time-invariant and we won't include it explicitly in our model.

Equations 1 and 2

We want to estimate country-specific investments in infrastructures as a function of the variables previously defined: Y_{jt}, P_{jt}, Z_{jt}, W_{jt}, D_{jt}. Be $X_{jt} = (Z_{jt}, W_{jt})$ the collection of country-specific characteristics that determine investment levels.

Let g_{jt}^{S} be the growth rate of $S = \{I_{jt}, Y_{jt}, P_{jt}\}$, whose use instead of levels is going to be clear later. We aim at estimating the following empirical counterpart of $I_{jt}^{*}(\cdot)$, separately for health and education:

$$1) \quad g_{jt}^{I} = \beta^{0} + \beta^{1} g_{jt}^{Y} + \beta^{2} g_{jt-1}^{Y} + P_{jt} + \beta^{3} \Delta pub_{jt} + \delta_{j} + \varepsilon_{jt}$$

where

$$1.h) \quad P_{jt} = \beta^{4} g_{jt}^{P} + \beta^{5} age65_{jt}$$

captures population growth (g_{jt}^{P}), as well as its ageing (measured as fraction of the population above 65 years old) ($age65_{jt}$) for the healthcare sector;

$$1.e) \quad P_{jt} = \beta^{4} g_{jt}^{P} + \beta^{5} age14_{jt}$$

captures population growth (g_{jt}^{P}), as well new students (measured as fraction of the population between 0 and 14 years old) ($age14_{jt}$) for the education sector, and

$$2) \quad \Delta pub_{jt} = \alpha^{0} + \alpha^{1} pub_{jt-1} + \alpha^{2} g_{jt}^{Y} + \alpha^{3} D_{jt} + \tau_{j} + \eta_{jt}$$

is the variation in public contribution to gross capital formation in health. Country specific unobservable heterogeneity X_{jt} is captured by time-invariante fixed effects (δ_{j}, τ_{j}) and iid shocks (ε_{jt}, η_{jt}).

Equations 1 and 2

Equations 1 and 2 model inputs as a function of macro economic variables. We estimate them separately for health and education.

Equation 1 will be used to estimate the general trend of per-country investments in social infrastructures, measured as net fixed assets. Equation 2 explicitly models the public sector contribution to social infrastructures in terms of gross capital formation. This serves two purposes: on one hand, it allows to use Δpub_{jt} as an explanatory variable of Equation 1. On the other, it provides interesting forecasts in its own right, showing the evolution of public gross investments as predicted by the model.

Equation(s) 3

Finally, we want to model outcomes (quality/level of the service) as a function of inputs (investments). The idea is to use measures of outcomes that: are comparable across countries, present sufficient time and country variability, and that are strongly correlated with investments.

Healthcare: We use a measure of unmet needs to proxy for these outcomes. We use three measures that reflect affordability (af), accessibility (ac) and availability (av). These measures are measured as fraction of the population reporting unmet needs for medical examination or treatment due to being, respectively: (af) too expensive, (ac) too far to travel or (av) waiting lists .

We relate this measures, out_{jt}^{o} , with $o=\{af,ac,av\}$, with investments per capita and estimate the following three equations (3h.1, 3h.2, 3h.3):

3h) $$out_{jt}^{o} = \Phi(\gamma_0^o + \gamma_1^o I_{jt}/P_{jt} + \gamma_2^o t + \lambda_j^o + \xi_{jt}^o)$$

where λ_j^o is an unobserved random effect, t is a time trend, and ξ_{jt}^o is an iid error. The function $\Phi(\cdot)$ establishes that the relationship between the dependent and independent variable is non-linear, as described in the next paragraph.

Equation(s) 3

Education: We use as a measure of service quality the incidence of dropouts in the age 18-24. Several factors enter in the decision of leaving education, such as the benefit of continuing studying and its cost. As such, it is a good measure of outcome.

We relate this measure, out_{njt}^{D} with investments per capita and estimate the following equation (3e):

3e) $$out_{jt}^{0} = \Phi(\gamma_{0}^{0} + \gamma_{0}^{1} I_{jt}/P_{jt} + \gamma_{0}^{2} t + \lambda_{j}^{0} + \xi_{jt}^{0})$$

With similar notation to 3h). We also have experimented with OECD's PISA (Programme for International Student Assessment) results, however the data are collected every 3 years and present weak correlation to investments, so we prefer our results based on dropouts.

Econometric challenges

We want to estimate eq.1 and eq.2, leveraging the panel structure. Equation 2 is endogenous to 1 and eq.1 is endogenous to eq.3. They are separately estimated.

To avoid nonstationarity problems (unit-root), we work with growth rates (g_{jt}^{S}) or with first differences (Δpub_{jt}). Dickey-Fuller tests reject nonstationarity in these cases. We include fixed effects (δ_j, τ_j) to control for unobserved heterogeneity and we account for heteroskedastic errors.

To account for unobserved persistent effects to the endogenous variables, we include lagged values of the variable. Our main specifications include autoregressive processes (AR) of order 2 for eq.1 and order 1 for eq.2. We include or 2-step lagged variables of g_{jt}^{Y} to account for non-immediate effects.

The main challenge is endogeneity of g_{jt}^{Y} (and possibly g_{jt}^{P} for healthcare) with g_{jt}^{I}, as well as that of Δpub_{jt}. We abstract from collinearity of said variables, deeming them second order. To account for this endogeneity, we implement Arellano-Bond (1991) dynamic panel estimation on eq.1, which uses the following exclusion restriction $\mathbb{E}(g_{jt-\tau}^{Y}\Delta\varepsilon_{jt})=0$ for $t\geq 3, \tau\in[2,5]$.

Including government deficit presents several more problems. First, the endogeneity problem is more severe, since by definition public investments are financed by public expenditure, which is financed through a mix of taxation and debt. For a given year, the expenses for investments contribute to deficit formation. What we want to capture, however, is the inverse causal relationship, where fiscal tightness can hinder current or future investments.

Econometric challenges

Estimating the coefficient for an endogenous variable is hopeless, without e.g. an instrumental variable approach. In order to take this endogeneity into account, we include a 5-years lagged variable for deficit, which should capture long-term credit market tightness without incurring in this problem. Second, the forecasted values we have are self-reported by member countries and are therefore highly unreliable.

Eq.3 presents additional difficulties, namely the truncation at zero of the dependent variable, both in eq. 3h) and 3e) (whose support is and shows probability mass at 0). We estimate a panel Tobit regression with random effects. The random effects take care of unobserved heterogeneity in a context, Tobit, where fixed effects cannot be used because of the incidental parameter problem.

Results Healthcare - 1

Eq. 1		Eq. 2		Eq. 3.1		Eq. 3.2		Eq. 3.3	
$g\downarrow jt\uparrow I$		$\Delta pub\downarrow jt$		$out\downarrow jt\uparrow ac$		$out\downarrow jt\uparrow av$		$out\downarrow jt\uparrow af$	
$g\downarrow jt\uparrow Y$	0.0085	$g\downarrow jt\uparrow Y$	465.94**	$I\downarrow jt$ / $P\downarrow jt$	-41.259	$I\downarrow jt$ / $P\downarrow jt$	-325.9***	$I\downarrow jt$ / $P\downarrow jt$	-981.1***
$g\downarrow jt -1\uparrow Y$	0.11502***	$\Delta pub\downarrow jt -1$	0.14111*	t	-0.011***	t	0.019	t	-0.021
$age 65\downarrow jt$	0.0004	$D\downarrow jt-5$	-1.8607						
$g\downarrow jt\uparrow P$	-1.0517								
$\Delta pub\downarrow jt$	0.000016***								
$g\downarrow jt -1\uparrow I$	0.4654***								
$g\downarrow jt -2\uparrow I$	0.0246								
$\beta\uparrow 0$	0.0038	$\alpha\uparrow 0$	3.4745	$\gamma\downarrow ac\uparrow a$	0.42760	$\gamma\downarrow av\uparrow 0$	1.1802	$\gamma\downarrow af\uparrow 0$	4.1327
f.e.	yes	f.e.	yes	r.e.	yes	r.e.	yes	r.e.	yes

The table shows coefficients estimated for Equations 1, 2 and 3. Equations 1 and 2 include fixed effects; Equations 3.1, 3.2 and 3.3 include random effects. P-values: * < 0.1; ** < 0.05; *** < 0.01

Results Healthcare – 2

Results for the estimation of Equations 1 to 3 are presented in the previous table.

Equation 1: GDP, both in its current and its lagged form, is the strongest predictor of investments in health (as measured by their z-scores, not reported). In particular, a 1% increase in GDP is associated with an increased in the subsequent year's investments of 0.12%. Investments present strong persistence: this is to be expected since the decision and implementation process is often pluriannual. Through an impulse response, determined by this autocorrelation, a variation in any of the covariates will have persistent effects on the forecasted investments. This means that subsequent increases in any of the independent variables (such as GDP) stack over time, possibly determining explosive trajectories for investments. The fact that some coefficients are not significant can be explained with the likely high multicollinearity. Such multicollinearity affects inference (the standard errors' estimators), but does not bias the predictions.

All variables have their expected sign, with the exception of population, even conditioning on fixed effects. This can be explained with the fact that more developed countries contextually show decreasing (or stable) populations and per-capita increase in net assets. Finally, $age65_{jt}$ has the expected positive sign. However, the coefficient is not significant and very imprecise in line with previous literature.

Equation 2: All variables have their expected sign. Since the dependent variable (Δpub_{jt}) is here in first differences, rather than in growth rate, the interpretation is not straightforward. An increase of 1% in GDP determines an average year-on-year increase of €M4.7. As a comparison, that is a 1.5% increase with respect to the median public gross capital formation in our sample period (€M314). The coefficient of deficit (-1.86) should be interpreted with caution, as explained before, because it's likely to suffer from endogeneity bias, even when included with many lags. Its sign suggests that, when a country is under persistent indebting, it will eventually reduce its investments in the long term.

Results Healthcare – 3

Equations 3.1 - 3.3: All the coefficients have the expected negative signs: an increase in per-capita investments is associated with a decrease in the fraction of the population that report unmet needs. In other words, when investments increase, the healthcare system is more accessible, available and affordable. The coefficients are not very informative since the initial distribution of the (censored) dependent variable are very different. Moreover, the independent variables might be collinear with the time trend, which has been included to strengthen the forecast, resulting in imprecise estimates.

- Graphic results from the forecasts in healthcare are presented in slides 43, 45, 47, 49, 51 (EU wide) and 53, 55, 57 (by country).
- Slide 43 and 45 show the total net annual healthcare investments aggregated across asset classes. The historical data show a slow down of investments since 2007, in conjunction with the start of the financial and public finance crisis in many European countries. Given the long term nature of most of infrastructure investments, it is possible that this slow down was partially in act and can only partially be attributed to the crisis. Note that we do not explicitly include the financial crisis in the model. We could have done that, for example, by adding a structural break in the time series. Since we are looking at a very long period, we assume that the crisis effect are absorbed over the years, leading to a reversion to the mean.
- Slide 47 shows the extant and forecasted healthcare infrastructures. If the economic and population expansion will stay constant, the real assets stock will keep on increasing steadily. While infrastructure stocks have almost doubles in the last 20 years (from above €500B of mid 1990s to above €1000B of mid 2010s), we expect to keep on growing and surpass €1500B by 2040 in a BAU scenario.
- Slide 49 suggests that, if the current trend will continue, the fraction of future investments due to the public sector will progressively reduce. The model suggests that, from the current share of between 30% and 40%, the private sector will provide infrastructure for a bit less than 60% by 2040.

Results Education – 1

Eq. 1e		Eq. 2e		Eq. 3e	
$g\downarrow jt\uparrow I$		$\Delta pub\downarrow jt$		$out\downarrow jt\uparrow ac$	
$g\downarrow jt\uparrow Y$	0.0522	$g\downarrow jt\uparrow Y$	988.24**	$I\downarrow jt\ /\ P\downarrow jt$	-1872.84***
$g\downarrow jt-1\uparrow Y$	0.0888**	$\Delta pub\downarrow jt-1$	0.1155*	t	-0.547***
$g\downarrow jt-2\uparrow Y$	0.02669	$D\downarrow jt-5$	-1.8485		
$age\ 014\downarrow jt$	0.0030				
$g\downarrow jt\uparrow P$	-0.1354				
$\Delta pub\downarrow jt$	0.000003				
$g\downarrow jt-1\uparrow I$	0.3529***				
$g\downarrow jt-2\uparrow I$	-0.03439				
$\beta\uparrow 0$	-0.0458	$\alpha\uparrow 0$	-20.108	$\gamma\downarrow ac\uparrow a$	16.83***
f.e.	yes	f.e.	Yes	r.e.	yes

The table shows coefficients estimated for Equations 1, 2 and 3. Equations 1 and 2 include fixed effects; Equations 3.1, 3.2 and 3.3 include random effects. P-values: * < 0.1; ** < 0.05; *** < 0.01

Results Education – 2

Results for the estimation of Equations 1 to 3 are presented in the previous table.

Equation 1e: As in the case for healthcare, investments present a strong persistence and last year's investments are the strongest predictor of current ones. GDP, both in its current and its lagged form, is as strong predictor as well. In particular, a 1% increase in GDP is associated with an increased in the subsequent year's investments of 0.05% Again, the fact that some coefficients are not significant can be explained with the likely high multicollinearity. One of such predictors is population in the age 0-14, whose coefficient is not significant, although it has the expected sign. This can be explained with the probable long time to adjust infrastructures in response to short-term shocks. To rule out this explanation, we have experimented with lagged terms of population, without differences. As a result, we interpret non-significance as an effect of multicollinearity.

All variables have their expected sign, with the exception again of population, even conditioning on fixed effects. However, the term is not significant.

Equation 2e: All variables have their expected sign. Again, the dependent variable ($\Delta pu\,b_{\downarrow}jt$) is here in first differences. An increase of 1% in GDP determines an average year-on-year increase of €M9.8. As a comparison, that is a 1.8% increase with respect to the median public gross capital formation in our sample period (€M552). The coefficient of deficit (-1.84) should be interpreted with caution, as explained before, because it's likely to suffer from endogeneity bias, even when included with many lags. Its sign suggests that, when a country is under persistent indebting, it will eventually reduce its investments in the long term.

Equations 3e: All the coefficients have the expected negative signs: an increase in per-capita investments is associated with a decrease in dropouts. In other words, when investments increase, the education system is more accessible, available and affordable. The coefficients are not very informative since the initial distribution of the (censored) dependent variable are very different. Moreover, the independent variables might be collinear with the time trend, which has been included to strengthen the forecast, resulting in imprecise estimates.

Results Education – 2

Equations 3e: All the coefficients have the expected negative signs: an increase in per-capita investments is associated with a decrease in dropouts. In other words, when investments increase, the education system is more accessible, available and affordable. The coefficients are not very informative since the initial distribution of the (censored) dependent variable are very different. Moreover, the independent variables might be collinear with the time trend, which has been included to strengthen the forecast, resulting in imprecise estimates.

- Graphic results from the forecasts in Education are presented in slides 44, 46, 48, 50 (EU wide) and 52, 54, 56, 58 (by country).
- Slide 44 and 46 show the total net annual education investments aggregated across asset classes. Historical data show a more pronounced EU-wide increase in investments, when compared to healthcare. So much so that, in this case, the financial crises has not reduced not reduced to zero the growth rate. Yet, the model forecast a less accentuated growth rate of investment for the post-2020 scenario. This is due to the fact that investments seem to depend less from GDP growth, which it expected to increase steadily and push upwards healthcare infrastructures.
- Slide 48 shows the extant and forecasted education infrastructures. In line with the results on investments, the BAU scenario prospects smaller growth rates than the healthcare case, despite the more pronounced historical growth. We expect education infrastructure stocks to surpass €1300B by 2040 in a BAU scenario.

Results Education – 3

- Slide 50 shows private and public forecasted shares in infrastructures supply. We expect the relative shares to remain basically unchanged, unlike in the case of healthcare. These different results can be explained by comparing the coefficients in equations 2 for healthcare and education respectively. If total investments seem to react more to GDP variation in healthcare than education, (exclusively) public investments are more reactive to GDP in education than healthcare. This seems to correctively depict the current trend in Europe, where most countries' public education investments respond more than proportionally to booms and busts in the economy (and in resources available for finance). Since the baseline scenario is one of slow but steady economic growth, most countries public budgets are expected to respond with a progressive expansion of education expenditures.

Infrastructure gap – 1

We measure the «infrastructure gap» as the difference in investments business as usual, estimated through equations 1 and 2, and a counterfactual scenario where all investments with a sizeable effect on quality of service are realized. We explain below what we mean by “a sizeable effect on quality”. We call this counterfactual scenario “Optimal Benefit Scenario”:

A measure of infrastructure gap could be defined from the amount of infrastructure that maximizes social welfare. By subtracting the current (resp. forecasted) investment to this ideal level, it would be possible to obtain a measure of current (resp. forecasted) inadequacy or “gap”. The infrastructure level that maximizes the social welfare could in principle be derived by equating the marginal benefits from an additional unit of infrastructure to its marginal costs. If average costs, albeit at an aggregated level, are somewhat available and could be used to estimate marginal costs, marginal benefits are generally not readily available. Social benefits of healthcare include increased quality of life, reduction of risk, increase in productivity and many other measures that are difficult to estimate and forecast.

Given these difficulties, we abstract from a full cost-benefit analysis approach and we determine the infrastructure gap from marginal benefits on outcomes alone. The method is based on exploiting the existence of decreasing marginal benefits of per-capita investments on our measures of quality of service. In other words, the effect of additional investments has a lower impact on accessibility, affordability and availability when the infrastructural stock is already sizeable. We interpret this measure, that can be estimated, as a proxy of the social marginal benefits, albeit it cannot be expressed in monetary values. There is a level of investment per capita that does not have a sizeable influence anymore on quality of service. This level is a proxy of the social welfare maximizing level defined above and can be used to estimate the infrastructure gap. Since marginal costs are not taken into account, we can interpret this level as an upper bound.

Infrastructure gap – 2

We proceed as follows: first, we estimate nonparametrically the (nonlinear) relationship between the mean of the outcome variables ($out\downarrow nj\uparrow 0$) and investments per capita. We prefer to re-estimate this relationship, rather than using the data generating process estimated in 3h.1-3h.3 and 3e, to capture other unexpected endogenous interactions, derived from solving the 3 equations simultaneously. We then use simulation methods to obtain marginal effects of investment per capita and we single out where this marginal effects are sufficiently close to zero (statistically not different from zero).

For healthcare, this point is on average in the EU at €3,500 per capita, associated with an average differential improvement at 2040 of 8.5% increase in service quality as defined above. Whereas for education this point is on average an investment of €5,050 , associated with an average differential improvement at 2040 of 22.9% increase in service quality as defined above. We then invert this relationship to obtain the differential investment growth rate and the other variables of the model. We finally re-forecast the model to obtain counterfactual forecasts for all the other measures of interest. The difference between business as usual forecast and the counterfactual ones is an upper bound of the infrastructure gap.

SDA Bocconi

European Investment Bank

ANNEX B1.2. Glossary and Sources of Data

Fixed assets

Following the introduction of ESA 2010 EU member states provide Eurostat information regarding fixed capital formation and non-financial assets stock in the economy.

Gross fixed capital formation (P.51) consists of resident producers' acquisitions, less disposals, of fixed assets during a given period plus certain additions to the value of non-produced assets realised by the productive activity of producer or institutional units. Fixed assets are produced assets used in production for more than one year. According to Eurostat fixed capital formation excludes the acquisition of fixed assets to be used under an operational leasing contract. For the enterprise that is using the fixed asset, rentals are treated as intermediate consumption. For the owner of the asset, the cost of acquisition is recorded as gross fixed capital formation.

Values are expressed in:

1) current price (millions of) national currency and euro. They include inflation effects.
2) current prices / per capita
3) % of total government expenditure
4) replacement prices (stock, million of euro)

Data about gross fixed capital formation can be found in the following leafs of the Eurostat database:

- Cross-classification of gross fixed capital formation by industry and by asset stocks and flows (nama_10_nfa_st and nama_10_nfa_fl);
- Detailed breakdowns of main GDP aggregates (by industry and consumption purpose) (nama_10_dbr), Gross capital formation by industry (up to NACE A*64) (nama_10_a64_p5)
- Annual government statistics, General government expenditure by function (COFOG), gov_10a_exp

SDA Bocconi

Fixed assets

Eurostat classifies assets according to following categories:

- AN.111 Dwellings
- AN.112 Other buildings and structures
  - AN.1121 Buildings other than dwellings
  - AN.1122 Other structures
- AN.113 Machinery and equipment
  - AN.1131 Transport equipment
  - AN.1132 ICT equipment
  - AN.11321 Computer hardware
  - AN.11322 Telecommunications equipment
- AN114 Weapons systems
  AN.115 Cultivated biological resources (AN.116) (Costs of ownership transfer)
- AN.117 Intellectual property products: fixed assets that consist of the results of research and development, mineral exploration and evaluation, computer software and databases, entertainment, literary or artistic originals and other intellectual property products, as defined below, intended to be used for more than one year:
  - AN.1171 Research and development: Consists of the value of expenditure on creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and use of this stock of knowledge to devise new applications.
    The value is determined in terms of the economic benefits expected in the future. Unless the value can be reasonably estimated it is, by convention, valued as the sum of the costs, including those of unsuccessful research and development. Research and development that will not provide a benefit to the owner is not classified as an asset and is instead recorded as intermediate consumption.
  - AN.1172 Mineral exploration and evaluation

SDA Bocconi

Fixed assets

- AN.1173 Computer software and databases: Computer programs, program descriptions and supporting materials for both systems and applications software. Included are the initial development and subsequent extensions of software as well as acquisition of copies. Files of data organised to permit resource-effective access and use of the data. For databases created exclusively for own use the valuation is estimated by costs, which should exclude those for the database management system and the acquisition of the data.
- AN.1174 Entertainment, literary or artistic originals: Original films, sound recordings, manuscripts, tapes, models, etc., on which drama performances, radio and television programmes, musical performances, sporting events, literary and artistic output, etc. are recorded or embodied. Included are works produced on own-account. In some cases, such as films, there may be multiple originals.
- AN.1179 Other intellectual property products: New information, specialised knowledge, etc., not elsewhere classified, whose use in production is restricted to the units that have established ownership rights over them or to other units licensed by such units.

