

WINIR 2017 Symposium

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Why public funding of infrastructure will fail as a panacea for economic development and growth

A praxeological analysis in the tradition of Ludwig Lachmann – the preeminent Austrian capital theorist – will reveal severe logical flaws inherent to the prevailing academic discourse related to the funding of infrastructure projects. We will exemplify the merits of market-based funding, as opposed to publically raised infrastructure financing, by analysing the dynamic nature of financing processes and the important function of financial risk-bearing as a natural hedging mechanism against white elephant projects and the waste of public money. For commercial banks, equity providers and construction companies to agree on a funding structure, the allocation of entrepreneurial risks will have to be aligned to the participants’ respective ability and willingness to bear them. During the negotiation process, the fundamentally different nature of the project participants’ mandates invariably guides all parties to acknowledge their counterparties’ commercial positions, thereby creating the disciplining dynamics for an efficient risk allocation to materialise. Public agencies do not dispose of the means of replicating this process, nor do they dispose of a commercial yardstick required to ‘rightsize’ infrastructure, which is to align the cost of building and maintaining infrastructure with user demand. We will conclude the analysis by illustrating that financial markets do not fall from the sky, but that it is the nature of infrastructure technologies to shape financing and funding solutions – an ignored topic of economic research.

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1. Introduction

In a previous paper¹ we undertook an analysis of the nature of infrastructure assets, their emergence and transformation over time, and the functioning of competitive markets facilitating their provision. It was shown that prevalent simplistic notions of economies of scale and monopolistic markets defy the complex reality of market dynamics, making these ideas a dangerous starting point for policy action. In this paper, the nature of financing and funding of infrastructure projects will be analysed in detail. We will show why only market-based funding solutions are able to yield a rational risk allocation between the parties involved in an infrastructure financing process.

An economic snapshot seems to reveal a more than robust positive correlation between the wealth of economies and their respective infrastructure levels. Indicators, such as road density, telecommunication penetration levels, the number of people living off the energy grid and the availability of transport, all speak a clear language. Industrialised countries are blessed with more, better and cheaper services, while poor countries substantially lag behind in all categories. Accordingly, politicians and economists typically identify the investment in infrastructure as a prerequisite for economic development and growth. In poor countries, high infrastructure investment levels are seen as a blueprint to catch up with richer peers. In industrialised countries, increased investments in public infrastructure also appear attractive in the current environment of zero interest rates and sluggish growth.

Investment in infrastructure, however, only takes place if financial means can be secured throughout the lifetime of the asset. In a private setting this means that the finance and project parties have to agree on a funding structure and risk allocation in line with their respective mandates. It is these mandates that guide parties to only pursue specific commercial solutions, thereby constraining the overall solutions space of possible funding structures. The fact that commercial lenders are particularly restrictive if infrastructure project proposals do not meet their criteria, in respect of sovereign risk, loan tenor, technology maturity, sponsors or equity contribution in conjunction with the publically-held conviction of higher infrastructure levels needed for economic growth, gave birth to the idea of what is widely referred to as a *funding gap*.

At the outset, a brief summary of the popular discourse related to infrastructure funding gaps will be given. We will continue with an overview of capital theory and the problem of measurement of capital stocks in the context of infrastructure. The core of this paper is then devoted to a detailed analysis of how infrastructure funding solutions come into being and which dispositions guide the involved actors. A praxeological analysis in the tradition of the Austrian School will reveal severe logical flaws inherent to the prevailing public and academic discourse related to the funding of infrastructure projects. First, it will be argued that only market-based allocations of risk fully concur with ethical norms of human action and entrepreneurship in the face of uncertainty. Second, in negotiations of market-based infrastructure projects, different commercial interests and risk appetite exert a disciplining effect on the involved parties to act according to their mandates. In this process, actors create the information required to ‘rightsized’ infrastructure. Finally, we show that the funding

¹ Christoph Klein: “A Categorisation of Infrastructure: How old economic ideas defy the complex reality of markets.” Unpublished paper submitted to and presented at WINIR 2017 Symposium, Johannesburg.

structure is a product of the chosen technology (and its evolution over time) and explain why this lends itself to favouring market-based financing structures.

2. Infrastructure funding gaps

Economics and economic theory is as much susceptible to trends as all other areas of life. Some of these trends stem from the careful investigation of clearly identifiable social phenomena yielding tangible insights, some trends lead to an increased allocation of resources to channel further research into promising subject matters areas, and others are clearly driven by political agendas and lobbying efforts. Quite often, lobbying efforts are comprehensible in that they entail the provision of resources for a well-justified scientific cause. Sometimes, however, subjects are promoted to superstar status without any scientific merit whatsoever. The emergence of the notion of infrastructure funding gaps falls into the latter category.