According to ESA 2010 Manual acquisitions of intellectual property products are valued in different ways:

(a) for mineral exploration: by the costs of actual test drillings and borings, and the costs incurred to make it possible to carry out tests, such as aerial or other surveys;

(b) for computer software: by purchasers' prices when purchased on the market, or at its estimated basic price, or if no basic price is available, at its costs of production plus a mark-up for net operating surplus (except for non-market producers) when developed in-house;

(c) for entertainment, literary or artistic originals: valued at the price paid by the purchaser when it is sold, or if not sold, the following methods of estimation are acceptable:

(i) At the basic price paid for similar originals;

(ii) the sum of its production costs plus a mark-up (except for non-market producers) for net operating surplus; or

(iii) the discounted value of expected receipts.

SDA Bocconi

Fixed assets

According to OECD System of Health Accounts 2011 assets recorded in healthcare as fixed capital formation are:

- HK.1.1.1 Infrastructure
  - HK.1.1.1.1 Residential and non-residential buildings
  - HK.1.1.1.2 Other structures
- HK.1.1.2 Machinery and equipment
  - HK.1.1.2.1 Medical equipment
  - HK.1.1.2.2 Transport equipment
  - HK.1.1.2.3 ICT equipment
  - HK.1.1.2.4 Machinery and equipment n.e.c.
- HK.1.1.3 Intellectual property products: Intellectual property products are the result of research, development, investigation or innovation leading to knowledge that the developers can market or use to their own benefit in production, because use of the knowledge is restricted by means of legal or other protection. Intellectual property products could be produced by health care providers on their own account. Examples of intellectual property products are computer software and databases, and the results of research and development.
  - HK.1.1.3.1 Computer software and databases: Computer software consists of computer programmes, programme descriptions and supporting materials for both systems and applications software. Databases consist of data files organised in such a way as to permit resource-effective access to and use of the data.
  - HK.1.1.3.2 Intellectual property products n.e.c.

SDA Bocconi

Education sector

Education sector is considered as a whole. Eurostat in its cross-classification of gross fixed capital formation by industry and by asset stocks and flows (nama_10_nfa_st and nama_10_nfa_fl) does not provide a breakdown per education level category. Such a breakdown is available only for government gross fixed capital formation (gov_10a_exp, COFOG 99).

The breakdown of education is based upon the level categories of the International Standard Classification of Education (ISCED) of the United Nations Educational, Scientific and Cultural Organization (UNESCO). The system of classification was first defined in 1997 and then modified in 2011. The table synthetize the three systems of classification:

ISCED 2011	ISCED 1997	Eurostat
ISCED 01	-	Primary and pre-primary education
ISCED 02	ISCED 0	
ISCED level 1	ISCED level 1	
ISCED level 2	ISCED level 2	Secondary education
ISCED level 3	ISCED level 3	
ISCED level 4	ISCED level 4	Post-secondary non-tertiary education
ISCED level 5	ISCED level 5	Tertiary education
ISCED level 6		
ISCED level 7		
ISCED level 8	ISCED level 6	

SDA Bocconi

Affordable Housing Sector

- Class: 06.1.0 - Housing development (CS)
- Explanatory note
  - Administration of housing development affairs and services; promotion, monitoring and evaluation of housing development activities whether or not the activities are under the auspices of public authorities; development and regulation of housing standards;
  - slum clearance related to provision of housing; acquisition of land needed for construction of dwellings; construction or purchase and remodelling of dwelling units for the general public or for people with special needs;
  - production and dissemination of public information, technical documentation and statistics on housing development affairs and services;
  - grants, loans or subsidies to support the expansion, improvement or maintenance of the housing stock.
  - Excludes: development and regulation of construction standards (04.4.3); cash benefits and benefits in kind to help households meet the cost of housing (10.6.0).
- Class: 10.6.0 - Housing (IS)
- Explanatory note
  - Provision of social protection in the form of benefits in kind to help households meet the cost of housing (recipients of these benefits are means-tested);
  - administration, operation or support of such social protection schemes;
  - benefits in kind, such as payments made on a temporary or long-term basis to help tenants with rent costs, payments to alleviate the current housing costs of owner-occupiers (that is to help with paying mortgages or interest), provision of low-cost or social housing.

Infrastructure Gap

The infrastructure gap, broadly speaking, is defined as the inadequate level of infrastructure (Bourque 1985, Basile et al. 2001, McKinsey 2013) or as the difference between investment needs and actual spending (WEF 2012; 2014; 2016, EIB 2013).

Existing estimates have been many at local, national, regional and world-wide level calculated according to a variety of models that can be categorized in **(1) bottom-up microeconomic or micro-engineering models**, **(2) top-down macroeconomic models** and **(3) hybrid models**.

(1) Bottom-up models

Microeconomic and micro-engineering models, are both based on bottom up sectoral knowledge, and encompass a wide variety of grey literature, from national project pipelines, that may span from a basic project list identifying local gaps, to comprehensive reports, such as the UK Infrastructure and Projects Authority Report, one of the most articulated one in Europe, to sectoral analyses.

At global level the most renowned micro studies on the infrastructure gap are the “Infrastructure to 2030” reports by the OECD (2006, 2007, 2012). The three reports cover telecoms, electricity, transports (road, water, airports, ports, rail corridors as well as oil & gas transport). For each sector or sub-sector, specific micro trends, based on the articulacy of the sector, are identified. (e.g. within the telecommunication sector, the transatlantic sub sector and within this the optical cable subsector. In this last subsector two trends are identified: the long-distance fiber network can be expected to grow in both band width per channel (wavelength) and number of wavelengths (time) per fiber.). Population and income projections are then embedded in each sectoral demand analysis and future investment needs per sector are estimated. Projections have been also adjusted to meet climate change demand in the most recent report (OECD 2017). Regarding Europe, noteworthy, is the European Commission (EC) (2011) estimate on infrastructure needs in transnational energy from a project pipeline priority perspective.

On a national and sectorial basis, a wide variety of academic literature discusses the appropriateness of assessing projects based on Computable General Equilibrium (CGE) models or Cost Benefit Analysis (CBA) models for the quantification of the infrastructure project pipeline. In some cases, models were aggregated and generalized to assess infrastructure needs at regional scale.

Infrastructure gap

(2) Top-down models

Research on macroeconomic models, which explain and predict levels of infrastructure based on macroeconomic variables, stems from the seminal research conducted by Marianne Fay for the World Bank Group in 2000. This work disentangled the primary relationship between macroeconomic variables and the level of infrastructure needed. The model assumes that infrastructure has to classes of users: individuals and companies: the first demand infrastructure as a consumption good, the latter as input into production. The research, originally limited to Latin America, found that economic infrastructure demand is explained by aggregated output, sectoral share of GDP; as well as variables such as density, urbanization and trade.

This line of research was further expanded at a global level (Fay and Yepes 2003) in which it proved its validity through the registered high explanatory power of the model (R squared over 90 percent across infrastructure classes except water). The model was updated with better or more recent data and adapted to different regions for finer results: Yepes (2004) for East Asia and the Pacific, Fay and Morrison (2007) for Latin America, Estache and Yepes (2004) for Sub Saharan Africa, Fedderke and Bogetic, (2005) for South Africa, Chatterton and Puerto (2005), for South Asia and Bhattacharyay (2010) for the Asia Pacific.

Theory underpinning these works was left basically untouched until Oxford Economics (2017) under a G20 initiative, developed the Global Outlook on Infrastructure making use of stochastic frontier modelling techniques. This allowed the introduction of 'quality-adjusted' performance measures allowing the determination of the spending required for a country to match the performance of its best performing peers. The main theoretical contribution to the Fay (2000) model is the shift in the definition of infrastructure need. Previously it was understood as the need to match the demand required for consumption by individuals and the demand required to satisfy production needs. It's now interpreted dynamically, as the level necessary to raise the game across the board. Need is evaluated by comparing what peers are doing: countries with similar characteristics are expected to dedicate a similar amount of resources to infrastructure and while countries converge to higher levels of infrastructure the entire model adapts to the new frontier.

Infrastructure gap

(3) Hybrid models

Grey literature produced several models, combining sectoral approaches to macroeconomic evaluations. The McKinsey Global Institute (2013) estimated the global infrastructure need by studying what is required to keep pace with anticipated growth, the report applies the limited 70 percent "rule of thumb" approach, and does not estimate what would be needed to meet a range of broader aspirations. The model uses capital stock values as a proxy of current infrastructure stock and estimates need by projecting global infrastructure through demand drivers in different infrastructure categories sourced from the (OECD 2006, 2007, (IEA), and Global Water Intelligence (GWI), cross checked with historical spending investment for roads, rail, ports, airports, power, water, and telecommunications infrastructure (which averaged about 3.8 percent of global GDP).

A second widely referred to model is the World Economic Forum (WEF) (2012; 2013; 2014) model in which the investment in infrastructure gap is based on OECD (2006; 2007; 2012) expenditure estimates as percentage of GDP. Sector trends were generalized to find an average annual investment need for 2010-2030 of about 3.9 percent of GDP. In 2014 the WEF report was expanded to encompass also social infrastructure, replicating the same model. Most recent among the hybrid models is the Oliver Wyman (2017) report yet based on WEF (2012, 2013, 2014) estimates.

Regarding Europe, the European Investment Bank (EIB) (2013) collected, separated out and updated investment in infrastructure gaps with estimates from (OECD 2006, 2007, 2012; EC 2011 and McKinsey 2013). The McKinsey Global Institute examined the value of infrastructure stock using a perpetual inventory model for 12 countries for which comprehensive historical spending data are available. This analysis showed that, with a few exceptions such as Japan (arguably an "over-investor" in infrastructure), the value of infrastructure stock in most economies averages around 70 percent of GDP.

Infrastructure gap: literature review

Title	Authors	Institution	Year	Sector	Category	Model	Methodology	Findings	Time-Horizon	Nominal Gap
Investing in Infrastructure What is Needed from 2000 to 2010?	Fay and Yepes	World Bank	2003	Economic Infrastructure	Top down	Fay 2000 model	OLS with fixed effects	High performance of the model (over 90% across infrastructure) In the case of water we manage to explain 60% of cross country and over time variation in coverage.	2005-2010	B$ 848 (need)
Infrastructure for 2030 VOL 1	OECD	OECD	2006	Telecoms, Electricity, Surface transport and Water	Bottom Up	Trend driven demand	Expert Knowledge on driving trends	Sum of all micro sector trends I (role of rise in income and reduction of cost of infrastructure service and emerging technologies economic growth, notably growth in per capita income, is acknowledged as the major determinant of the growth in the demand for infrastructure. (only variable used for projections)	2013-2030	T$ 3,7 (need) annual
Infrastructure for 2030 VOL 2	OECD	OECD	2007	Electricity, Water and Transport	Bottom Up	Trend driven demand	Expert Knowledge on driving trends	Sum of all micro sector trends (role of rise in income and reduction of cost of infrastructure service and emerging technologies	2000-2030	n.a
Strategic Transport Infrastructure Needs to 2030	OECD	OECD	2012	Airports, Ports, Rail corridors and Oil & Gas transport	Bottom Up	Trend driven demand	Expert Knowledge on driving trends	Sum of all micro sector trends (role of rise in income and reduction of cost of infrastructure service and emerging technologies	2010-2030	B$ 11,28 (need)
Strategic Infrastructure – Steps to Prioritize and Deliver Infrastructure Effectively and Efficiently	WEF	WEF	2012	Economic and Social Infrastructure	Hybrid				2010-2030	T$ 1 annual
Infrastructure productivity: How to save $1 trillion a year	McKinsey Global Institute	McKinsey Global Institute	2013	Economic Infrastructure	Hybrid				2010-2030	T$ 57 need
Strategic Infrastructure: Steps to Operate and Maintain Infrastructure Efficiently and Effectively	WEF	WEF	2014	Economic and Social Infrastructure	Hybrid				2010-2030	T$ 1 annual
Global Infrastructure Outlook: Infrastructure investment needs 50 countries, 7 sectors to 2040	Oxford Economics	G20	2017	Economic Infrastructure	Top down		standard static panel data models with fixed effects	The key innovation of our study is to combine the approaches used by these authors to model infrastructure needs, with the stochastic frontier modelling techniques. Performance of the model (over 70% across infrastructures except ports 40%)	2015-2040	T$ 94 (need)
Investing in Climate, Investing in Growth. Ch. 3 Infrastructure for climate and growth	OECD	OECD	2017	Electricity, Water and Transport	Bottom Up	Trend driven demand	Expert Knowledge on driving trends		2016-2030	T$ 94 (need)
Bridging the infrastructure gap: Engaging in the private sector in critical national development	Oliver Wayman	Oliver Wayman	2017	Economic Infrastructure	Hybrid				2010-2030	T$ 1 annual

SDA Bocconi

European Investment Bank

PHASE B2
THE PUBLIC VALUE OF SOCIAL INFRASTRUCTURE

PHASE B2 - THE PUBLIC VALUE OF SOCIAL INFRASTRUCTURE

Researcher: Francesca Casalini

Table of contents

SDA Bocconi

European Investment Bank

B2.1. Introduction
The Public Value of Social Infrastructure

The Concept of Public Value

The key question of this research phase can be framed in the academic debate about the **shift from New Public Management (NPM) to the concept of Public Value (PV)** (Moore, 1995; O'Flynn, 2007).

Despite the emphasis placed on results and efficiency by the NPM movement (Pollit, 2005), **research on project performance reports that the majority of infrastructure projects worldwide failed to meet time and budget targets** (Flyvbjerg, 2003). Scientific literature also discusses many examples of construction of the so-called **white elephants, i.e. facilities and infrastructures of little practical use and negative social value** (Robinson and Torvik, 2005).

An indeed, scholars like Robinson and Torvik (2005) argue that **a central issue is why investment is inefficiently allocated, rather than why there is underinvestment.**

Incorporating PV into infrastructure planning and evaluation may therefore help to better orient investments and add value to society.

Public Value: a definition

Public Value (PV) describes the value an organization contributes to society (Moore, 1995). In particular, this concept reconsiders the way in which the public sector is engaged in the delivery of public infrastructure and services to achieve superior social impacts.

However, PV is not just governmental (Jørgensen & Bozeman, 2007). During the last decade, greater emphasis has been put on social and public value creation by the private sector (Meynhardt, 2009). **The term "impact" has become part of the everyday lexicon of social enterprises, social sector funders, as well as investors and companies** (Ebrahim & Rangan, 2014), and it is used to refer to an organization's specific and measurable role in creating lasting changes in people's lives and environment.

The Public Value of Social Infrastructure

Social infrastructure and services are provided in response to the needs of communities and **they generate a variety of explicit and implicit benefits but these are difficult to measure and interiorise into project appraisal** (Casey 2005). We know that spending on social service-provision has positive returns. For example, Psacharopoulos and Patronis (2010) found annual returns to education investment in OECD countries ranging from 8.5 to 13.4%. The RAND Corporation projected that, for every dollar invested in pre-school education, there is a net-return of $2.60 (Karoly, 2008). Casey (2005) purported, for every $1 invested in community infrastructure, $10 could be saved in costs on poor health, reduced crime and better employment outcomes, amongst other things. However, there is less agreement on how infrastructure's contribution to these outcomes can be measured. Over the past 15 years, a growing body of literature has tried to demonstrates the benefits of social infrastructure but **links between expenditure and outcomes remain elusive** (Gallet & Doucouliagos, 2017).

Sector	Evidences	References
Healthcare	▪ Health infrastructure investments reduce infection rates ▪ Hospitals volumes reduce delays in cancer diagnosis Better quality infrastructure promote a desire to get well among patients and improve health outcomes ▪ Health ICT increases clinician's adherence to guidelines but not health outcomes	Blankart, 2012; Chaudhry et al., 2006; Douglas & Douglas, 2004; Edkins & Ive, 2010; Jamal et al., 2009; Thomson et al., 2010; van den Berg, 2005; Zimring et al., 2004
Education	▪ School size and ICT infrastructure improve the well-being of students and have an impact on school attendance and drop-out rates ▪ Students are less likely to attend schools in need of structural repair	Abalde, 2014; Bradley & Taylor, 1998; Cuyvers, De Weerd, Dupont, Mols, & Nuytten, 2011; Durán-Narucki, 2008; Ive & Edkins, 2010; Leithwood & Jantzi, 2009
Social housing	▪ Investments in social housing and community infrastructure lead to savings for reduced crime and better employment opportunities	Casey, 2005

SDA Bocconi

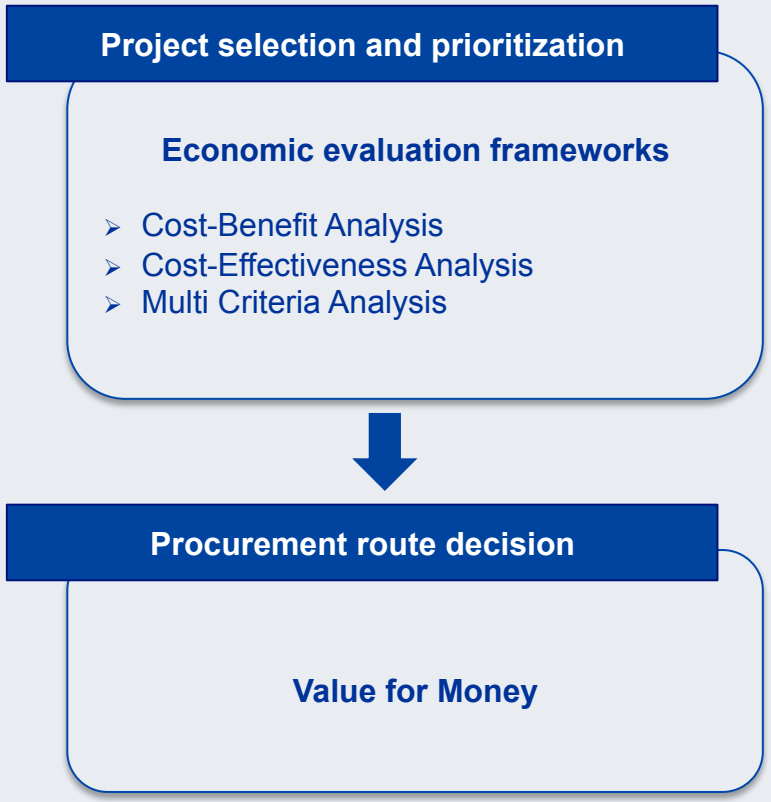
European Investment Bank

B2.2. Assessing the Public Value of Infrastructure
Conventional Evaluation Frameworks

Frameworks used to appraise social infrastructure

Many government authorities and MDBs around the world require that infrastructure projects that apply for funding present a **justification which goes beyond the financial sustainability**, in order to ensure that their operations comply with their broad objectives of inclusive economic growth, environmental sustainability, and regional integration (ADB, 2017; EIB, 2013; European Commission, 2014; Gertler, Martinez, Premand, Rawlings, & Vermeersch, 2016).

Two frameworks have been massively used in the practice for appraising the value of infrastructure investments. The first set of frameworks includes the **Cost-Benefit Analysis (CBA)** and other methods such as the **Cost-Effectiveness Analysis (CEA)** and the **Multi-Criteria Analysis (MCA)** and has been mainly used for project selection and prioritization. The second framework is the **Value for Money (VfM)**, which has been used, at project level, to select the best procurement route and, in particular, to support the PPP option compared to the traditional procurement.



Project selection and prioritization: economic evaluation frameworks

The purpose of economic evaluation is **to inform decision-making by assessing the value a project holds for the society as a whole** (Drummond, Sculpher, Claxton, Stoddart, & Torrance, 2015).

Financial evaluation is an important part of infrastructure projects' assessment, however **indications of financial sustainability do not necessarily provide reliable estimates of the value of a project from a 'social' point of view**, as they focus rather on the incremental cash flows (both capex and opex) generated by the project from the investors' perspective.

On the contrary, the word 'social' is often used in the literature about economic evaluation to denote the idea that included in the assessment are the effects of the project on all the individuals in the society, and not just the parties directly involved (Brent, 2007).

Different types of economic evaluation methods are used to guide public policy decision-making:

- Cost-Benefit Analysis
- Cost-Effectiveness Analysis
- Multi Criteria Analysis

Main economic evaluation frameworks

Cost-Benefit Analysis (CBA)	Often used as a tool in e.g. **environmental and transport policy** (Grant-Muller, Mackie, Nellthorp, & Pearman, 2001)
Cost-Effectiveness Analysis (CEA)	Dominant method for evaluations of **healthcare programs** (Drummond et al., 2015)
Multi Criteria Analysis (MCA)	Alternative approach which offers the potential to overcome the challenges of CBA and CEA, especially when making **complex decisions that include multiple criteria, simultaneously consider quantitative and qualitative data, and involve multiple stakeholders** (Dodgson, Spackman, Pearman, & Phillips, 2009).

Comparison of economic evaluation frameworks

	CBA	CEA	MCA
Main Objective	To assess if a project is worth the investment	To select the project configuration that ensure the lowest cost per unit of impact	To compare costs and impacts of alternative investment options
Identification of benefits	Single or multiple benefits, not necessarily common to the different alternatives	Single benefit, common to the different alternatives and expressed in the same natural unit, but achieved to different degrees	Single or multiple benefits, common to the different alternatives, but achieved to different degrees
Measurement of benefits	Expressed in monetary value and discounted at the social discount rate Lists benefits that cannot be easily monetised and explain why they cannot be monetised	Expressed in natural units (e.g. life-years gained)	Based on the informed judgement of the appraiser, it applies scores and weightings to each of the benefit in order to arrive to a single score
Main output of analysis	Benefit-Cost Ratio (BCR) Economic Internal Rate of Return (EIRR) Economic Net Present Value (ENPV)	Cost-Effectiveness Ratio (CER)	Total Weighted Score (TWS)
Interpretation of main output of analysis	BCR > 1, ENPV > 0, EIRR > is worth the investment E	Project with lower CER is better	Project with higher TWS is better

Cost-Benefit Analysis (CBA)

CBA is the most commonly used approach to appraise public investment projects (Florio, 2014). CBA is a straightforward concept, allowing comparison of projects based on a single metric (Thomopoulos, Grant-Muller, & Tight, 2009).

Within CBA, **both the potential costs and benefits of a particular project are estimated across a set of impacts and converted into monetary terms by multiplying impact units by prices per unit**.

The basic principle underlying CBA is that decisions have to maximize the net socio-economic benefits of projects (Boardman, Greenberg, Vining, & Weimer, 2017). In other words, there is an underlying assumption that public investment decisions should be founded on the aggregation of individuals' willingness to pay (Brent, 2007).

Once all project cost and benefits have been quantified and valued in money terms, CBA quantifies the economic performance of a project in terms of:

- Economic Net Present Value
- Economic Rate of Return
- Benefits to Costs Ratio

Main outputs of CBA

Economic Net Present Value (ENPV)	The difference between the total social benefits and costs, discounted at the social discount rate; if the ENPV is higher than zero, it means that project's economic benefits exceed project's economic costs.
Economic Rate of Return (ERR)	The rate that produces a zero value for the ENPV; if the ERR is higher than the social discount rate, it means that project's economic benefits exceed project's economic costs.
Benefits to Costs Ratio (BCR)	The ratio between discounted economic benefits and costs; if BCR is higher than 1, it means that project's economic benefits exceed project's economic costs.

Criticisms of CBA

While CBA is generally considered a relevant tool for creating better and neutral results for decision-making, it has been **criticised for two main reasons** (Hwang, 2016):

- **Monetary valuation**: because there are no natural prices or monetary values for goods like human life, **CBA approximates the price of non-market goods whose values are incommensurable** (Ackerman & Heinzerling, 2002; Adler, 1998);

- **Discounting**: discounting future value to compare them with present value becomes **controversial when it is applied to the monetary value of non-market goods**, as it would encourage, in an extreme example, to adopt a program that saves one life today over a program that would save millions of lives in the future (Ackerman & Heinzerling, 2002; Clowney, 2006); furthermore, **the choice of the most appropriate social discount rate has long been a contentious issue** and subject to intense debate in the economics literature (Bradford, 1975).

Wider Economic Effects

CBA for transport infrastructure – i.e. the sector in which this tool has been more extensively applied – traditionally assumes perfect competition in all sectors but the transportation one so that it is reasonable to assume that the consumer surplus corresponds to the total social benefit (e.g. Fosgerau & Kristensen, 2005; Jara-Diaz, 1986). This approach has allowed in the past to **simplify the evaluation procedure and focus the analysis on the transport market, ignoring any effects on other markets such as labor, housing, and consumer goods** (Kidokoro, 2004).

The OECD itself has recently claimed that wider economic effects cannot be ignored (Venables, 2017) . However, whilst there have been relatively strong developments surrounding the theoretical basis for wider economic effects, there remains **little established practice on how to translate these ideas into robust techniques for individual projects**.

Cost-Effectiveness Analysis (CEA)

The CEA approach is similar to CBA but with a fundamental difference. Instead of comparing net benefits with net costs, total costs are divided by an appropriate unit to measure effectiveness.

CEA focuses on a **single-dimension of effectiveness and reports it in natural units**. It aims to select the project that, for a given level of effectiveness, minimises the net present value of costs or, alternatively, for a given cost, maximises the effectiveness level.

Therefore, **the CEA is the most suitable approach when the aim of the project is achieving the output at minimal cost** (Cellini & Kee, 2010; Johannesson, 1995).

CEA is the preferred evaluation framework when **the policy context implies that the service level must be supplied**. The project appraisal then focuses on whether the project constitutes the most efficient alternative to supply the service.

Main output of CEA

Cost-Effectiveness Ratio (CER)	Total costs sustained to achieve a single unit of outcome; the lower the cost per unit, the most effective and efficient the project option.

This methodology is often used in the **economic evaluation of health-care programmes** (Drummond et al., 2015), but it can also be used to assess some **education and environmental projects**.

For these examples, simple CEA ratios are used, such as the **cost per life-year gained**, the **cost of education per student,** the **cost per unit of emission reduction**, etc.

Multi Criteria Analysis (MCA)

MCA has been proposed as a means of taking account of a number of different aspects or attributes of benefits (Baltussen & Niessen, 2006).

This evaluation approach is relatively simple (Janssen, 2012). Based on the objectives of the responsible decision-makers, a group of impacts is defined. Unlike CBA, these impacts can be assessed in a number of ways, such as a measured quantity, qualitative assessment or rating. These assessments are then transformed into a scale (typically 0-100), giving a score for each impact for each project. The overall performance of the project can then be estimated by producing a **total weighted score (TWS)**, calculated by multiplying each impact score by a relative weight for that impact and then summing over all impacts.

Pros	Cons
Proponents claim that, **where standard CBA or CEA are not applicable, MCA provides a systematic, transparent approach that increases objectivity and generates results that can be reproduced** (Bonte, Janssen, Mooren, Smidt, & van de Burg, 1998; Korhonen, Moskowitz, & Wallenius, 1992). MCA is considered a useful tool also when the size of the project to be assessed is small and the evaluator possesses limited resources and/or capabilities for carrying out a full CBA.	On the contrary, opponents see the choice and use of weights within the MCA as somewhat arbitrary and the interpretation and role of the overall project score can also be misunderstood in the appraisal context. In particular, **there may be a sense that the MCA is *making the decision* rather than *supporting the decision-maker* where projects are ranked by overall score** (Grant-Muller et al., 2001).

EIB use of economic evaluation frameworks across sectors

In appraising the economic viability of investment projects, the EIB uses **CBA, CEA and MCA as complementing methodologies**. The EIB uses CBA whenever possible. Depending on the nature of the alternatives to be assessed, and the type of data available, a comprehensive CBA may not be possible. In such cases, the CBA may be replaced by a CEA or a MCA.

Given that the CEA is only practicable when the output is homogeneous and easily measurable, it is usually applied by the EIB in sectors such as energy, waste management, water and wastewater.

In sectors such as education, health and projects addressing the urban environment the output can have many dimensions and may not be easily measurable, therefore the MCA is a more suitable methodology.

In general, **within the context of social infrastructure, benefit valuation has been considered to be more complex than in the transport sector** (Adhikari, 1999; Hummel-Rossi & Ashdown, 2002) and the literature lacks guidelines and examples on the categories of benefits to be applied to healthcare, education, and housing infrastructure.

Most frequently used methodologies per sector

Evaluation framework	Sectors of application
CBA	▪ Agro-industry ▪ Energy ▪ Manufacturing ▪ Telecommunications ▪ Tourism ▪ Transport ▪ Water and wastewater
CEA	▪ Energy ▪ Solid waste management ▪ Water and wastewater
MCA	▪ Healthcare ▪ Education ▪ Urban and Regional Development

Source: EIB 2013

An example of MCA applied to healthcare infrastructure

Description of the investment project

Building of a new acute hospital of 295 beds, which will facilitate and support the transformation of local healthcare services; two existing acute hospitals are present at local level and they will be merged into a single service and relocated to a new greenfield site acute hospital that is complementary to and networked with other local health and social care services in the area.

Option evaluation

- **Do-minimum option (1)**, i.e. investing in existing hospital facilities to meet statutory/health and safety standards and replacing the equipment
- **Do-medium (2)**, i.e. refurbishing and extending the existing hospitals
- **Do-maximum (3)**, i.e. building a new hospital on a new site

Financial evaluation

Capex and Opex (EurM)	(1)	(2)	(3)
Initial capex	47.6	180.2	210.7
Life-cycle capex	80.0	34.1	30.1
Annual opex	43.9	44.3	44.2
Net Present Cost (30 years, at 4% financial disc. rate)	**846.5**	**967.5**	**991.9**

MCA		Option scores			Weighted option scores		
Criteria	**Weights**	**(1)**	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**
High quality care	20%	5	8	9	100	160	180
Service synergies	17%	3	7	10	51	119	170
Accessibility	17%	6	7	9	102	110	153
Patient environment	15%	3	7	10	45	105	150
Statutory requirements	10%	8	9	10	80	90	100
Ease/timing of implementation	8%	6	8	1	48	64	8
Future flexibility	13%	2	5	8	26	65	104
Total Weighted Scores	**100 %**				**452**	**722**	**865**
NPC/TWS					**1.87**	**1.34**	**1.15**
Rank					**3**	**2**	**1**

Source: figures are hypothetical and are used just to show the MCA methodology applied to multiple option evaluation.

A revised MCA – The WB Infrastructure Prioritization Framework

Since information in many contexts is limited and many costs and benefits are difficult to monetize, CBA is particularly difficult when governments possess limited resources for appraising large sets of small- and medium-sized projects. In response to the need for an expanded set of tools to support infrastructure prioritization and selection under conditions of imperfect or basic project appraisal and limited resources, **the World Bank has developed the Infrastructure Prioritization Framework (IPF)** (Marcelo, Mandri-Perrott, House, & Schwartz, 2016).

The IPF is a multi-criteria prioritization approach that synthetises project-level financial, economic, social, and environmental indicators into **two indices: social-environmental (SEI) and financial-economic (FEI)**.

Calculation of the SEI and the FEI composite indicators allows the ranking of projects within a sector, according to projected relative performance along each dimension. Projects are then plotted on a Cartesian plane, with axes defined by the SEI and FEI scores, like in the chart on the right side. Including the budget limit (i.e. the red dashed lines) allows to define the quadrants, where quadrant A includes projects with higher priority to be funded.

FEI

Economic efficiency

- Life-cycle costs
- Operational improvements
- Use of management Information Systems and smart design
- Etc…

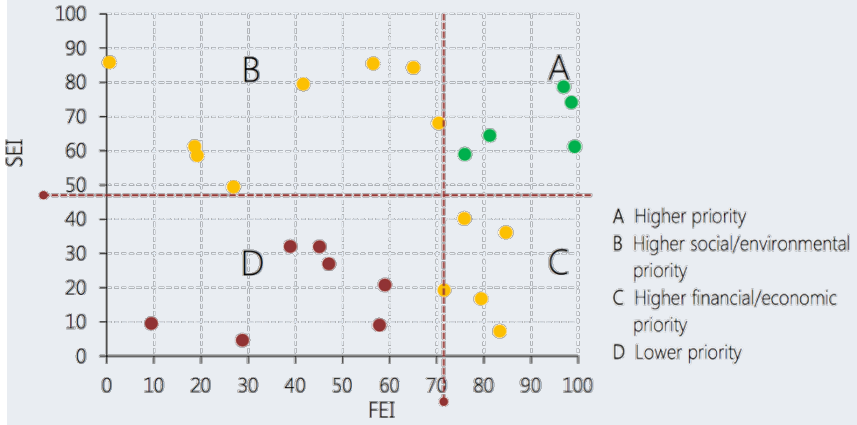
SEI

Environmental and social sustainability

- Minimize environmental impact
- Inclusion, gender, accessibility
- Etc…

Economic and social contribution

- Job creation
- SMEs development
- GDP growth
- Etc…



Source: Marcelo et al. 2016

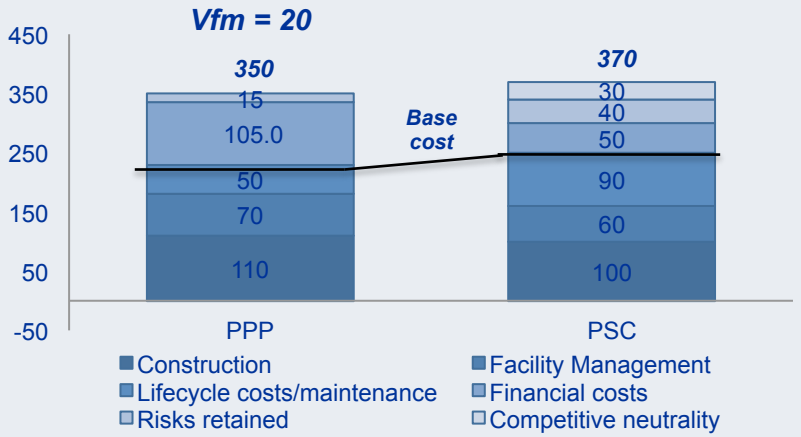
Procurement route decision: Value for Money (VfM)

Where government authorities and MDBs can engage in PPPs, they need to **supplement the traditional investment decision** (whether to undertake the project or not, usually based on an economic justification applying the methodologies discussed before) **with a procurement route decision**. There is general acceptance among scholars and practitioners that this decision should be based on a VfM analysis (Farquharson, de Mästle, & Yescombe, 2011).

In general, in public management, VfM is an umbrella concept that attempts to capture three dimensions of performance simultaneously – the so-called '3Es': Economy, Efficiency and Effectiveness – and it describes an explicit commitment to ensuring the best results possible are obtained from the money spent (McKevitt, 2015; Talbot, 1999). **At project level, VfM is an analysis that compares delivering an investment through a PPP with implementing it through a conventional procurement**. The VfM analysis computes the present value of the total lifecycle costs incurred by government in case of a PPP and compares them to an equivalent and usually hypothetical project financed and delivered by the public sector according to a traditional approach, which is referred to as the public sector comparator (PSC).

The figure below shows the main terms of benchmark of the two options – i.e. PPP and PSC:

- **base cost** (design and construction; facility management and life cycle cost and or maintenance costs)
- **financial costs,** which are considered, according to some methodologies, to account for the opportunity cost of the capital; whilst in other cases it is not considered (e.g. in the UK and in British Columbia);
- **competitive neutrality**, which correct the PPP option for the higher taxation that is applied to a PPP project and which contributes to the payment charge calculation; and
- **the value of risks retained** by the public sector.



Source: figures are hypothetical and are used just to show the main trends of project costs under the two options.

Criticisms of VfM

Despite the emphasis placed on cost-efficiency, risk-transfer and incentives (Iossa & Martimort, 2015), VfM, affordability and desirability of PPP remain widely contested (Hellowell & Vecchi, 2015; Reeves, 2013; Siemiatycki, 2011). Hodge & Greve (2017) argue that the "success" of the PPP model cannot be determined without asking "success for whom". Boardman & Hellowell (2017) indicate that PPP should be considered as a VfM option only if it achieves specific government goals and maximizes the value to society.

One of the main criticisms levelled at the VfM is that it focuses solely on the financial cost (risk-adjusted) of PPP or traditional procurement. Van den Hurk & Hueskes (2017) claim that elements that go beyond mere financial benefits and deliver social value have largely been overlooked by the VfM analysis. According to Hueskes, Verhoest, & Block (2017), PPP can help to achieve sustainability goals, but social parameters must be considered for extending VfM framework. The European PPP Expertise Centre (EPEC) suggests that **non-financial benefits, i.e. socio-economic benefits to service users or wider society from an infrastructure investment implemented via PPP**, should be quantified and presented alongside the financial cost comparison for each option in order to acquire a more complete picture of VfM.

Non-financial benefits of PPP

Despite methodologically complex (Grimsey & Lewis, 2005), EPEC suggests that the following non-financial benefits of PPP should be incorporated into the VfM framework.

Accelerated Delivery	On-time delivery of the infrastructure	▪ Earlier delivery of the infrastructure and the outputs of related public services
Enhanced Delivery	Life-cycle approach to cost optimization and incentive to provide innovative solutions in the delivery of public services	▪ Better asset condition ▪ Improved service quality (stronger customer orientation; improved output; etc)
Wider Social Impacts	Positive externalities	▪ Increased employment in depressed areas ▪ Reduced carbon emissions

SDA Bocconi

European Investment Bank

B2.3. Public Value Creation and Measurement
What can we learn from Social Impact Investing?

Social impact investing and impact evaluation

In the last decade, a greater emphasis has been placed on social and public value creation by the private sector (Meynhardt, 2009).

We have assisted to the rise of a **new breed of private corporates and investors, who increasingly seek to achieve more than monetary returns with their investment activities and see a value in driving social impact** (Bugg-Levine & Goldstein, 2009; Donohoe & Bugg-Levine, 2010).

This has originated the the emergence of different **social impact investment approaches**, with different social and financial return expectations (Bénabou & Tirole, 2010; Buckland, Hehenberger, & Hay, 2013; Freireich & Fulton, 2009; Grabenwarter & Liechtenstein, 2011; Porter & Kramer, 2011).

Social Impact investiment approaches

- **Venture philanthropy**
- **Responsible or ESG** (environmental, society and governance) **investment**
- **Impact investing**
- **Shared value creation**

Impact evaluation

Along with these efforts aimed at sustainable, responsible business, there has been a **rise in the tools available for measuring the social impact of business** (Florman, Klingler-Vidra, & Facada, 2016).

The most widely advocated set of approaches to social performance measurement involve an assessment of impacts or results, which are broadly labelled as "***impact evaluation"* and *"outcome measurement"*** (Ebrahim & Rangan, 2014).

These tools are used by **different stakeholders and for different objectives**. They are used by investors as well as investees and intermediary organizations, with the purpose of screening, rating, assessment, management, monitoring and ex-post evaluation.

Since **what is being measured is rarely quantifiable in a single number**, such as a dollar value, or a quantity, and it can be **unlikely standardized across different sectors and organizations**, investees and investors have developed specific sets of metrics and evaluation methodologies.

Impact evaluation frameworks: a classification

The desire to demonstrate impact has propelled the proliferation of **more than 150 impact evaluation methods** (Florman et al., 2016).

Many authors have provided a classifications for numerous impact assessment methodologies in use. Such classifications are an important tool, as they shed a light on the peculiarities and commonalities among the different approaches, and provide for a comprehensive understanding of the field.

Hereby, three of the most prominent classifications are analysed:

- Olsen & Galimidi (2008) provide a classifications concerning the functional type; i.e. **Rating, Assessment, and Management Systems**;
- So & Staskevicius (2015) link measurement objectives to the project timeline; i.e. **due-diligence phase, pre-approval phase and post-investment phase**;
- Reeder & Colantonio (2013) group methodologies according to two main features, i.e. **the degree of synthesis of social and environmental returns and the degree of participation.**

Functional type	▪ **Rating**: summarised by a score or symbol, based on a fixed set of indicators ▪ **Assessment**: fixed or customised set of indicators to evaluate characteristics and/or results of a portfolio ▪ **Management**: tools to manage operational information about impact drivers
Project timeline	▪ **Pre-investment: estimating** impact for due-diligence and **planning** impact through strategy ▪ **Post-investment**: **monitoring** impact to improve program and **evaluating** impact to prove impact created
Degree of synthesis	▪ The result is **synthetized in a single indicator or a number**, or not
Degree of participation	▪ **Consultantion and discussion** vs. **top-down technocratic** approaches

Impact evaluation frameworks: a classification

Method	Description	Methodology	Functional type	Timeline	Degree of participation	Users
B Rating System	Online survey, database and report designed to analyse and improve a company's performance relative to social and environmental standards.	Depending on the industry, organisations are asked between 60 and 170 questions to assess their performance across 5 categories: governance and impact on employees, community, environment and consumers. The report gives a real-time overall score (out of 5 stars) and 10 to 15 sub-categories scores.	Rating	Planning and Monitoring Impact	Low	Entrepreneurs / organizations and investors
Global Impact Investing Rating System (GIIRS)	Comprehensive and transparent system for assessing the social and environmental impact of developed and emerging market companies and funds with a ratings and analytics approach analogous to Morningstar investment rankings and Capital IQ financial analytics	It provides a score by assessing performance against several impact areas (governance, community, workers, environment, socially- and environmentally-focused business model). After completing a GIIRS Assessment, companies are assessed and reviewed by GIIRS and only at the end receives a GIIRS Ratings Report.	Rating, Assessment	Monitoring and Evaluating Impact	Low	Investors
IRIS Metrics	Online library with performance indicators with standardised definitions. Its aim is to provide a set of standardised indicators for organisations to use when reporting their social and environmental performance.	Organisations can adopt IRIS metrics by selecting a set of IRIS indicators that are applicable to their work, and reporting performance data consistent with those indicators. IRIS does not indicate which metrics an organisation should use; it is left to the organisation to decide.	Rating, Assessment	Monitoring and Evaluating Impact	Medium / High	Entrepreneurs / organizations and investors

Impact evaluation frameworks: a classification

Method	Description	Methodology	Functional type	Timeline	Degree of participation	Users
Social Impact Assessment (SIA)	Projected impact assessment like financial projections. It follows the SROI Framework to define, measure and document impact.	3 steps: 1. definition of an organisation's social value proposition through the theory of change 2. qualification of social value by listing the 3 most correlate social indicators with the desired outcomes. 3. monetisation of social impact value to be created in the next 10 years.	Assessment	Estimating Impact	Medium / high	Entrepreneurs / organizations and investors
SROI Framework	Set of guidelines for the measurement of non-financial impact per investment for use by companies and investors, non-profits and funders, and governmental entities.	Six stages: Scope and stakeholders, Mapping outcomes, Evidencing outcomes, Establishing impact, Calculating the SROI, Reporting and Embedding. Guidelines include advice on the attribution of impact, how to determine whether an impact is worth measuring and cost accounting.	Assessment, Management	Estimating, Monitoring and Evaluating Impact	High	Entrepreneurs / organizations and investors
Balanced Scorecard Modified to Include Impact	It assumes that companies measure operational performance in terms of five outcomes perspectives that go beyond financial measures alone: financial, customer, business process, learning-and-growth, and social impact to arrive at a more useful view of near term and future performance.	Each organisation establishes a scorecard to measure performance and to communicate performance to stakeholders.	Management	Planning and Monitoring Impact	Medium	Entrepreneurs / organizations

Social Return on Investment (SROI)

A technique widely advocated is **Social Return on Investment (SROI)**, which is designed to understand, manage and report on the value created by an intervention across three realms: **social, economic and environmental – referred to as the *triple bottom line***. SROI was developed in 1997 by the Roberts Enterprise Development Fund with **its roots in cost-benefit analysis** (Lingane & Olsen, 2004; Nicholls, 2006).

The SROI Network (2012) outlines a **6-step framework** that can be implemented and adapted to the needs of any organisation and project:

1. **Definition of scope and key stakeholders involved**;
2. **Mapping and definition of outcomes**;
3. **Evidencing of outcomes and attribution of value**, i.e. for each outcome defined in the previous stage, the organisation should come up with suitable indicators of performance
4. **Establishment of impact**, i.e. understanding if and to what extent the analysed outcomes are directly linked to the activities of the organisation
5. **SROI calculation**;
6. **Reporting, use and embedding**, i.e. the results should be presented to the project's stakeholders and, also, be interpreted to obtain management insights for the organisation itself.

A comparison between SROI and CBA

SROI is based upon the principles of CBA, as costs and benefits are quantified and compared to evaluate the desirability of a given intervention expressed in monetary units. However, **key differences exists between the two approaches**.

Context of application	SROI has its **focus on the third sector**, compared to CBA that has been extensively applied to public service and infrastructure provision
Scope of the impact assessment	SROI has been described as an **extension of the CBA** to incorporate in addition the **broader socio-economic and environmental outcomes** (Banke-Thomas, Madaj, Charles, & van den Broek, 2015)
Stakeholders' involvement	The calculation of SROI requires to **involve stakeholders at every stage** (Arvidson et al., 2010) through assessing how much stakeholders value the intervention

Social Impact Bonds (SIBs)

A form of social impact investing is **Social Impact Bond (SIB)**, which can be defined as a **public – private plural partnership (4Ps)** (to use the words of Henry Minztberg Mintzberg, 2015; Mintzberg et al., 2005), with a contractual structure very similar to the PFI model, aimed at financing and delivering welfare services (Jackson, 2013; Stoesz, 2014).

Given the set of contracts involved, the up-front capital provided by private investors and the payment made by the government if pre-determined performance standards are met, **SIBs have been considered as an expansion of the long-term infrastructure PPP model into social program delivery** (Joy & Shields, 2013; Warner, 2013).

SIBs have been conceived not only to overcome the shortcomings of traditional public and third-sector service provision, i.e. lack of capital, performance management, efficiency and accountability, but also to **bring more innovation in service design and delivery and encourage key stakeholders to focus on the achievement of higher social outcomes** (Fraser, Tan, Lagarde, & Mays, 2018; Leventhal, 2012).

Peculiarities of SIBs

- SIBs are **payment for performance contracts**, where the main performance indicator is an improved **social outcome**
- **A plurality of stakeholders is involved**: private investors, non-profit service providers, and the public sector
- **Private investors and providers take the risk to reach social outcomes** as they are paid for the social improvement achieved
- **The VfM** applied to SIB quantifies, in monetary terms, **the impact of improved outcome**
- **All parties involved in the contract need to agree on the outcomes that trigger payments**, as well as on the timing of measurement and the methodology by which the program will be evaluated

Critical reflections on SIBs

SIB Database

In order to discuss the emerging features of SIBs, we have mapped and analysed the main experiences developed across the world (see **ANNEX B2.1.**). Our database of SIBs includes 90 projects with information as at December 2017.

Critical reflections on SIBs

Degree of innovation and risk	▪ The main rationale for introducing SIBs is the need to improve the outcome delivery, through innovation in social service provision ▪ However, **international experiences show that the majority of SIBs are based on already implemented and well-established models** ▪ In many cases, **private investors do not bear the risk** of achieving the social outcomes, since guarantees are provided	▪ Investors motivated by a return on investment may have little incentive to fund risky innovative experiments ▪ **Well designed guarantees may be important to mitigate the risks associated to innovative experiments** and sustain the attraction of private capital into SIBs, especially in their early phase of development
Short-termism of the impact to be achieved	▪ The VfM methodology applied to SIB quantifies in monetary terms the impact of improved outcomes ▪ However, **the focus has been more on the realization of savings in the public budget as a consequence of improved outcomes** rather than on the improved outcomes themselves	▪ This approach could make governments and delivery organizations to **prefer programs which may generate short-term savings but limited long-term social impacts** ▪ The short-term perspective may be preferred also by investors

SDA Bocconi

European Investment Bank

B2.4. Conclusion and Recommendation

Discussion on conventional evaluation frameworks

Frameworks and metrics to evaluate the PV of infrastructure are abundant	**Traditional evaluation frameworks, such as the CBA, are well established and used by governments and MDBs across the world to evaluate infrastructure project**. CBA, CEA and MCA are rooted in the economic theory and inherently incorporate public value dimensions. They are used as complementing tools by many organizations.
However the evaluation is difficult and CBA is rarely applied to social infrastructure	**CBA usually considers only the direct effects on the primary market, thus excluding wider economic benefits**, in order to simplify the analysis (Kidokoro, 2004). Within the context of social infrastructure, benefit valuation has been considered to be even more complex (Adhikari, 1999; Hummel-Rossi & Ashdown, 2002) and the literature lacks guidelines and examples on how to apply it.
Ex-ante analysis are not reliable	**CBA is conventionally applied ex-ante and rarely supplemented with empirical ex-post risk analysis** focused on documented uncertainties in the estimates of costs and benefits that enter into the analysis. **Large inaccuracies in forecasting are well documented and some authors conclude that CBA is not to be trusted for major infrastructure project** (Flyvberg 2009). In economics, this have led to discussions of the necessity of 'firing the forecaster' (Akerlof and Shiller, 2010, p. 146).
Results of the evaluation are subject to political influence	Competition between projects and authorities creates political and organizational pressures that in turn create an **incentive structure that makes it rational for project promoters to emphasize benefits and de-emphasize costs and risks** (Flyvbjerg 2009). In addition, policy makers are trapped into a short-term approach (Benitez et al., 2010; P. Jackson, 1988) and **infrastructure projects are often seen as redistribution aimed at influencing the outcomes of elections** (Besley & Coate, 1997). In this context, white elephants may be preferred to socially efficient projects if the political benefits are large compared to the surplus generated by efficient projects (Robinson and Torvik 2005)

Lessons learnt from social impact investing

There are private investors that are willing to take the risk of social outcome	The rise of social impact investing demonstrates that there are investors that are willing to take the risk to reach social outcomes. In particular, **SIBs are an example of pay-for-performance contracts where the payment mechanism is linked to the achievement of pre-determined social outcomes**.
Many impact evaluation methodologies exist, no standardized approach	Along with the rise of social impact investing, **many impact evaluation methodologies have been developed**. They have their roots in the economic theory (e.g. SROI) and **incorporate the broader socio-economic and environmental outcomes**. Besides the efforts to create common approaches, investees and investors apply **specific sets of metrics** depending on the type of project and sector.
A number of stakeholders are involved	In social impact investing, PV creation bases its practice in the systems of dialogue, exchange and co-creation among relevant interest groups (Stoker, 2006). Therefore, impact evaluation involves stakeholders at every stage through assessing how much they value the intervention. **All parties involved usually agree on the main outcomes measured as well as the timing of measurement**. The evaluation is often performed by an independent evaluator.
Impact evaluation is carried out at every stage, and for different purposes	Impact evaluation is carried out for **rating, assessment and management** purposes, at different stage, i.e. **pre, during and post the investment**. Results are usually compared and triangulated on an on-going basis.

Recommendations

RECOMMENDATION 1

CBA and other economic evaluation frameworks are the preferred tools to measure the public value of social infrastructure, but:

- They should include wider **socio-economic and environmental outcomes**
- They should be used **not only for *ex-ante* project prioritization and screening, but also for project monitoring and *ex-post* evaluation**

RECOMMENDATION 2

To avoid that project promoters adopt opportunistic behaviours and overestimate project benefits and/or underestimate costs:

- Forecasts and business cases should be made subject to **independent peer review**
- **Payment-for-social-performance mechanisms** should be incorporated (e.g. if social outcomes are not achieved as foreseen, an increase in the loan interest rate is applied).

Key points of attention

- Given that the casual links between infrastructure expenditure and social outcome are elusive, it is vital to **involve relevant stakeholders** to identify the main expected results of a project
- As demonstrated by SIBs, the incentive – base structure of the **PPP approach can be seen as the preferred perimeter to experiment payment-for-social-performance** mechanisms
- The amount of money requested to develop hard infrastructure, the long-term perspective to generate social results, the risk-adverse profile of long-term investors generally involved in infrastructure projects (Vecchi et al., 2016), and their preference for standardized solutions could **prevent the application of the SIB model to infrastructure-based PPP**
- **Small-scale experimentations and well-designed guarantees** may be important to attract private capital and test the application of this mechanism

ANNEX B2.1. Social Impact Bonds

Scope of the database and use of data

Our database collects data on the Social Impact Bonds (SIB) that have been implemented at international level as at December 2017.

The database of SIBs includes only the initiatives that have been explicitly defined as "SIBs" and whose relevant contracts had been already signed as at December 2017. It does not include SIBs in a phase of development, due to the limited information publicly available. An extensive desk research was conducted to collect the relevant information, using Social Finance* online resources as first sources of information and complementing them through the analysis of academic and grey literature, projects' reports, factsheets and press releases.

In the database, SIBs are classified according to three main dimensions:

1. Country, which is the nation where the SIB has been implemented and where the public outcome funder and the target beneficiaries are located;
2. Year, which is the year in which the SIB's relevant contracts have been signed;
3. Social issue, which is the area in which the SIB tackles the social challenge.

For each observation, the following information was sourced: target population, contract length, investment raised and maximum outcome payment, target and maximum IRR (internal rate of return), availability of a guarantee to reduce capital loss, outcome payer, service provider, intermediary and investors. It must be noted that, in many cases, the target IRR and the availability of guarantees to reduce capital loss are not disclosed, therefore such data is available only for the 30% and the 57% of observations, respectively.

---

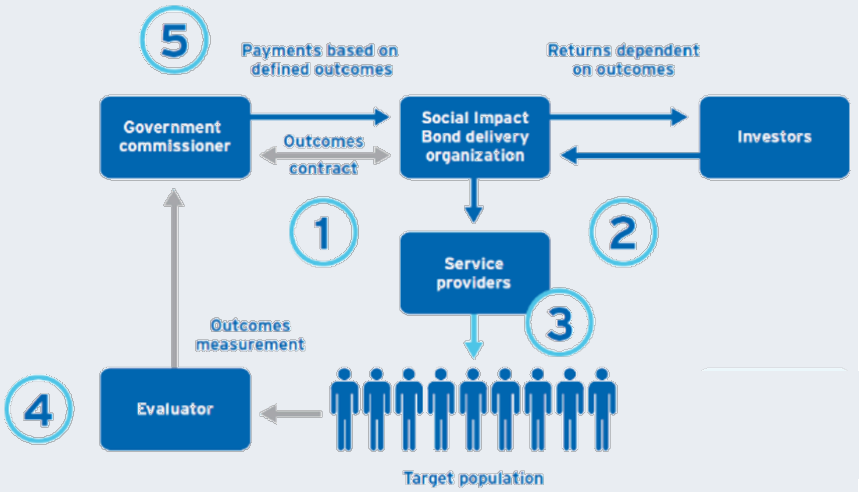
* Social Finance is a not for profit organisation that partners with the UK Government, the social sector and the financial community with the mission to find better ways of tackling social problems. They have set up the first SIB in Peterborough and actively contributed to the spread of the SIB model at international level. They manage the largest database of SIBs, publicly accessible at this link: https://sibdatabase.socialfinance.org.uk

What a Social Impact Bond is

SIBs are innovative contractual and financing mechanism in which governments or commissioners enter into agreements with social service providers, such as social enterprises or non-profit organizations, and private investors to pay for the delivery of pre-defined social outcomes. SIBs are also known as Pay-for-Success Bonds (USA) or Pay-for-Benefits Bonds (Australia).

SIBs involve, in essence, a set of contracts, the basis of which is an agreement by government to pay for an improvement in a specific social outcome once it has been achieved. Investors provide the up-front capital to deliver the intervention, thus assuming the financial risk. These funds are passed to service providers, generally through an intermediary, to cover their investment and/ or operating costs to deliver an intervention to a selected target group of beneficiaries. If the measurable outcomes agreed up-front are achieved, government will repay the investors for their initial investment plus a return for the financial risks they took. In case of lower or higher performance in the achievement of the target outcomes, the payment will be, respectively, higher or lower; in the latter case, no payment is secured in case no outcome is generated.

The scheme and the stakeholders involved



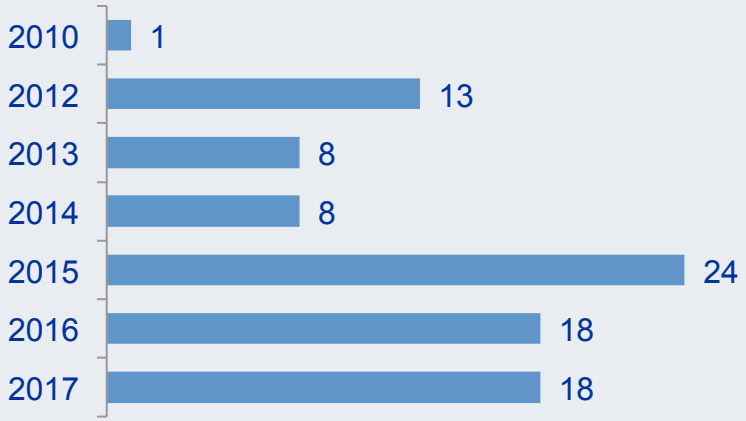
Data in brief: SIB number and geographies

After the first SIB was launched in the UK in 2010 (in Peterborough), the number of deals has grown consistently, reaching a number of 90 implemented projects worldwide, as at December 2017. Besides the number of SIBs launched at international level, the market is still in a phase of development, with many local experiences but no critical mass.

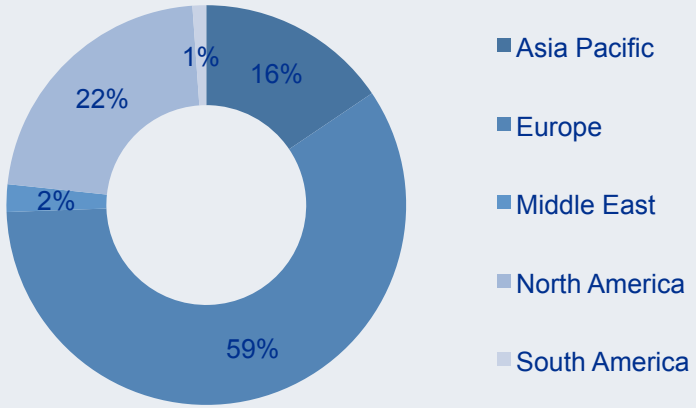
In terms of geographical expansion, SIBs have been mainly developed in Europe, North America, and Asia Pacific. Even if they have been mainly applied in developed countries, they have been experimented also in developing countries as Development Impact Bonds (DIBs).

The highest number of implemented projects is found in the United Kingdom, where the Government, leveraging the money coming from the Big Lottery Fund, has created 7 investment funds to spur SIB funding and launched 33 projects. The country with the second-highest number of SIBs is the United States, with 16 SIBs. Continental Europe's first SIBs were established in Germany and the Netherlands, followed by Belgium and Portugal. Australia has implemented 6 SIBs, and Canada has developed 4 SIBs.

SIB implemented per year



SIB implemented per continent



Data in brief: SIB social areas and contractual length

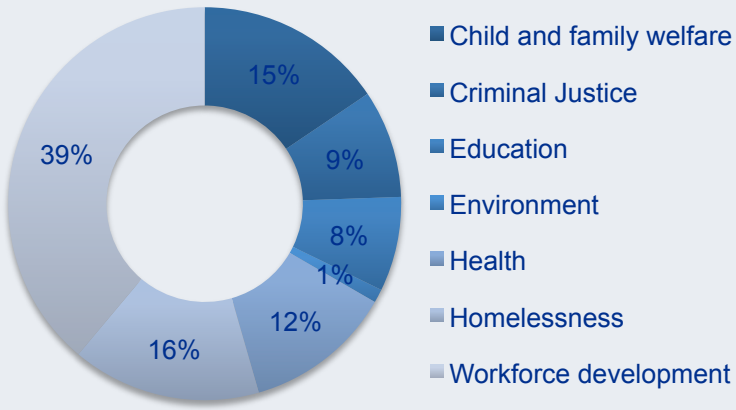
In terms of social areas, SIBs provide an opportunity to address problems where existing public policy interventions have not achieved the desired social outcomes and traditional models have failed to deliver the innovation needed to make inroads with these issues.

The largest number of SIBs have been issued to tackle social problems in three areas:

- Workforce development, with a particular focus on youth and refugee unemployment;
- Homelessness, with projects mainly focusing on housing provision as well as intensive case management and employment needs to vulnerable people;
- Child and family welfare, with a particular focus on providing assistance to low income families with children at the edge of care.

In terms of contractual length, SIBs usually consist of multi-year year projects. The average duration is 4.4 years, with a maximum of 10 and a minimum of 1 year project.

SIB implemented per social area



SIB contractual length

Social area	Average Duration (years)
Child and family welfare	5.5
Criminal Justice	5.1
Education	3.9
Environment	5.0
Health	4.5
Homelessness	4.2
Workforce development	4.0
Total	**4.4**

Data in brief: SIB financial elements

Despite their name – i.e. "bond" –, which would refer to a bond-like structure, SIBs around the world have been issued in the form of debt as well as equity investments. The type of security used and, in many cases, the issue of a public guarantee may significantly affect the risk and return profile of a SIB. The projects in the UK have generally been structured more like equity investments, while in the US and Continental Europe debt-like structures secured with a guarantee are more common.

The investment size of implemented SIBs is, on average, 3.2 million Euro.

The return profile of SIBs is quite variable and, in many cases, undisclosed. In terms of outcome payment, implemented SIBs will repay, on average, if the foreseen social outcome is achieved, the 190.4% compared to the amount of capital invested, within a range that goes from the 100% (capital reimbursement) to the 500%. In terms of IRR, implemented SIBs target, on average, the 5.20% on an annual basis, within a range that goes from the 1% to the 12%.

SIB Investment size and outcome payment per social area

Social area	Average Investment raised in EUR (in million)	Average Outcome payment / Investment raised %
Child and family welfare	2.99	167.2%
Criminal Justice	6.70	132.7%
Education	3.28	136.8%
Environment	21.00	113.2%
Health	5.30	189.4%
Homelessness	2.38	237.4%
Workforce development	1.66	209.9%
Total	**3.19**	**190.4%**

Observations: 80; Undisclosed: 10.

SIB target and maximum IRR per social area

Social area	Average Target IRR	Average Max IRR
Child and family welfare	6.4%	12.5%
Criminal Justice	5.5%	10.1%
Education	3.3%	13.7%
Environment	3.4%	n/a
Health	6.3%	9.8%
Homelessness	5.3%	9.2%
Workforce development	5.0%	8.8%
Total	**5.2%**	**10.4%**

Observations: 27; Undisclosed: 63.

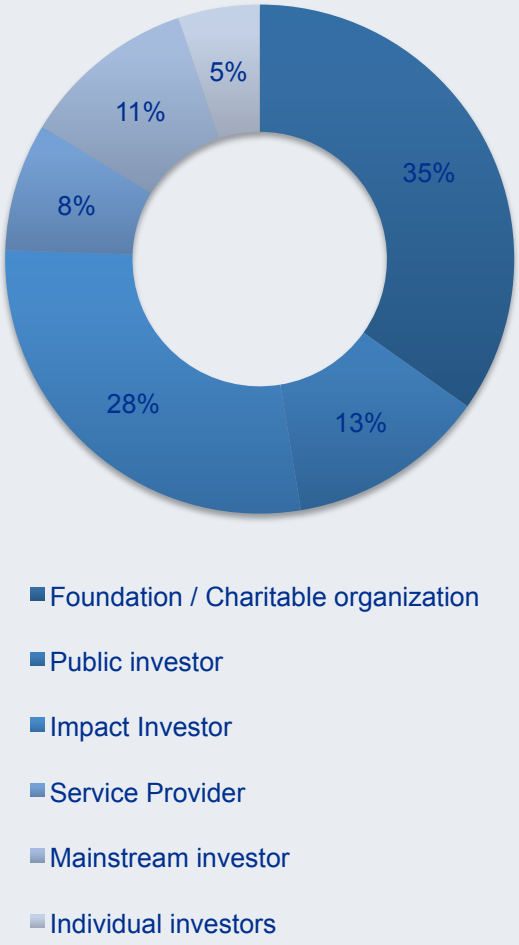
Data in brief: SIB investors

In terms of investors involved, statistics report a number of 238 active investors in SIBs.

Investors are mainly represented by the following categories:

- Foundations, charitable organizations and religious institutions: they represent the majority of SIB investors;
- Impact investors: impact investing firms are specialized asset managers with the mandate to commit capital to enterprises and projects that pursue both social and financial returns; they represent the second largest group of investors in SIBs;
- Mainstream investors: banks and traditional financial intermediaries are involved only in few projects; they commit money within their CSR policies or, when protected by guarantees, within their standard asset management portfolios; the latter case is often a way to provide alternative investment opportunities to their high net worth individual investors.

SIB investors per category



SDA Bocconi

European Investment Bank

PHASE C
REVIEW OF PPP MODELS IN HEALTHCARE AND EDUCATION

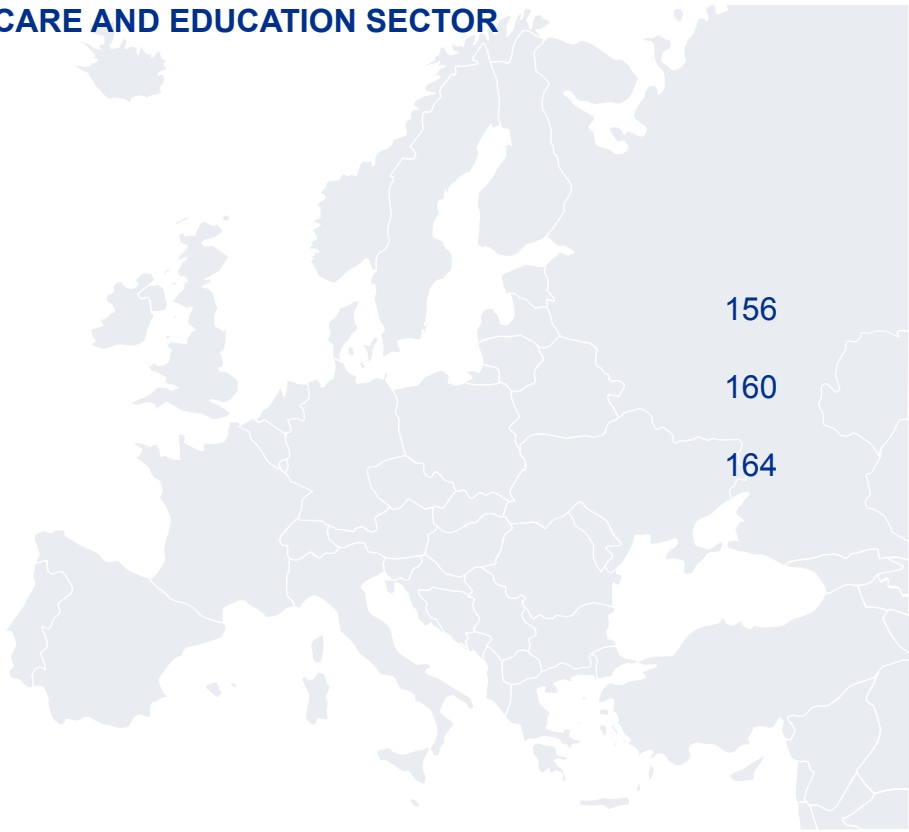
SDA Bocconi

European Investment Bank

PHASE C – REVIEW OF PPP MODELS IN THE HEALTHCARE AND EDUCATION SECTOR

Researcher: Niccolò Cusumano

Table of contents

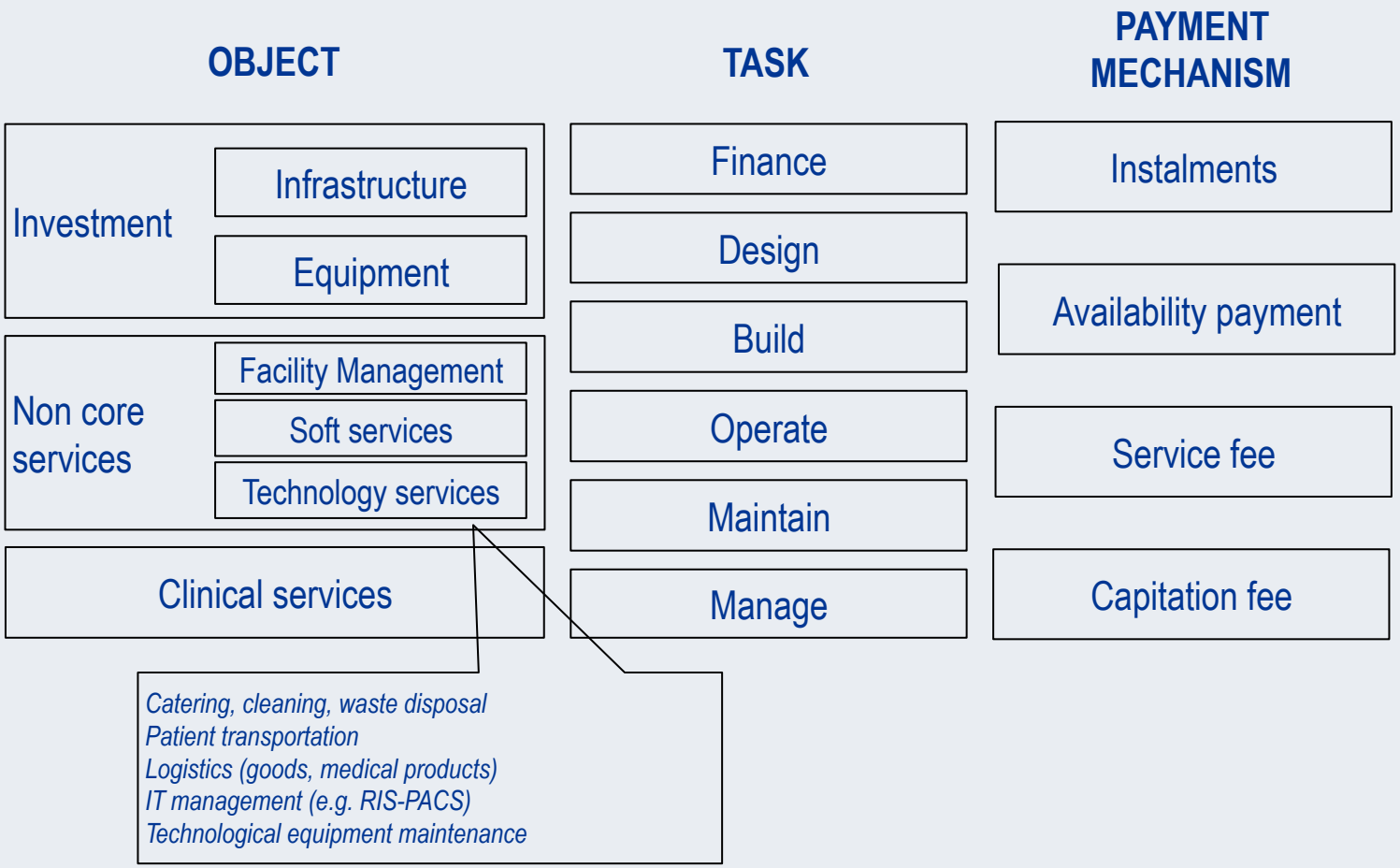


SDA Bocconi

European Investment Bank

C.1. PPP in the healthcare sector

PPP in healthcare: building blocks



OBJECT OF THE PPP

In the healthcare sector, the investment can relate to:

- the construction of a new hospital/healthcare facility;
- the refurbishment and modernization of an old one or parts of it;
- the provision of the medical equipment, such as RMI, laboratory equipment, operating theatres.

Services included in a partnership can be either non-clinical / non-core services and clinical / core services. Non-clinical services relate to facility management and they can be distinguished in “hard services”, i.e. those services related to the operation and maintenance of the building and its equipment, and “soft services,” referred to all those functions not directly linked to the physical building, such as cleaning, catering, waste collection, security and logistics.

TASKS OF THE PRIVATE OPERATOR

The private partner can be entrusted with several tasks:

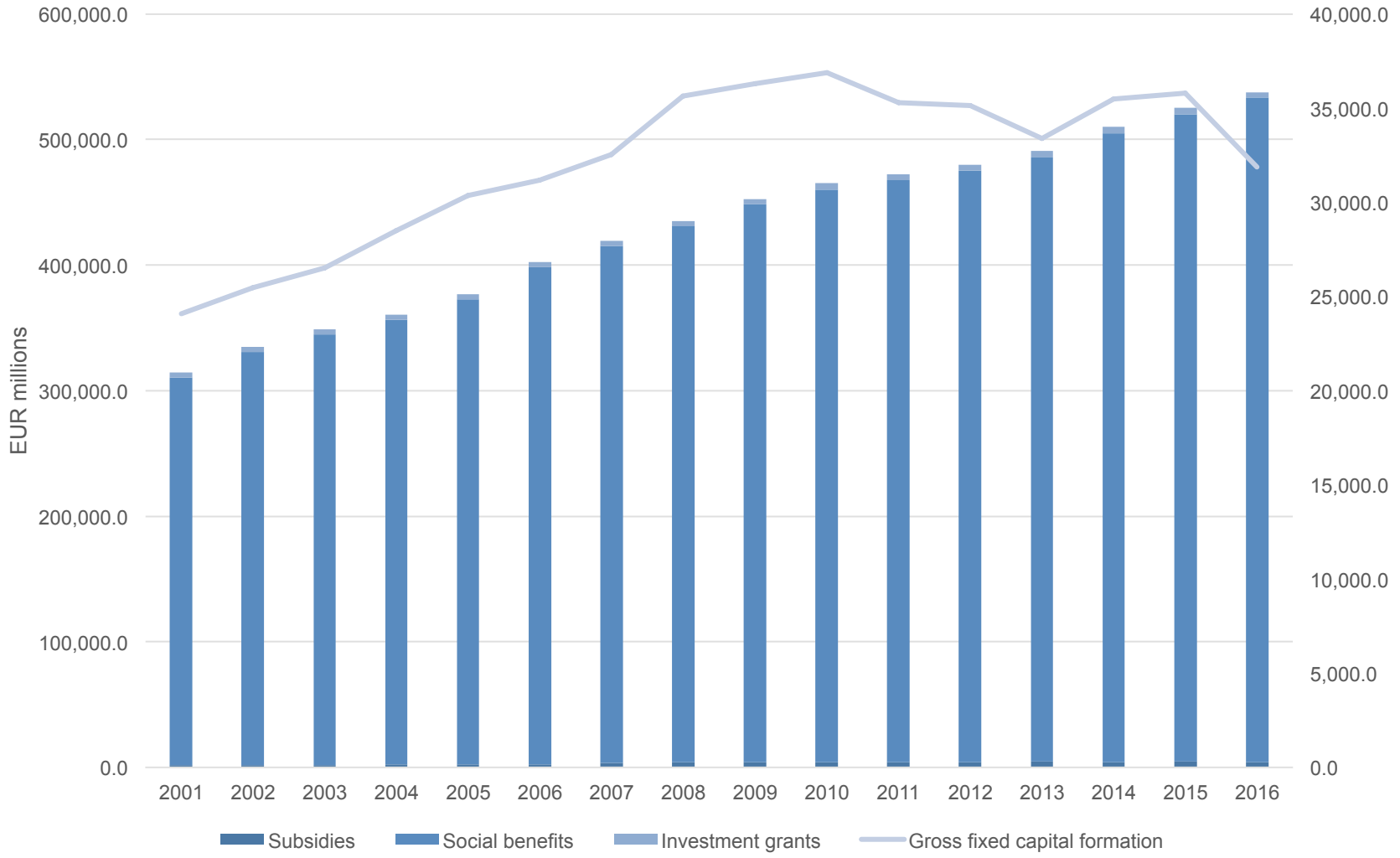
- provide financial resources to cover investment costs;
- design a facility or a service;
- perform building works;
- control the functioning of a building and equipment;
- maintain facilities and equipment;
- operate equipment and non-core services;
- manage clinical services.

PAYMENT MECHANISM

In the health sector the following are the most widespread payment methods (OECD, 2016):

- Instalments: payment corresponded to the private partner at the achievement of defined delivery milestone.
- Availability payment: the payment is linked to the availability of an asset (facility or equipment). Availability is defined as the request that the asset (or a section of the asset) is open, functioning, meets the performance, safety, quality criteria specified by the contract and permitting full use by the public authority.
- Service fee: payment for service performed.
- Capitation fee: With capitation scheme providers are paid a fixed amount of money on the basis of number of patients for delivering a range of services.

Transfer of public resources to families and private health providers in the EU

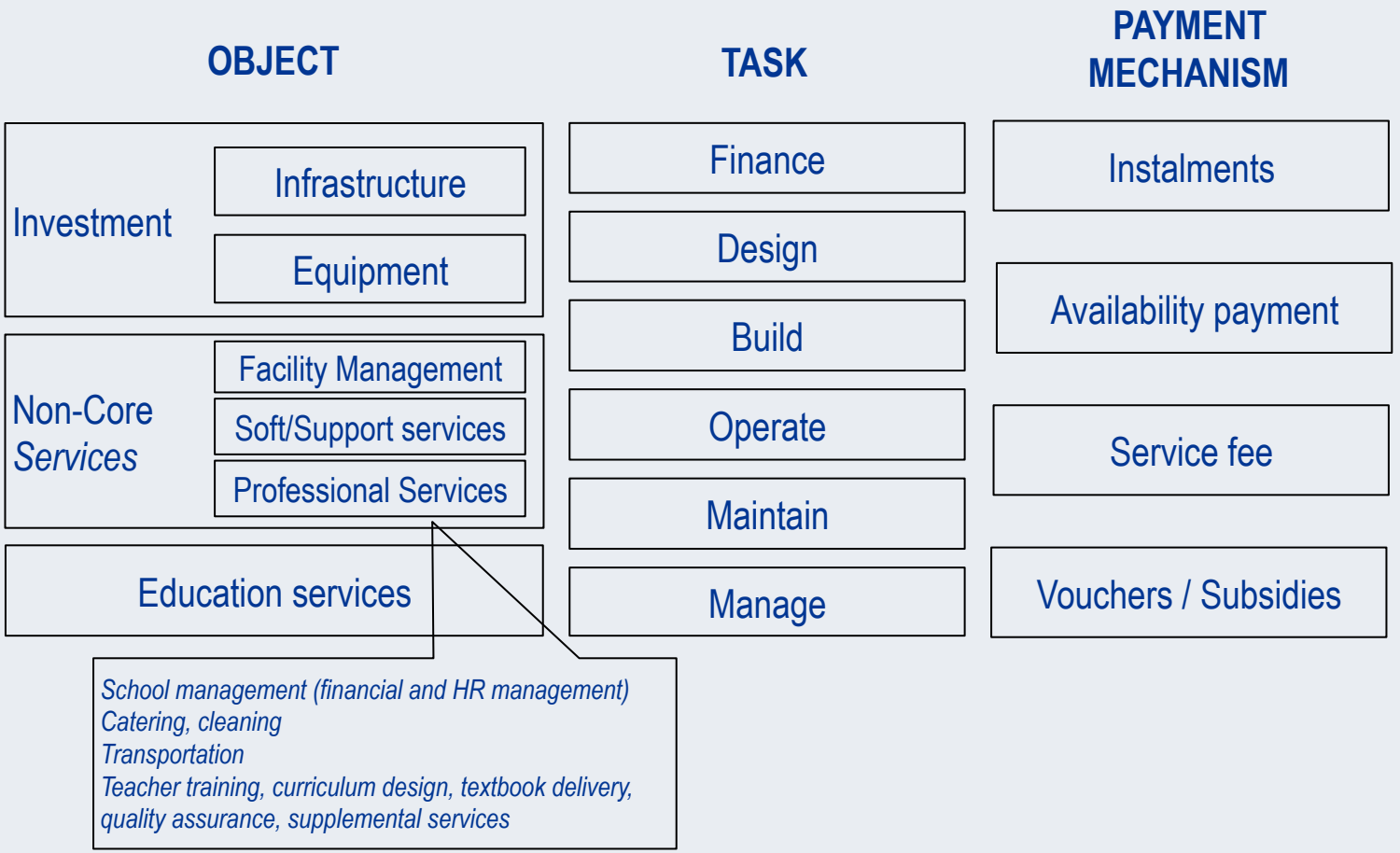


SDA Bocconi

European Investment Bank

C.2. PPP in the education sector

PPP in education: building blocks



OBJECT OF THE PPP

In the education sector the investment may involve:

- the construction or redevelopment of a school/university/education facility,
- the provision of facility equipment, furniture and education technology.

In education, the service dimension is far more important than the capital component. Like in the healthcare we shall distinguish between core and non-core services. Non-core services may relate to facility management, the provision of soft services (like cleaning, catering, transportation), or other professional services (Patrinos et al., 2009) such as teacher training, textbook delivery, external quality assurance . Quite obviously, the provision of education is the core service.

TASKS OF THE PRIVATE OPERATOR

Like in the healthcare sector, a private operator can be entrusted with different tasks, such as:

- provide financial resources to cover investment costs;
- design a facility or a service;
- perform building works;
- control the functioning of a building and equipment;
- maintain facilities and equipment;
- provide non-core services;
- manage education services.

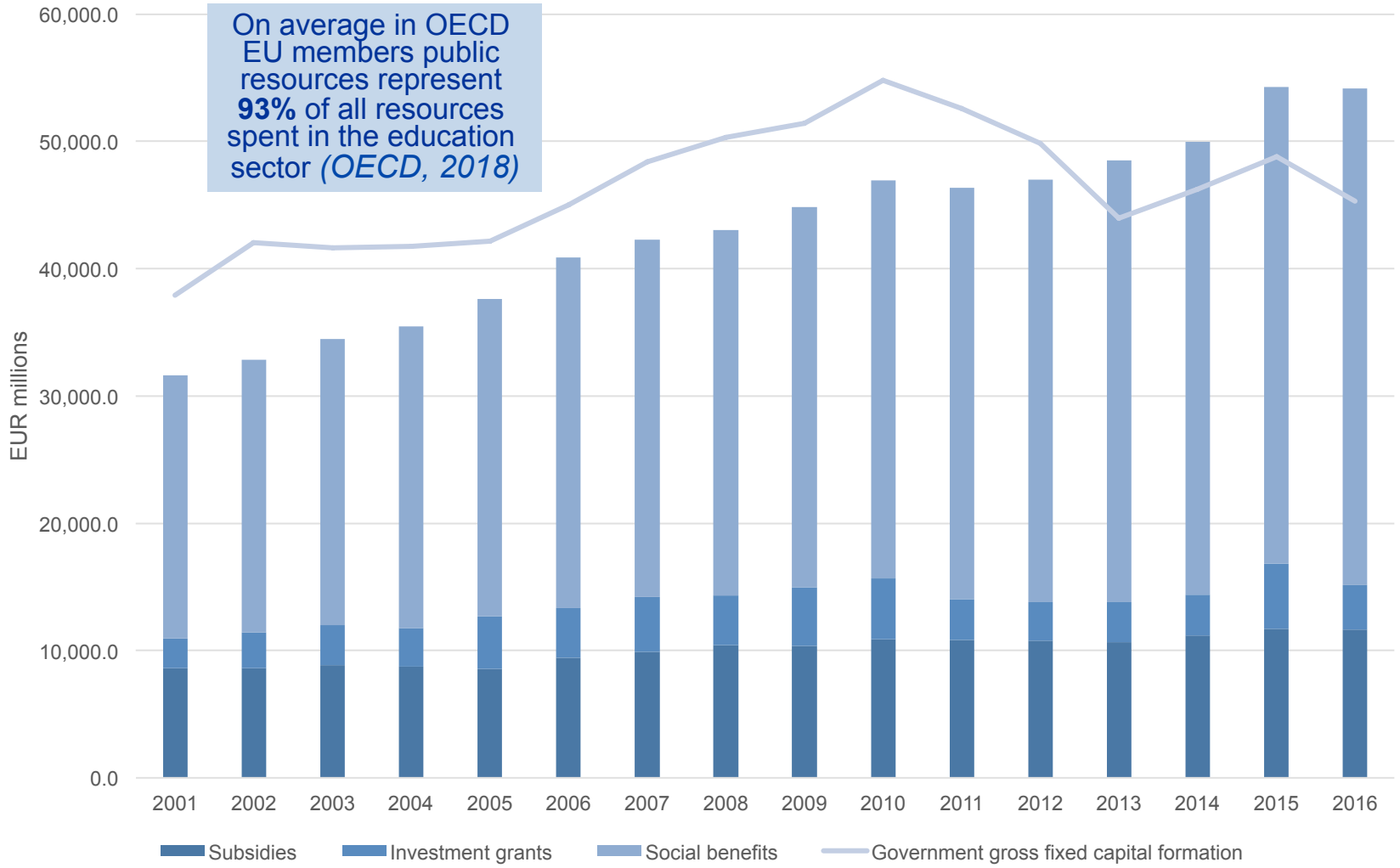
PAYMENT MECHANISM

Looking at remuneration mechanisms, if we consider the provision, operation and maintenance of physical facilities, similar logics discussed previously for healthcare may apply.

Core services can be remunerated through a voucher system, with the aim in this case to create some sort of quasi-market competition, or subsidies/transfers to the education provider in order to keep the service free for users. It is important to note that, contrary to healthcare where co-morbidities and individual clinical conditions may represent a major risk because they can lead to high variance in the cost of individual treatments, in education, even at individual level, costs are more predictable.

Transfer of public resources to families and private education providers in the EU

On average in OECD EU members public resources represent **93%** of all resources spent in the education sector *(OECD, 2018)*



Source of data: Eurostat, data are expressed in current prices

SDA Bocconi

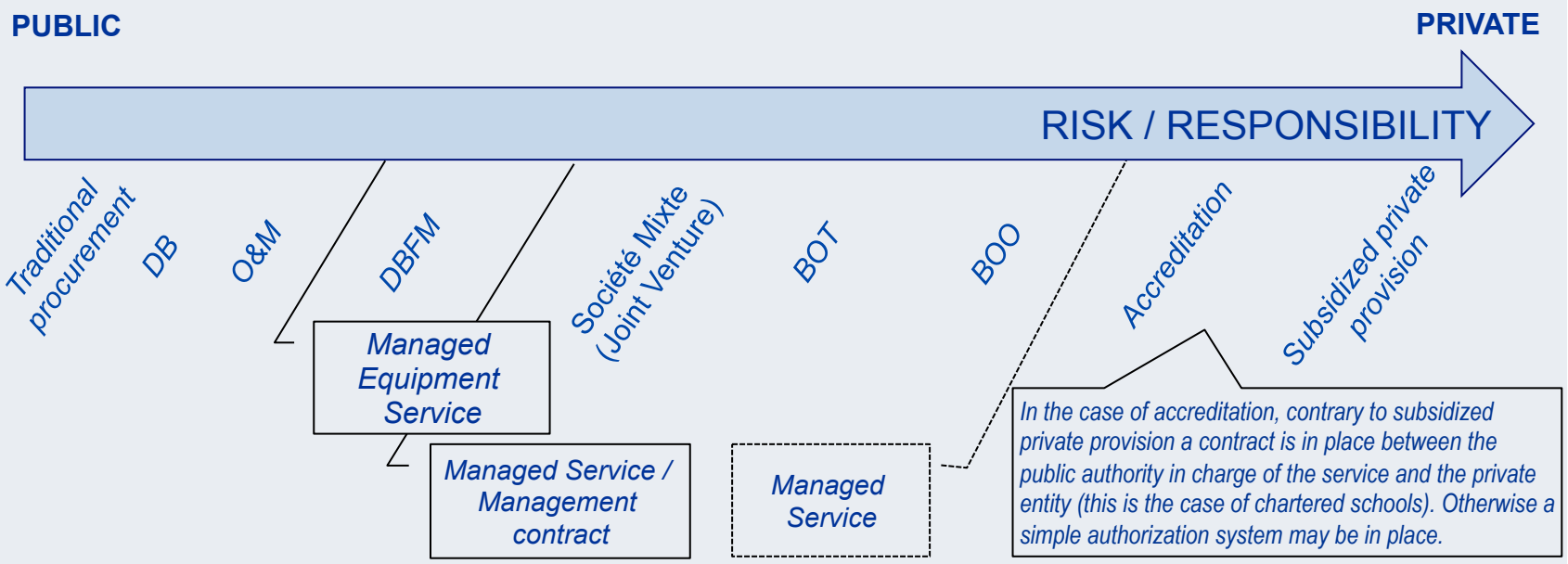
European Investment Bank

C.3. Issues in PPP in the education and healthcare sectors

Choosing the PPP model

When choosing how to frame a PPP project a public authority can opt, on one side, to bundle together many elements, mixing investments and services, or, at the opposite side, to design more focused contracts.

PPP contracts can be placed across a spectrum ranging from a pure public provision of service/ infrastructure, to a full privatization. On the public end of the spectrum, we can find traditional public procurement as a first attempt to outsource some tasks to the private sector. In this case public authorities not only play a steering role, but define in detail the terms of reverence of the contract. The private sector has the responsibility to carefully fulfil its duties. At the opposite end, public sector decides to "exit" from the provision of a service and play "only" the role of regulator. Off course the definition of the rules of the game influence the behaviour of market players, however it is only an indirect relation. PPPs lie between these two extremes.



Implementation of PPP in healthcare and education

Montagu, Harding, & Montagu (2012) point out, **there are at least six big differences in the application of PPP models to the healthcare sector**, which can be applied to the education sector as well:

1. government, not individuals, is the primary purchaser of outputs;
2. market risks are generally not transferable to the private partner;
3. it is difficult to measure performance and outcomes;
4. demographic and epidemiologic conditions evolution require changes to the contract during its life;
5. technology and organizational configurations change frequently over time;
6. there is a different ratio of capital and operating costs compared to other sectors: in a health project operating costs represents the bulk of expenses compared to, for example, a water sanitation project where the opposite comes true.

Existing academic literature offers no definite answers to these challenges and there is no general agreement even on the definition of partnerships, on risk management, on the drivers beyond the adoption of PPPs, and performance evaluation (Wang, Xiong, Wu, & Zhu, 2017).

Important gaps still remain in scholarly and practitioner understanding of how the concept has been applied (Roehrich, Lewis, & George, 2014) and only a limited number of articles are grounded in empirical research (Torchia, Calabrò, & Morner, 2015).

Even more relevant is the fact that academic literature almost ignores “downstream service implementation”, i.e. the actual working mechanism of partnerships, focusing, instead, in issues of interorganizational cooperation, contract design, outcome evaluation and concerns about public accountability (Waring & Currie, 2013).

PPP and value for money

- PPPs are bundled contracts that, in principle, can incentivize the delivery of on-time, on-budget and on-quality infrastructure (Hart 2003), thanks to a risk&reward model (Iossa & Martimort 2015).
- There are contrasting evidences regarding PPP Value for Money (VfM) (Siemiatycki 2011; Reeves 2013; Hellowell & Vecchi 2015).
- A recent report of the House of Commons in the UK has declared that “it is unacceptable that after more than 25 years the Treasury still has no data on benefits to show whether the PFI model provides value for money” (pp. 5, House of Commons 2018).
- The robustness of a VfM anlysis is affected by the “apparent differences” in the cost of public and private capital (Makovsek & Moszoro 2017), since the cost of public capital does not explicitly include the risk premium (Klein 1997).
- Evidences from the healthcare sector in the UK demonstrate that private investors extract a higher than normal return from PPP transactions (Hellowell & Vecchi 2012; Vecchi & Hellowell 2013; Vecchi et al. 2013) even if they are not justified by the level of risks of the PPP contracts (Makovsek & Mozoro 2017), but higher entry barriers, lack of management and financial skills in the public sector (Colla et al. 2015).
- Uncertainty about benefits and higher financial costs undermine social desirability of PPP (de Bettignies & Ross 2010; Boardman & Hellowell 2017; Vecchi & Casalini 2018).

SDA Bocconi

European Investment Bank

PHASE D
MOBILIZING PRIVATE RESOURCES FOR SOCIAL INFRASTRUCTURE INVESTMENTS

PHASE D - MOBILIZING PRIVATE RESOURCES FOR SOCIAL INFRASTRUCTURE INVESTMENTS

Researcher: Francesca Casalini

Table of contents

SDA Bocconi

European Investment Bank

D.1. Long-term Private Investors Investing in Infrastructure

Infrastructure: an interesting asset class for private investors

As discussed in Section A of this report, while a substantial proportion of infrastructure has been historically owned by public authorities and financed through taxation and/or public debt, over the last 30 years, public budgets constraints and privatization policies have led to a reconsideration of the need to shift the investment effort to the private sector and to the development of Public Private Partnerships (PPPs).

In recent years, besides industrial sponsors and developers, who were the main private investors in infrastructure projects before mid-2000s, **infrastructures are garnering interest from a new range of long-term investors, like pension funds and life insurance companies** (Gatti 2014), attracted by the long maturities and stable returns associated with infrastructure-related financial securities (World Economic Forum 2013).

In fact, **after the global financial crisis, the institutional investment community has been engaged in a 'search for yield'** – i.e. for higher returns than accrue to traditional asset classes – **and infrastructure have been cited as a potentially desirable 'alternative asset class'** (Gatti and Della Croce 2015).

Characteristics of infrastructure investments

From the point of view of a private investor, infrastructure projects show **attractive characteristics**, such as (Gatti 2012):

- Long term assets with long economic life
- Low technological risk
- Provision of key public services
- Strongly non elastic demand
- Natural monopoly or quasi monopoly market contexts
- High entry barriers
- Regulated assets
- Frequent natural hedge against inflation
- Stable, predictable operating cash flows
- Low correlation with traditional asset classes and overall macroeconomic performance

Existing investment vehicles for private infrastructure financing

There are a number of different vehicles on offer for private investment in infrastructure (OECD 2015).

Both **debt and equity instruments** have been used, either publicly or privately traded.

Among the different instruments available, institutional investors have traditionally invested in infrastructure through listed companies and fixed-income instruments (Gatti and Della Croce 2015).

It is only in the last two decades that investors have started to **recognize infrastructure as a distinct asset class and to hold the view that, while listed infrastructure tends to move in line with broader market trends, investing in unlisted infrastructure – although illiquid – can be beneficial for ensuring proper diversification and yield upside** (Inderst 2009; World Economic Forum 2014).

Unlisted equity or debt are indeed typical "buy and hold" asset classes, suited to long-term investors with a clear preference for stable – although not exceptionally high – returns.

Asset Category and Trading Mode			Investment Model	
			Direct (to infrastructure projects)	**Indirect (through infrastructure operators or asset managers)**
Debt	Listed		▪ Listed Project Bonds	▪ Listed Infrastructure Debt Funds ▪ Infrastructure Corporate Bonds
Debt	Unlisted		▪ Syndicated Project Loans ▪ Unlisted Project Bonds ▪ Direct/Co-Investment Lending to Infrastructure Project	▪ Unlisted Infrastructure Debt Funds
Equity	Listed			▪ Listed Infrastructure Equity Funds ▪ Listed Infrastructure Corporate Stocks ▪ ETFs
Equity	Unlisted		▪ Direct/Co-Investment in Infrastructure Project Equity	▪ Unlisted Infrastructure Equity Funds

Trends in private infrastructure financing

Debt financing

The most widespread financial technique that allows the participation of private capital to unlisted infrastructure is **project financing**, based on a simple combination of multiple tranche loans and equity (Yescombe 2011). Project finance debt has been provided to infrastructure projects mainly in the form of syndicated bank loans, with a pool of banks headed by one or more mandated lead arrangers (MLAs) organizing the financing package for a single borrower.

From the perspective of institutional investors other than banks, a more attractive alternative to syndicated loans is represented by the financing of infrastructure projects through **project bonds**. Project bonds, which are issued by the SPV, are more standardised capital market instruments, with a higher degree of liquidity, a lower cost of funding, if the issue size is sufficiently large to generate enough floating securities, and a longer maturity than the tenors of syndicated loans that banks normally accept (Gatti and Della Croce 2015). Project bonds, however, are only a limited portion of the total debt committed to infrastructure financing, representing slightly less than 10% of the total infrastructure debt at the end of 2016 (Project Finance International 2017)

Equity financing

On the equity side, before mid-2000s, almost all infrastructure projects received equity financing by **industrial sponsors and developers**, typically the off-taker, the EPC contractor, the suppliers and/or the companies responsible for the operation and maintenance of the infrastructure to be delivered.

Starting from mid-2000s, thanks to the diversification strategies put in place by institutional investors, data indicate a clear upward trend in global infrastructure fundraising for **private equity investments**, with aggregate funds under management that have risen from USD 1.1 billion in 2004 to USD 363.3 billion at the end of 2016 (Preqin 2017).

While market analysis suggests that **unlisted equity funds are the most common vehicle** (Probitas Partners 2016), the route via which institutional investors access unlisted infrastructure equity has undergone considerable change over the last four years, with a greater number of investors seeking to invest or co-invest directly in infrastructure assets (Preqin 2016).

SDA Bocconi

European Investment Bank

D.2. Government policies to mitigate the risk of infrastructure investments and attract private capital

Government policies to attract private investors in public infrastructure

Despite the huge private liquidity available, with retirement systems and life insurers in OECD countries holding, respectively, USD 30.2 trillion and USD 14.7 trillion in assets in 2014 (OECD 2015), and the theoretical ideal match between the risk and return profile of these investors and the characteristics of infrastructure as an asset class, **the uptake of institutional investors has been slow**.

In addition to the lack of a transparent and stable regulatory framework, this has been due to, *inter alia,* negative experiences with early investments, discontent with the vehicles used to access infrastructure assets and a lack of government facilitation (Gatti and Della Croce 2015).

To sustain the attraction of alternative risk-adverse long term investors into the infrastructure sector, especially in the **aftermath of the global financial crisis**, many governments have introduced **policies and financial instruments to mitigate the financial risks associated with infrastructure development, and thereby enhance the availability, and/or reduce the cost, of private capital** (Hellowell, Vecchi, & Caselli, 2015).

Categories of government policies

The actions and tools that government can offer for mitigating the market risks are specifically oriented to **reduce or eliminate the demand risk, to increase and/or stabilize free cash flows and to sustain the projects' bankability**.

These measures can be grouped into main five categories:

1. **grants**,
2. **availability-based payments**,
3. **credit enhancement tools**,
4. **direct provision of debt and equity capital**, and
5. **other measures**.

Each measure can be then articulated into specific instruments.

1. Grants

Grants reduce the capital requirements of the project or integrates revenues; it is generally delivered by contracting authority, even if some dedicated fund at national level may exists.

A grant can be of three types:

1.1 Lump sum capital grant**,** to reduce the need of private capital; it may delivered at the contract signature or during the implementation of the works, usually on a milestone-basis; in the latter case, a performance bond may be required to guarantee the correct allocation of the grant;

1.2 ***Revenue grant***, to increase the revenue volume and stability when the risk of demand is retained by the private player and tariffs are set at social value; it is generally defined at the contract signature and it can be paid by the authority as a periodic fixed amount (with a stronger effect on the mitigation of demand risk) or as revenue integration (it leaves the demand risk on the concessionaire);

1.3 ***Grant on debt interests***, to reduce the amount of interests due to the debt provider, thus mitigating the effect of high interest rates or the volatility of the demand on the debt repayment plan.

2. Availability-based payments

Availability payments neutralize the demand risk, while leaving on the private concessionaire the performance risk and the optimization of the cost/income ratio (Fitch Rating, 2015).

Though the availability payment is the typical payment mechanism for social infrastructure, where the main user is the public authority (such as in the case of hospitals), increasingly it has been used also for economic infrastructure. In this latter case the service can be delivered free of charge to users or the tariff are retained by the public authority.

The availability payment done by the authority to the concessionaire can be reduced by applying penalties that can be linked not only to the “pure” availability, but also to other quality and safety standards (the so called “constructive availability”).

Tanks to the positive effects on the stability of the cash flow of the project, the availability payment allows the concessionaire to access lower interest rate debt and more comfortable covenants (such as lower DSCR).

3. Credit-enhancement tools

Credit- enhancement tools are realized directly by a government of by its own controlled agency or development bank and can assume three forms:

3.1 Minimum payment to reduce the demand risk, which is partially retained by the contracting authority, which is committed to guarantee a certain level of revenues, generally those necessary to cover the debt service at some level of the DSCR (debt service cover ratio); Borgonovo, Gatti, & Modonesi, (2013) demonstrated that the presence of revenue guarantees reduces the variability of Cover Ratios and IRRs, since it allows a more accurate and stable estimation of future operating cash flows generated by the project;

3.2 Guarantee in case of default: it pays debt principal and interest in the case of concessionaire's default;

3.3 Guarantee in case of refinancing: it repays lenders if the concessionaire fails to refinance the loan at maturity; actually, in the context of " mini perm" (i.e. a debt structure that can - soft mini perm - or must - hard mini perm - be refinanced after the construction phase) there is a risk that existing debt will not be repaid from new borrowing (risk of refinancing), especially in case of increased interest rates or changed market conditions.

4. Direct provision of debt and equity capital

Provision realized directly by a government of by its own controlled agency or development bank, can take three main forms:

4.1 Subordinated (junior) debt aimed at enhancing the credit quality of the senior debt through in order to attract investment from insurance companies and pension funds;

4.2 Debt, provided at market condition*,* to cope just with the liquidity shortage, **or *at lower interest rate*** to help the project to meet the expectation of debt capital investors, in term of interest rate, DSCR and maturity. In this latter case it should be considered the crowding out effect that this mechanism can generate;

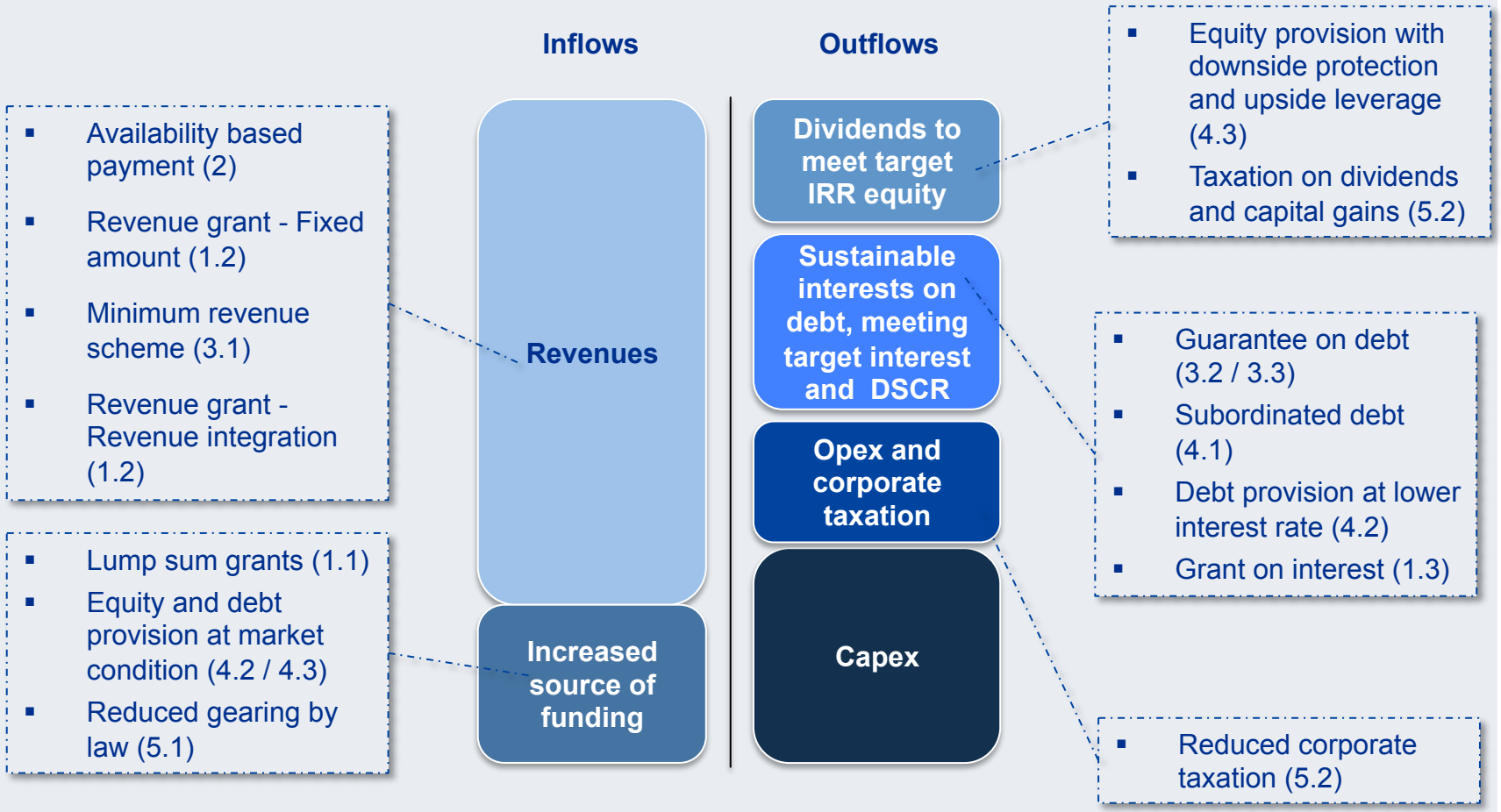
4.3 Equity*,* provided at market conditions or at more advantageous conditions: the aim is generally to fill the equity gap; to reduce the financial gearing, therefore reducing the exposure to credit risk and to offer downside protection or upside leverage to private equity holders.

5. Other measures

5.1 Officially mandated change to capital structure (reduced gearing), as introduced in the UK under PFI2, aimed at strengthening the ability to absorb fluctuations in cash-flows and thereby further insulate the lenders' exposure to credit risk;

5.2 Favorable taxation schemes*,* for the Special Purpose Vehicle to sustain the general viability of the project (the effect is to increase free cash flow to operation) or for the equity investors on "certain qualified dividends" and long-term capital gains.

The effects of government policies on project cash flows



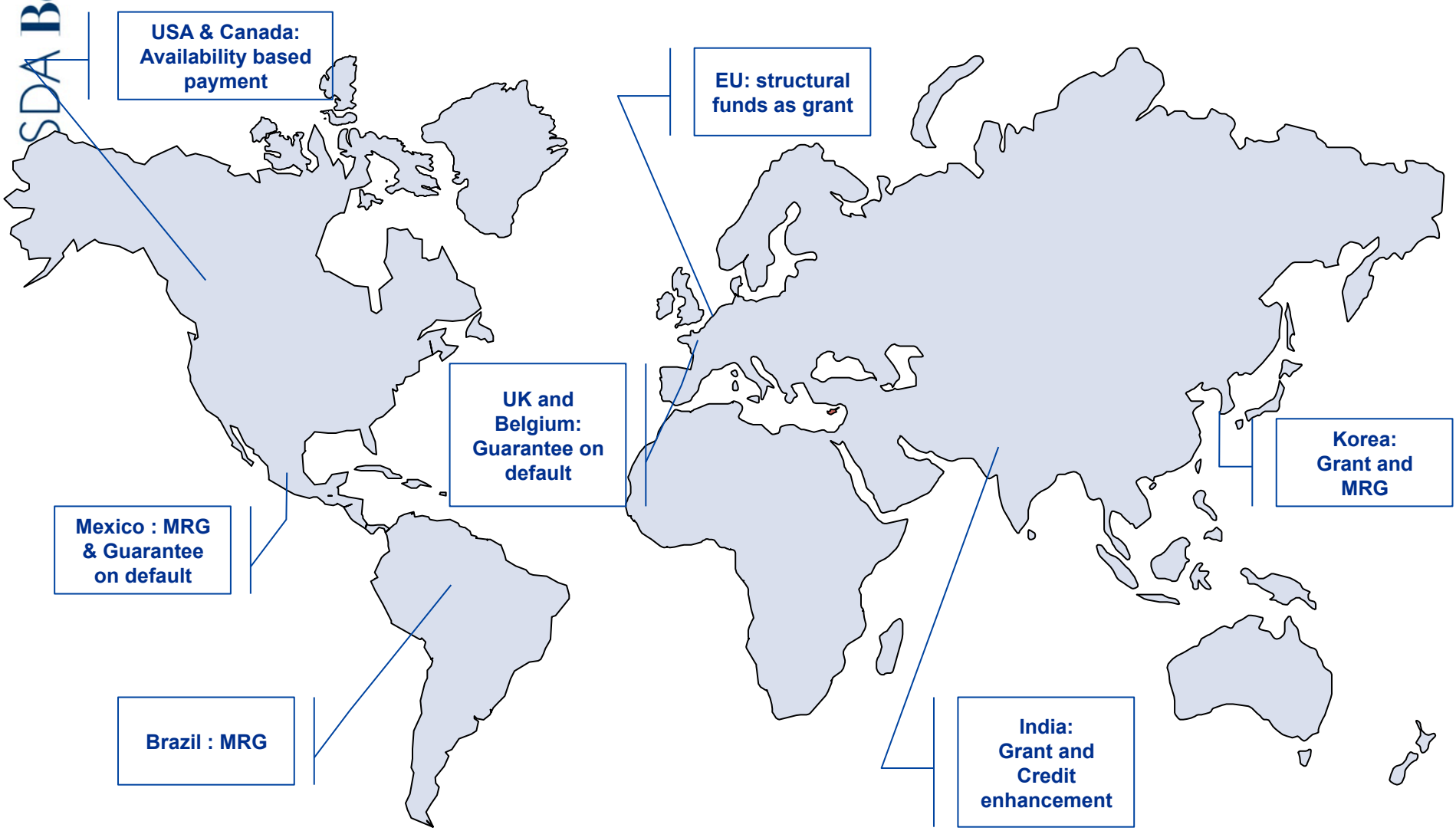
Source: Vecchi et al. (2017)

SDA Bocconi

European Investment Bank

D.3. International Experiences

International experience: an overview



Category and Experience Number	Country / Region	Instrument Type	Lesson Learned
Grants			
Experience 1	EU	Lump sum capital	Within the 2014-2020 coehsion policy cycle, it is recommended to allocate EU structural funds also through PPP. Blended PPP projects have been successful mostly when the private partner was selected prior to the application for the grant and the national public authority was already providing finance for an important portion of the project in addition to any EU grant contribution
Experience 2	Korea	Lump sum capital	"Act on private participation in infrastructure, art. 53" explicitly foresees the awarding of public grants; the situations when the grant may be issued are prescribed by law in art. 37 of the "Enforcement decree"; the amount of subsidy should not exceed the 30% of construction costs for road projects, the 40% for port infrastructures and the 50% for railway projects
Experience 3	India	Lump sum capital	In 2005, the Government of India launched the Viability Gap Funding scheme, to provide up-front capital grants at the construction stage. Grants may not exceed 20% of the project cost and are disbursed only after the private company has made its required equity contribution; the amount of subsidy is determined through a competitive bidding process

Category and Experience Number	Country / Region	Instrument Type	Lesson Learned
Availability-based Payments			
Experience 4	US	Availability payment	After that five out twelve toll based concessions projects already operational by 2014 failed, the availability payment system has been introduced by the US Department of Transportation and eight new schemes without traffic risks awarded
Experience 5	Canada	Availability payment	In Canada, almost all the concessions are availability- based since the adoption of PPP and none that reached the operational stage have faced a significant threat of financial failure or termination due to poor contractor performance
Credit Enhancement			
Experience 6	Korea	Minimum Payment	From 1995 to 2006, The Minimum Revenue Guarantee guaranteed 70-90% the projected revenues for a period of 15-20 years and it turned out to be a financial burden for the Korean Government. In 2006 the system was revised in 2006 and the Government guaranteed 65%–75% of the projected revenue for 10 years only for solicited projects.
Experience 7	Brazil	Minimum Payment	This transaction is a good example of demand risk mitigation, where the mechanism used is based on minimum and maximum levels of demand; If passenger traffic fluctuation is within a pre-determine range, the private concessionaire absorbs the upside or downside, while outside this range, the public authority shares the gains or losses

Category and Experience Number	Country / Region	Instrument Type	Lesson Learned
Experience 8	Mexico	Minimum Payment	BANOBRAS, the Development Bank of Mexico, provides a guarantee to cover full and timely payment committed to the private sponsor under a PPP project with the aim to help subnational entities (states and municipalities) attract private investors, and this mechanism is particularly valuable for entities with a lower credit rating
Experience 9	UK	Guarantee in case of default	The UK Guarantee Scheme was introduced by the HM Treasury in 2012 to avoid delays to investment in UK infrastructure projects that may have stalled because of adverse credit conditions making it difficult to secure private finance. It provides, on a commercial basis, a sovereign-backed guarantee, which must cover a financial obligation. However, the contribution of the scheme to the National Infrastructure Plan has been modest to date and it is due to close at the end of December 2016.
Experience 10	Mexico	Guarantee in case of default	Always in Mexico, loan guarantees in case of default are offered by the BANOBRAS, the Development Bank, and FONADIN, the Infrastructure Fund of the Mexican Federal Government. However, these schemes have not been as widely used as expected, since they do not assume the construction risk.
Experience 11	India	Guarantee in case of default	The Credit Enhancement Scheme, managed by the Indian Infrastructure Finance Company Limited (IIFCL), is available for brownfield projects and provides partial credit guarantee to enhance the credit rating of bonds of infrastructure companies. The scheme is currently under pilot phase.

Category and Experience Number	Country / Region	Instrument Type	Lesson Learned
Direct provision of debt or equity			
Experience 13	EU	Subordinated debt	The Project Bond Initiative, launched in 2012 by the European Commission and the European Investment Bank to facilitate institutional investors financing of infrastructure projects, has been applied to projects in the sectors of transport, energy, and ICT. In all these cases, the provision of the subordinated debt by the European Investment Bank enhanced the rating of the bonds, on average, by 3 notches.
Experience 14	US	Subordinated debt / Debt	The TIFIA program provides direct loans (either junior or senior) to qualified infrastructure projects of regional and national significance, with at least USD 50 million of eligible costs. Loans provided by TIFIA typically have a lower interest with flexible repayment terms.
Experience 15	UK	Debt	The first experiment was introduced in 2004, under the Credit Guarantee Finance (CGF) initiative. In March 2009, the UK Treasury announced the establishment of a short- term new private limited company: the Treasury Infrastructure Finance Unit (TIFU), which would have provide state loans to projects at prevailing market rates.
Experience 16	Belgium	Equity	In the Flemish region, the public limited company Via-Invest was established in 2006 with the aim to fill in the missing links in the Flemish road network via PPPs. Via-Invest is a structural joint venture between the Agency for Roads and Traffic, the Department of Transport and Public Works and the investment company PMV. Via-Invest acts as a holding company for various SPV and provides them with risk capital.

SDA Bocconi

European Investment Bank

LIST OF REFERENCES

Abalde, M. A. (2014). School Size Policies.

Ackerman, F., & Heinzerling, L. (2002). Pricing the priceless: Cost-benefit analysis of environmental protection. *University of Pennsylvania Law Review*, *150*(5), 1553–1584.

ADB. (2017). Guidelines for the Economic Analysis of Projects. *Mandaluyong City, Philippines: Asian Development Bank, 2017.*

Adhikari, R. (1999). Economic Analysis of Health Sector Projects-A Review of Issues, Methods, and Approaches.

Adler, M. (1998). Incommensurability and cost-benefit analysis. *University of Pennsylvania Law Review*, *146*(5), 1371–1418.

Admati, A. R., & Pfleiderer, P. (1994). Robust financial contracting and the role of venture capitalists. *The Journal of Finance*, *49*(2), 371–402

Akerlof, G. A., & Shiller, R. J. (2010). *Animal spirits: How human psychology drives the economy, and why it matters for global capitalism*. Princeton university press.

Allen & Overy. (2009). *Global infrastructure development and delivery. The stimulus for debate.* Retrieved from http://www.allenovery.com/archive/Documents/Legacy/52624.pdf

Allen, F., & Santomero, A. M. (2001). What do financial intermediaries do? *Journal of Banking & Finance*, *25*(2), 271–294.

Andrès, L., Biller, D. and Herrera Dappe, M. (2014). Infrastructure Gap in South Asia: Infrastructure Need, Prioritization, and Financing. *Policy Research Working Paper 7032*. World Bank Group. Washington DC.

Arena, M., Bengo, I., Calderini, M., & Chiodo, V. (2016). Social impact bonds: blockbuster or flash in a pan? *International Journal of Public Administration*, *39*(12), 927–939.

Arvidson, M., Lyon, F., McKay, S., & Moro, D. (2013). Valuing the social? The nature and controversies of measuring social return on investment (SROI). *Voluntary Sector Review*, *4*(1), 3–18.

Aschauer, D. A. (1989), Is Public Expenditure Productive? *Journal of Monetary Economics*. Vol 23, 177-200.

Axelson, U., Jenkinson, T., Strömberg, P., & Weisbach, M. S. (2013). Borrow cheap, buy high? The determinants of leverage and pricing in buyouts. *The Journal of Finance*, *68*(6), 2223–2267.

Bachher, J. S., & Monk, A. H. B. (2013). Platforms and Vehicles for Institutional Co-Investing. *Rotman International Journal of Pension Management*, *6*(1).

Baltussen, R., & Niessen, L. (2006). Priority setting of health interventions: the need for multi-criteria decision analysis. *Cost Effectiveness and Resource Allocation*, *4*(1), 14.

Banke-Thomas, A. O., Madaj, B., Charles, A., & van den Broek, N. (2015). Social Return on Investment (SROI) methodology to account for value for money of public health interventions: a systematic review. *BMC Public Health*, *15*(1), 582.

Barlow, J., Roehrich, J., & Wright, S. (2013). Europe Sees Mixed Results from Public-Private Partnerships for Building and Managing Healthcare Facilities and Service. *Health Affairs*, *32*(1), 146–154. http://doi.org/10.1377/hlthaff.2011.1223

Barrett, P. S., Zhang, Y., Davies, F., & Barrett, L. C. (2015). *Clever classrooms: Summary report of the HEAD project*. University of Salford.

Basile, R., de Nardis, S. and Girardi, A. (2001). Regional Inequalities and Cohesion Policies in the European Union. *ISAE Working Paper No. 23.*

Belli, P. (2001). *Economic analysis of investment operations: analytical tools and practical applications*. World Bank Publications.

Bénabou, R., & Tirole, J. (2010). Individual and corporate social responsibility. *Economica*, *77*(305), 1–19.

Benitez, D., Estache, A., & Søreide, T. (2010). Dealing with politics for money and power in infrastructure. *World Bank Policy Research Working Paper No. 5455.*

Besley, T., & Coate, S. (1997). An economic model of representative democracy. *The Quarterly Journal of Economics*, *112*(1), 85–114.

Bhattacharyay, N.B. (2010). Estimating demand for infrastructure in energy, transport, telecommunications, water and sanitation in Asia and the Pacific: 2010-2020. *Asian Development Bank*. Tokyo.

Bhattacharyya, A. (2012). Adjustment of Inputs and Measurement of Technical Efficiency: A Dynamic Panel Data Analysis of Egyptian manufacturing sectors. *Empirical economics*. 42(3): 863-80.

Blades, D. (2015). A short-cut method of estimating capital stocks: When can it be used and how well does it work? *Review of Income and Wealth*. Series 61, Number 2.

Blanc-Brude, F., Hasan, M., & Whittaker, T. (2016a). Benchmarking Infrastructure Project Finance: Objectives, Roadmap, and Recent Progress. *The Journal of Alternative Investments*, *19*(2), 7–18.

Blanc-Brude, F., Hasan, M., & Whittaker, T. (2016b). *Cash Flow Dynamics of Private Infrastructure Project Debt, Empirical evidence and dynamic modelling. EDHEC Infrastructure Institute Publications March*.

Blankart, C. R. (2012). Does healthcare infrastructure have an impact on delay in diagnosis and survival? *Health Policy*, *105*(2–3), 128–137.

Bleaney, M., Gemmell, N. and Kneller, R. (2001). Testing the endogenous growth model: public expenditure, taxation, and growth over the long run. *Canadian Journal of Economics*. Vol. 34, No. 1

Boardman, A. E., & Hellowell, M. (2017). A comparison and evaluation of government approaches to value for money analysis. *Journal of Comparative Policy Analysis: Research and Practice*, *19*(3), 191–206.

Boardman, A. E., Greenberg, D. H., Vining, A. R., & Weimer, D. L. (2017). *Cost-benefit analysis: concepts and practice*. Cambridge University Press.

Bonte, R. J., Janssen, R., Mooren, R. H. J., Smidt, J. T. D., & van de Burg, J. J. (1998). Multicriteria analysis: making subjectivity explicit. *New Experiences on Environmental Impact Assessment in the Netherlands: Process, Methodology, Case Studies*, 23–28.

Bottini, N. Coehlo, M and K, J (Forthcoming). Infrastructure and Growth.

Bourque, P. J., (1985). The Infrastructure Gap. *Growth and Change*.

Bradford, D. F. (1975). Constraints on government investment opportunities and the choice of discount rate. *The American Economic Review*, 887–899.

Bradley, S., & Taylor, J. (1998). The effect of school size on exam performance in secondary schools. *Oxford Bulletin of Economics and Statistics*, *60*(3), 291–324.

Brealey, R., Leland, H. E., & Pyle, D. H. (1977). Informational asymmetries, financial structure, and financial intermediation. *The Journal of Finance*, *32*(2), 371–387.

Brealey, R., Myers, S., & Allen, F. (2013). *Principles of Corporate Finance*. New York: McGraw-Hill. Retrieved from http://www.waterstones.com/waterstonesweb/products/richard+a-+brealey/stewart+c-+myers/alan+j-+marcus/fundamentals+of+corporate+finance/6358665/

Brent, R. J. (2007). *Applied cost-benefit analysis*. Edward Elgar Publishing.

Broyer, S., and J. Gareis, (2013). How large is the infrastructure multiplier in the euro area? *Natixis FLASH Economics,* No. 227.

Buckland, L., Hehenberger, L., & Hay, M. (2013). The growth of European venture philanthropy. *Stanford Social Innovation Review Summer*, 33–39.

Bugg-Levine, A., & Goldstein, J. (2009). Impact Investing: Harnessing Capital Markets to Solve Problems at Scale. *Community Development Investment Review*, *5*(2), 30–41.

Byles, T., & Wilson, C. (2008). *An Introduction to Building Schools for the Future*. *Partnership for Schools*.

Cadot, O., Röller, L.H. and Stephan, A. (2006). Contribution to productivity or pork barrel? The two faces of infrastructure investment. *Journal of public Economics*. 90 (6), 1133-1153

Calderón, C. and Servén, L. (2004). The Effects of Infrastructure Development on Growth and Income Distribution. *Policy Research Working Paper*. World Bank Group. Washington, DC.

Calderón, C.,Moral-Benito, E. and Servén, L. (2011). Is Infrastructure Capital Productive? A dynamic heterogeneous approach. *Working Paper Series Banco de Espagna* .The World Bank. Madrid.

Canning, D. (1998). A Database of World Infrastructure Stocks 1959-95. *Policy Research Paper 1929*. The World Bank. Washington DC.

Casey, S. (2005). *Establishing standards for social infrastructure*. UQ Boilerhouse, Community Engagement Centre.

Cashin, C., Chi, Y.-L., Smith, P. C., Borowitz, M., & Thomson, S. (2014). Health provider P4P and strategic health purchasing. *Paying for Performance in Health Care*, 3.

Cellini, S. R., & Kee, J. E. (2010). Cost-effectiveness and cost-benefit analysis. In J. S. et al. Wholey (Ed.), *Handbook of practical program evaluation* (Vol. 3). San Francisco: Wiley-Blackwell.

Chan, Y. (1983). On the positive role of financial intermediation in allocation of venture capital in a market with imperfect information. *The Journal of Finance*, *38*(5), 1543–1568.

Chatterton, I. and Puerto, O.S. (2011). Estimation of infrastructure investment needs in South Asia region. *Policy Research Working Paper*. World Bank Group. Washington, DC.

Chaudhry, B., Wang, J., Wu, S., Maglione, M., Mojica, W., Roth, E., … Shekelle, P. G. (2006). Systematic review: impact of health information technology on quality, efficiency, and costs of medical care. *Annals of Internal Medicine*, *144*(10), 742–752.

Clowney, S. (2006). Environmental Ethics and Cost-Benefit Analysis. *Fordham Envtl. L. Rev.*, *18*, 105.

Cox, B. R. (2011). Financing homelessness prevention programs with social impact bonds. *Rev. Banking & Fin. L.*, *31*, 959.

Cui, C., Liu, Y., Hope, A., & Wang, J. (2018). Review of studies on the public–private partnerships (PPP) for infrastructure projects. *International Journal of Project Management*, *36*(5), 773–794.

Cuyvers, K., De Weerd, G., Dupont, S., Mols, S., & Nuytten, C. (2011). Well-Being at School. *OECD Papers*.

de la Maisonneuve, C. and Oliveira Martins, J (2013). A Projection Method for Public Health and Long- Term Care Expenditures. *OECD Economics Department Working Paper.*

Della Croce, R. (2011). *Pension Funds Investment in Infrastructure: Policy Actions* (OECD Working Papers on Finance, Insurance and Private Pensions No. 13).

Della Croce, R., & Sharma, R. (2014). *Pooling of Institutional Investors Capital, Selected Case Studies in Unlisted Equity Infrastructure*.

Diamond, D. W. (1984). Financial intermediation and delegated monitoring. *The Review of Economic Studies*, *51*(3), 393–414.

Disley, E., & Rubin, J. (2014). Phase 2 report from the payment by results Social Impact Bond pilot at HMP Peterborough. *Ministry of Justice Analytical Series. London: Rand Europe*. Dodgson, J. S., Spackman, M., Pearman, A., & Phillips, L. D. (2009). Multi-criteria analysis: a manual. *Department for Communities and Local Government. London, UK*.

Donohoe, N. O., & Bugg-levine, A. (2010). *Impact Investments An Emerging Asset Class* (Global Research No. November 2010). Retrieved from http://www.jpmorganchase.com/corporate/socialfinance/document/impact_investments_nov2010.pdf.

Douglas, C. H., & Douglas, M. R. (2004). Patient-friendly hospital environments: exploring the patients' perspective. *Health Expectations*, *7*(1), 61–73.

Drummond, M. F., Sculpher, M. J., Claxton, K., Stoddart, G. L., & Torrance, G. W. (2015). *Methods for the economic evaluation of health care programmes*. Oxford university press.

Durán-Narucki, V. (2008). School building condition, school attendance, and academic achievement in New York City public schools: A mediation model. *Journal of Environmental Psychology*, *28*(3), 278–286.

Ebrahim, A., & Rangan, V. K. (2014). What impact? A framework for measuring the scale and scope of social performance. *California Management Review*, *56*(3), 118–141.

Eckstein, O. (1958). Water resource development-the economics of project evaluation. *Water Resource Development-the Economics of Project Evaluation.*

Edkins, A., & Ive, G. (2010). Operating healthcare infrastructure: Analysing the evidence. *KPMG International*.

Egert, B., Kozluk. T and Sutherland, D. (2009). Infrastructure and growth: Empirical evidence. *OECD Economics Department Working Paper No. 685.*

EIB. (2013). The Economic Appraisal of Investment Projects at the EIB. *European Investment Bank. Projects Directorate. March 2013*.

Eisenhardt, K. M. (1989). Agency theory: An assessment and review. *Academy of Management Review*, *14*(1), 57–74.

Engel, E., Fischer, R., & Galetovic, A. (2009). *Soft budgets and renegotiations in public-private partnerships*. National Bureau of Economic Research.

EPEC. (2009). *The financial crisis and the PPP market. Potential Remedial Action*.

EPEC. (2011). *State Guarantees in PPPs*. Retrieved from http://www.eib.org/epec/resources/epec-state-guarantees-in-ppps-public.pdf

EPEC. (2011). The Non-Financial Benefits of PPPs. A Review of Concepts and Methodology. *European PPP Expertise Centre. June 2011*.

EPEC. (2015). *PPP Motivations and Challenges for the Public Sector Why (not) and how*.

EPEC. (2016). *Hurdles to PPP investments - A contribution to the Third Pillar of the Investment Plan for Europe*.

Estache, A. and Garsous, G. (2012). The impact of infrastructure on growth in developing countries. *IFC Economics Notes*

European Commission. (2010). EUROPE 2020 A strategy for smart, sustainable and inclusive growth. *Communication from the Commission COM(2010) 2020*. Brussels.

European Commission. (2011). Impact assessment accompanying Regulation of the European Parliament and of the Council on guidelines for trans-European energy infrastructure and repealing Decision No 1364/2006/EC *Commission Staff Working Paper.*

European Commission. (2014). Guide to cost-benefit analysis of investment projects. *European Commission. Directorate-General for Regional and Urban Policy*.

European Commission. (2014). Infrastructure in the EU: Developments and Impact on Growth. *European Economy, Occasional Papers*. No. 203.

European Commission. (2015). The 2015 Aging Report: Economic and budgetary projections for the 28 EU Member States (2013-2060). *European Commission Directorate-General for Economic and Financial Affairs Publications*

European Commission. (2016). Access to health services in the European Union. *Expert Panel on Effective Ways of Investing in Health.*

European Commission. (2016). Next steps for a sustainable European future: European action for sustainability. *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions.*

European Commission. (2016). Synthesis Report on the assessment of Member States' building renovation strategies. *JRC Science for Policy Report.*

Evans, D. J., & Sezer, H. (2004). Social discount rates for six major countries. *Applied Economics Letters*, *11*(9), 557–560.

Fang, L., Ivashina, V., & Lerner, J. (2015). The disintermediation of financial markets: Direct investing in private equity. *Journal of Financial Economics*, *116*(1), 160–178.

Farquharson, E., de Mästle, C. T., & Yescombe, E. R. (2011). How to engage with the private sector in public-private partnerships in emerging markets. *Washington, DC: World Bank Group*.

Fay, M. (2000). Financing the Future. Infrastructure Needs in Latin America, 2000-05. *Policy Research Working Paper 2545.* World Bank Group. Washington DC.

Fay, M. and Morrison, M. (2007). Infrastructure in Latin America Recent Developments and Key Challenges. World Bank Group. Washington DC.

Fay, M. and Yepes, T. (2003). Investing in Infrastructure. What is Needed from 2000 to 2010? *Policy Research Working Paper 3102*. World Bank Group. Washington DC.

Fedderke, J. and Bogetic, Z. (2005). Infrastructure and growth in South Africa: Benchmarking productivity and investment needs. (Presentation to Economic Society of South Africa Conference, 2005).

Fenn, G. W., Liang, N., & Prowse, S. (1996). The Economics of the Private Equity Market. *Fed. Res. Bull.*, *82*, 26.

Fitch Rating. (2015). *Rating Criteria for Availability-Based Projects Global Infrastructure & Project Finance*.

Florio, M. (2014). *Applied welfare economics: Cost-benefit analysis of projects and policies*. Routledge.

Florman, M., Klingler-Vidra, R., & Facada, M. J. (2016). A critical evaluation of social impact assessment methodologies and a call to measure economic and social impact holistically through the External Rate of Return platform.

Flyvbjerg, B. (2009). Survival of the unfittest: why the worst infrastructure gets built—and what we can do about it. *Oxford Review of Economic Policy*, *25*(3), 344–367.

Flyvbjerg, B., Skamris Holm, M. K., & Buhl, S. L. (2003). How common and how large are cost overruns in transport infrastructure projects? *Transport Reviews*, *23*(1), 71–88.

Forrer, J., Kee, J. E., Newcomer, K. E., & Boyer, E. (2010). Public–private partnerships and the public accountability question. *Public Administration Review*, *70*(3), 475–484

Fosgerau, M., & Kristensen, N. B. (2005). Who Gains? Allocation of Freight Transport User Benefits from International Infrastructure Projects in Multicountry Cost–Benefit Analysis. *Transportation Research Record*, *1906*(1), 18–25.

Fox, C., & Albertson, K. (2012). Is payment by results the most efficient way to address the challenges faced by the criminal justice sector? *Probation Journal*, *59*(4), 355–373.

Fransen L., del Bufalo, G and Reviglio, E. (2017). Boosting investments in social infrastructure in Europe. *Report of the High-Level Task Force on investing in Social Infrastructure in Europe chaired by Romano Prodi and Christian Sautter*

Fraser, A., Tan, S., Lagarde, M., & Mays, N. (2018). Narratives of promise, narratives of caution: A review of the literature on Social Impact Bonds. *Social Policy & Administration*, *52*(1), 4–28.

Freireich, J., & Fulton, K. (2009). *Investing for Social & Environmental Imapct.* Retrieved from http://monitorinstitute.com/downloads/what-we-think/impact-investing/Impact_Investing.pdf.

Gallet, C. A., & Doucouliagos, H. (2017). The impact of healthcare spending on health outcomes: A meta-regression analysis. *Social Science & Medicine*, *179*, 9–17.

Gatti, S. (2014). *Government and Market Based Instruments and Incentives to Stimulate Long-term Investment Finance in Infrastructure* (OECD Working Paper).

Gatti, S., & Della Croce, R. (2015). International trends in infrastructure finance. In S. Caselli, G. Corbetta, & V. Vecchi (Eds.), *Public Private Partnership for infrastructure and business development*. New York: Palgrave Macmillan.

Gatti, S., Borgonovo, E., & Modonesi, D. (2013). *Governmental guarantees in the Valuation of highway projects: a simulation-based real options approach*.

Gertler, P. J., Martinez, S., Premand, P., Rawlings, L. B., & Vermeersch, C. M. J. (2016). *Impact evaluation in practice*. The World Bank.

Gompers, P. A. (1996). Grandstanding in the venture capital industry. *Journal of Financial Economics*, *42*(1), 133–156.

Grabenwarter, U., & Liechtenstein, H. (2011). *In Search of Gamma - An Unconventional Perspective on Impact Investing*. *SSRN Electronic Journal*. Retrieved from http://www.ssrn.com/abstract=2120040.

Grant-Muller, S. M., Mackie, P., Nellthorp, J., & Pearman, A. (2001). Economic appraisal of European transport projects: the state-of-the-art revisited. *Transport Reviews*, *21*(2), 237–261.

Grimsey, D., & Lewis, M. K. (2005). Are Public Private Partnerships value for money?: Evaluating alternative approaches and comparing academic and practitioner views. In *Accounting forum* (Vol. 29, pp. 345–378). Elsevier.

Gustafsson-Wright, E., Gardiner, S., & Putcha, V. (2015). The potential and limitations of impact bonds: lessons from the first five years of experience worldwide. *Brookings. Global EcEconomy and Development. Retrieved from: Https://Www.Brookings.Edu/Wp-Content/Uploads/2015/07/Impact-Bondsweb.Pdf*.

Hamilton, G., Kachkynbaeva, M., Wachsmuth, I., & Masaki, E. (2012). A Preliminary Reflection on the Best Practice in PPP in Health care Sector: A Review of Different PPP Case Studies and Experiences. In *Conference, PPPs in Health Manila*.

Harberger, A. C. (1969). The discount rate in public investment evaluation. In *Conference on the Economics of Water Resource Development*. Western Agricultural Economics Research Council Denver, CO.

Harris, R. S., Jenkinson, T., & Kaplan, S. N. (2014). Private equity performance: What do we know? *The Journal of Finance*, *69*(5), 1851–1882.

Hellowell, M., & Pollock, A. M. (2010). Do PPPs in social infrastructure enhance the public interest? Evidence from England's National Health Service. *Australian Journal of Public Administration*, *69*, S23-S34.

Hellowell, M., Vecchi, V., & Caselli, S. (2015). Return of the state? An appraisal of policies to enhance access to credit for infrastructure-based PPPs. *Public Money & Management*, *35*(1), 71–78.

Hellowell, M., Vecchi, V., & Gatti, S. (2015). *Government Policies to Mitigate the Risks of Infrastructure Projects: A Framework for Classification And Analysis*

Hepburn, C. (2007). Use of discount rates in the estimation of the costs of inaction with respect to selected environmental concerns. *OECD Papers*, *7*(28), 1–42.

Hodge, G. A., & Greve, C. (2017). On public–private partnership performance: A contemporary review. *Public Works Management & Policy*, *22*(1), 55–78.

Hodge, G., & Greve, C. (2007). Public – Private Partnerships: An International Performance Review. *Public Administration Review*, *67*(3), 545–558.

Hodge, G., & Greve, C. (2010). Public-Private Partnerships: Governance Scheme or Language Game? *Australian Journal of Public Administration*, *69*, S8–S22. http://doi.org/10.1111/j.1467-8500.2009.00659.x

Hood, C. (1991). A public management for all seasons? *Public Administration*, *69*(1), 3–19.

Howes, R., & Robinson, H. (2006). *Infrastructure for the built environment: global procurement strategies*. Routledge.

Hueskes, M., Verhoest, K., & Block, T. (2017). Governing public–private partnerships for sustainability: An analysis of procurement and governance practices of PPP infrastructure projects. *International Journal of Project Management*, *35*(6), 1184–1195.

Hummel-Rossi, B., & Ashdown, J. (2002). The state of cost-benefit and cost-effectiveness analyses in education. *Review of Educational Research*, *72*(1), 1–30.

Hwang, K. (2016). Cost-benefit analysis: its usage and critiques. *Journal of Public Affairs*, *16*(1), 75–80.

Inderst, G. (2009). *Pension Fund Investment in Infrastructure*. *OECD Working Papers on Finance, Insurance and private pensions*.

Inderst, G. (2013). Private Infrastructure Finance and Investment in Europe. *EIB Working Papers 2013 / 02*.

International Monetary Fund. (2014). Is it time for an Infrastructure Push? The Macroeconomic effects of public investment. *World Economic Outlook*.Leeper, E. M., Walker, T. B. and Yang, S.S. (2010). Government Investment and Fiscal Stimulus in the Short and Long Runs. *Journal of monetary Economics* 57 (8), 1000-1012.

Iossa, E., & Martimort, D. (2015). The Simple Microeconomics of Public-Private Partnerships. *Journal of Public Economic Theory*, *17*(1), 4–48.

Ive, G. J., & Edkins, A. (2010). The impact of school renewal: Analyzing the evidence.

Jackson, E. T. (2013). Evaluating social impact bonds: questions, challenges, innovations, and possibilities in measuring outcomes in impact investing. *Community Development*, *44*(5), 608–616.

Jackson, P. (1988). The management of performance in the public sector. *Public Money & Management*, *8*(4), 11–16.

Jamal, A., McKenzie, K., & Clark, M. (2009). The impact of health information technology on the quality of medical and health care: a systematic review. *Health Information Management Journal*, *38*(3), 26–37.

Janssen, R. (2012). *Multiobjective decision support for environmental management* (Vol. 2). Springer Science & Business Media.

Jara-Diaz, S. R. (1986). On the relation between users' benefits and the economic effects of transportation activities. *Journal of Regional Science*, *26*(2), 379–391.

Johannesson, M. (1995). The relationship between cost-effectiveness analysis and cost-benefit analysis. *Social Science & Medicine*, *41*(4), 483–489.

Jørgensen, T. B., & Bozeman, B. (2007). Public values: An inventory. *Administration & Society*, *39*(3), 354–381.

Joy, M., & Shields, J. (2013). Social impact bonds: the next phase of third sector marketization? *Canadian Journal of Nonprofit and Social Economy Research*, *4*(2), 39.

Kaplan, S. N., & Schoar, A. (2005). Private equity performance: Returns, persistence, and capital flows. *The Journal of Finance*, *60*(4), 1791–1823.

Karoly, L. A. (2008). Valuing Benefits in Benefit-Cost Studies of Social Programs. Technical Report. *RAND Corporation*.

Kidokoro, Y. (2004). Cost-benefit analysis for transport networks: theory and application. *Journal of Transport Economics and Policy (JTEP)*, *38*(2), 275–307.

Korhonen, P., Moskowitz, H., & Wallenius, J. (1992). Multiple criteria decision support-A review. *European Journal of Operational Research*, *63*(3), 361–375.

Leithwood, K., & Jantzi, D. (2009). A review of empirical evidence about school size effects: A policy perspective. *Review of Educational Research*, *79*(1), 464–490.

Leventhal, R. (2012). Effecting progress: Using social impact bonds to finance social services. *NYUJL & Bus.*, *9*, 511.

Levin, H. M. (2003). The public-private nexus in education. In *Educational partnerships and the State: the paradoxes of governing schools, children, and families* (pp. 171–186). Springer.

Liang, M., Mansberger, B., & Spieler, A. C. (2014). An overview of social impact bonds. *J. Int'l Bus. & L.*, *13*, 267.

Liebman, J., & Sellman, A. (2013). Social impact bonds: A guide for state and local governments. *Cambridge, MA: Harvard Kennedy School Social Impact Bond Technical Assistance Lab*.

Lingane, A., & Olsen, S. (2004). Guidelines for social return on investment. *California Management Review*, *46*(3), 116–135.

Marcelo, D., Mandri-Perrott, C., House, S., & Schwartz, J. (2016). *Prioritizing infrastructure investment: a framework for government decision making*. The World Bank.

Martin, S., & Scott, J. T. (2000). The nature of innovation market failure and the design of public support for private innovation. *Research Policy*, *29*(4), 437–447.

Matsukawa, T., & Habeck, O. (2007). *Review of risk mitigation instruments for infrastructure financing and recent trends and developments* (Vol. 4). World Bank Publications.

McHugh, N., Sinclair, S., Roy, M., Huckfield, L., & Donaldson, C. (2013). Social impact bonds: a wolf in sheep's clothing? *Journal of Poverty and Social Justice*, *21*(3), 247–257.

McKevitt, D. (2015). Debate: Value for money—in search of a definition. *Public Money & Management*, *35*(2), 99–100.

Meynhardt, T. (2009). Public value inside: What is public value creation? *Intl Journal of Public Administration*, *32*(3–4), 192–219.

Ministerstvo Prumyslu A Obchodu Department of Electrical Engineering (2014) National Energy Efficiency Action Plan of the Czech Republic.

Monk, A. H., & Sharma, R. (2015a). *Capitalising on Institutional Co-Investment Platforms* (Stanford Global Projects Center Working Paper).

Monk, A. H., & Sharma, R. (2015b). *Re-Intermediating Investment Management: A Relational Contracting Approach* (Stanford Global Projects Center Working Paper).

Montagu, D., Harding, A., & Montagu, D. (2012). A zebra or a painted horse ? Are hospital PPPs infrastructure partnerships with stripes or a separate species ? *World Hospitals and Health Services: The Official Journal of the International Hospital Federation*, *48*(2), 15–19.

Moore, M. H. (1995). *Creating public value: Strategic management in government*. Harvard university press.

National Audit Office. (2010). *The Academies Programme*. *The Academies Programme*.

National Audit Office. (2018). *Converting Maintained Schools to Academies*.

Nicholls, A. (2006). *Social entrepreneurship: New models of sustainable social change* (2008th ed.). Oxford University Press.

Nikolic, A., & Maikisich, H. (2006). *Public-Private Partnerships and Collaboration in the Health Sector, An Overview with Case Studies from Recent European Experience* (Health, Nutrition and Population (HNP) Discussion Paper).

O' Nolan, G., & Reeves, E. (2018). The Nature of Contracting Hazards in Public–Private Partnerships — Evidence from Ireland Gerald. *International Journal of Public Administration*, *41*(15), 1205–1216.

O'Flynn, J. (2007). From new public management to public value: Paradigmatic change and managerial implications. *Australian Journal of Public Administration*, *66*(3), 353–366.

OECD. (2006). Infrastructure to 2030: Telecom, Land Transport, Water and Electricity. Volume 1.

OECD. (2007) Infrastructure to 2030: Mapping Policy for Electricity, Water and Transport. Volume 2 Papers No. 1048

OECD. (2009). Measuring Capital. Chapter 11 *OECD Manual.*

OECD. (2015a). *Annual Survey of Large Pension Funds and Public Pension Reserve Funds*.

OECD. (2015b). *Infrastructure Financing Instruments and Incentives* (OECD series on institutional investors and long-term investment).

OECD. (2015c). *Mapping of instruments and incentives for infrastructure financing: a taxonomy*.

OECD. (2016). *Better Ways to Pay for Health Care*. http://doi.org/10.1787/9789264258211-en

OECD. (2016). Understanding Social Impact Bonds. *Paris: Organization for Cooperation and Development. Retrieved from Http://Www.Oecd.Org/Cfe/Leed/UnderstandingSIBsLux-WorkingPaper.Pdf*.

OECD. (2017). Investing in Climate, Investing in Growth, *OECD Publishing*. Paris.

Olsen, S., & Galimidi, B. (2008). Catalog of approaches to impact measurement: assessing social impact in private ventures. *The Rockfeller Foundation*.

Oosterhaven, J., & Elhorst, J. P. (2003). Indirect economic benefits of transport infrastructure investments. *Across the Border. Building upon a Quarter Century of Transport Research in the Benelux, De Boeck, Antwerpen*, 143–162.

Patrinos, H. A., Barrera-Osorio, F., & Guaqueta, J. (2009). *The Role and Impact of Public-Private Partnerships in Education*.

Percoco, M. (2008). A social discount rate for Italy. *Applied Economics Letters*, *15*(1), 73–77.

Pollitt, C. (2005). The new public management in international perspective: An analysis of impacts and effects. In *New Public Management* (pp. 286–304). Routledge.

Polonsky, M., & Grau, S. L. (2011). Assessing the social impact of charitable organizations—four alternative approaches. *International Journal of Nonprofit and Voluntary Sector Marketing*, *16*(2), 195–211.

Porter, M. E., & Kramer, M. R. (2011). Creating shared value. *Harvard Business Review*, *89*(1/2), 62–77.

Posnett, J. 2002. "Hospitals in a Changing Europe." In *European Observatory on Health Care Systems,* ed. M. McKee and J. Healy. Buckingham U.K., and Philadelphia: Open University Press.

Preqin. (2014). Global Social Infrastructure Deal Flow. *Preqin Infrastructure Online*.

Preqin. (2016). *Global Infrastructure Report*.

Probitas Partners. (2015). *Infrastructure Institutional Investors. Trends for 2016 Survey*. Retrieved from http://probitaspartners.com/wp-content/uploads/2015/09/probitas_partners_Infra_investor_surveyfor_2015.pdf

Project Finance International. (2016). *Yearbook 2016*.

Psacharopoulos, G., & Patrinos, H. A. (2004). Returns to investment in education: a further update. *Education Economics*, *12*(2), 111–134.

Public Accounts Committee. (2009). *The Building Schools for the Future programme: Renewing the secondary school estate*.

Reeder, N., & Colantonio, A. (2013). Measuring Impact and Non-financial Returns in Impact Investing : A Critical Overview of Concepts and Practice. *EIBURS Working Paper 2013/01funded by the European Investment Bank Institute.*

Revoltella, D., Brutscher, P., Tsiotras, A. and Weiss, C. (2016). Infrastructure Investment in Europe and International Competitiveness. *EIB Working Paper.*

Robertson, S. L., & Verger, A. (2012). Governing education through public private partnerships. *Public Private Partnerships in Education: New Actors and Modes of Governance in a Globalizing World*, 21–42.

Robertson, S., Mundy, K., & Verger, A. (2012). *Public private partnerships in education: New actors and modes of governance in a globalizing world*. Edward Elgar Publishing.

Robinson, D. T., & Sensoy, B. A. (2013). Do private equity fund managers earn their fees? Compensation, ownership, and cash flow performance. *Review of Financial Studies*, *26*(11), 2760–2797.

Robinson, J. A., & Torvik, R. (2005). White elephants. *Journal of Public Economics*, *89*(2–3), 197–210.

Roehrich, J. K., Lewis, M. A., & George, G. (2014). Are public–private partnerships a healthy option? A systematic literature review. *Social Science & Medicine*, *113*, 110–119. http://doi.org/10.1016/j.socscimed.2014.03.037

Roy, M. J., McHugh, N., & Sinclair, S. (2018). A Critical Reflection on Social Impact Bonds. *Standford Social Innovation Review. March, 2018. Retrieved from Https://Ssir.Org/Articles/Entry/A_critical_reflection_on_social_impact_bonds*.

Sandmo, A., & Dreze, J. H. (1971). Discount rates for public investment in closed and open economies. *Economica*, *38*(152), 395–412

Saussier, S. (2013). *An economic analysis of the closure of markets and other dysfunctions in the awarding of concession contracts* (EUI RSCAS No. 2013/08). Retrieved from http://hdl.handle.net/1814/26058

Savova, I. (2012). Europe 2020 Strategy – towards a smarter, greener and more inclusive EU economy? *Eurostat Statistics in focus 39/2012*

So, I., & Staskevicius, A. (2015). Measuring the 'impact'in impact investing. *Harvard Business School*.

Social Finance. (2011). A technical guide to developing social impact bonds. *London: Social Finance. Retrieved from Http://Www. Socialfinance. Org. Uk/Sites/ Default/Files/Technical_ Guide_Overview. Pdf.*, *25*, 2015.

Spackman, M. (2004). Time discounting and of the cost of capital in government. *Fiscal Studies*, *25*(4), 467–518.

Stoker, G. (2006). Public value management: A new narrative for networked governance? *The American Review of Public Administration*, *36*(1), 41–57.

Talbot, C. (1999). Public Performance-towards a new model? *Public Policy and Administration*, *14*(3), 15–34.

Thomopoulos, N., Grant-Muller, S., & Tight, M. R. (2009). Incorporating equity considerations in transport infrastructure evaluation: Current practice and a proposed methodology. *Evaluation and Program Planning*, *32*(4), 351–359.

Thompson, C. R., & McKee, M. (2004). Financing and planning of public and private not-for-profit hospitals in the European Union. *Health policy*, *67*(3), 281-291.

Thomson, C., Goodwin, J., & Yescombe, E. (2005). *Evaluation of PPP projects financed by the EIB. European Investment Bank*.

Thomson, D. S., Pronk, L., Alalouch, C., & Kaka, A. P. F. (2010). Quantifying the benefits of healthcare infrastructure investment.

Thomson, S., Foubister, T., Figueras, J. et al. (2009) *Addressing Financial Sustainability in Health Systems*. Copenhagen: WHO Regional Office for Europe on behalf of the European Observatory on Health Systems and Policies (HEN-OBS Joint Policy Summary No. 1).

Torchia, M., Calabrò, A., & Morner, M. (2015). Public–Private Partnerships in the Health Care Sector: A systematic review of the literature. *Public Management Review*, *17*(2), 236–261. http://doi.org/10.1080/14719037.2013.792380

UN Habitat. (2011). Infrastructure for Economic Development and Poverty Reduction in Africa. *The Global Urban Economic Dialogue Series*. United Nations Human Settlement Programme. Nairobi.

van den Berg, A. E. (2005). *Health impacts of healing environments; a review of evidence for benefits of nature, daylight, fresh air, and quiet in healthcare settings*. UMCG.

Vecchi, V., Borgonovo, E., Amadio, S., Cusumano, N., & Gatti, S. (2016). *Do public guarantees to infrastructure investments engender moral hazard of private bidders? A multiple agents based simulation* (Paper Laboratorio ASPI – Bocconi).

Vecchi, V., Hellowell, M., della Croce, R., & Gatti, S. (2017). Government policies to enhance access to credit for infrastructure-based PPPs: an approach to classification and appraisal. *Public Money & Management*, *37*(2), 133–140.

Venables, A. J. (2017). Incorporating wider economic impacts within cost-benefit appraisal. *OECD Discussion Paper. International Transport Forum. Roundtable Reports Quantifying the Socio-Economic Benefits of Transport.*, 109.

Verhoest, K., Petersen, O. H., Scherrer, W., & Murwantara Soecipto, R. (2014). *Policy commitment, legal and regulatory framework, and institutional support for PPP in international comparison: Indexing countries' readiness for taking up PPP*. PPP Conference 2013, Universiteit Antwerpen: University of Salzburg.

Wang, H., Xiong, W., Wu, G., & Zhu, D. (2017). Public – private partnership in Public Administration discipline : a literature review. *Public Management Review*, *00*(00). http://doi.org/10.1080/14719037.2017.1313445

Waring, J., & Currie, G. (2013). A Contingent Approach to the Organization and Management of Public–Private Partnerships: An Empirical Study of English Health Care. *Public Administration Review*, *73*(2), 313–326. http://doi.org/10.1111/puar.12020.A

Warner, M. E. (2013). Private finance for public goods: social impact bonds. *Journal of Economic Policy Reform*, *16*(4), 303–319.

World Economic Forum. (2012). Strategic Infrastructure Steps to Prioritize and Deliver Infrastructure Effectively and Efficiently. *World Economic Forum Industry Agenda.*

World Economic Forum. (2013). *Strategic Infrastructure. Steps to Prepare and Accelerate Public-Private Partnerships.* Retrieved from http://www3.weforum.org/docs/AF13/WEF_AF13_Strategic_Infrastructure_Initiative.pdf

World Economic Forum. (2014). *Direct Investing by Institutional Investors: Implications for Investors and Policy-Makers*.

Yepes, T. (2004). Expenditure on Infrastructure in East Asia Region, 2006-2010. *Background document for EAP's flagship 2005*. World Bank Group. Washington, DC.

Yescombe, E. R. (2011). *Public-private partnerships: principles of policy and finance*. Butterworth-Heinemann

Zhuang, J., Liang, Z., Lin, T., & De Guzman, F. (2007). *Theory and practice in the choice of social discount rate for cost-benefit analysis: a survey*. ERD working paper series.