Consultancies, public offices, think tanks and development banks have been outgunning themselves in estimating spending levels to *close* infrastructure gaps for the last couple of years. Since the advent of the so-called Structural Adjustment Programmes (SAP) in the late 1980s, investment in infrastructure has been a pervasive feature of every national development plan in low-income countries. It is a very recent phenomenon, however, that future infrastructure investment levels are estimated and aggregated over extended periods of time and coined as funding gaps. Infrastructure funding gaps now feature on top of political agendas and are calculated on a national, regional and worldwide level. It's worthwhile to quote a typical statement by management consultancy McKinsey in a piece termed 'Bridging Global Infrastructure Gaps':

From 2016 through 2030, the world needs to invest about 3.8 % of GDP, or an average of \$3.3 trillion a year, in economic infrastructure just to support expected rates of growth. Emerging economies account for some 60 % of that need. But if the current trajectory of underinvestment continues, the world will fall short by roughly 11 %, or \$350 billion a year. The size of the gap triples if we consider the additional investment required to meet the new UN Sustainable Development Goals.²

Authors at the Brookings Institute see vast unmet infrastructure needs of US\$1–1.5 trillion per year in both emerging and developing countries, which appear to constrain these countries' growth.³ These are mind-boggling numbers and constitute a regular feature of public discussion. It is needless to point out to the danger that those humungous numbers provide a convenient springboard for powerful lobby groups, such as infrastructure suppliers and politicians, to further their agenda. There is no underlying scientific evidence provided to support the estimates and the question of how the authors came to the conclusion of such gross levels of underinvestment would have to be answered. Either the expected growth rate of 3.8 % seems to be too high or something must be wrong with the projections of the infrastructure gap. The notion of a funding gap always suggests that there are clearly

² McKinsey Global Institute (2016).

³ Bhattacharya et al. (2015).

identifiable reasons for prevailing low investment levels and – assuming the correct identification of reasons – that some form of a policy toolset would be readily available to compel market actors to act in such a way that the ‘required’ investment levels are achieved.

Two challenges arise. First, we have to understand the nature of the proposed policy tools. If the underlying assumption is that policymakers will open infrastructure markets to competition and, ease access and repatriation of hard currency and improved property right legislation, hence a strengthening the institutional framework, then the foundation for increased investment levels are laid. The issue is, however, that immature institutions and associated high levels of entrepreneurial uncertainty are the reason for low infrastructure levels in the first place. For instance, the fact that Standard & Poor has only rated eighteen countries in sub-Saharan Africa (out of forty-eight), sixteen of which were assigned a B-rating, means that African markets basically do not appear on the radar screen of investors and financial institutions – for very good reasons.⁴ In a paper published by G-24, the authors define five project categories based on their financial viability. Category B comprises projects ‘that are commercially viable, but below private profit expectations. [...] private profit expectations can be very high in developing countries, in large part as perceived (and not always real) risk is seen as very high.’⁵ The authors would have to answer the questions of how a project can be commercially viable if it doesn’t satisfy profit expectations. Moreover, it would be interesting to learn how the authors distinguish between real and perceived risk (ex-ante).

Second, as important as the legislative side of the economy is for the provision of funding, the consumer base must be able to support the suggested infrastructure levels over the lifetime of the assets. If the state steps in to plug financial holes – ignoring any efficiency considerations – the country’s tax base must be able to accommodate the funding requirements without incurring ever-increasing public debt levels (which is the present reality in many countries). Ballooning public indebtedness is a sure sign of policy goals being at odds with economic realities. As noble as it is to make piped, potable water and sanitation available to everybody, this must not lead to the belief that this goal is readily achievable. For many prospective projects, income and savings levels, amongst other reasons, are insufficient to attract the private capital levels required for a viable financing and funding structure. If governments choose to step in, often based on alleged market failures or a lack of political feasibility, they must inevitably act on the assumption that publically-funded infrastructure would lift the economy to such prosperity levels as to enable the government to fully pay for the installation and operation of infrastructure as well as to service the debt. Public interventions to leapfrog the market process are nothing else than a bet against market reason. Accordingly, meta-goals such as the UN’s Millennium Development Goals (MDG) may help to illustrate global infrastructure levels as one of many indicators of well-being and dedicate public resources to certain sectors. In the end, however, investors and construction companies must be confident that their investments are economically feasible.

A paper published by The World Economic Forum also reports a ‘chronic shortage of funding for infrastructure and the resulting rationing in access to financing.’⁶ The authors do

⁴ See Standard & Poor’s Global Credit Portal.

⁵ Griffith-Jones and Kollatz (2015) in G24 – Intergovernmental Group of Twenty Four.

⁶ World Economic Forum (2014).

not see failing markets as culprits, but rather the ‘institutional challenges’ and the failure to adopt the user-pays principle. They correctly conclude that if end-users are unable to pay for the services, no funding structure will succeed to support the project in the long run. The authors deserve credit for being critical of the much-lauded public-private partnership (PPP) schemes, many of which suffered from an inadequate funding base simply for the fact that PPP projects rely on the same inadequate funding base as pure public projects. The paper also reported: ‘Without a strong and credible mechanism to deliver payments private developers and financiers cannot engage.’ This paper is one of the extremely rare examples in which authors concluded that successful infrastructure investments ultimately depend on consumers being able to pay for the assets’ usage. In other words, consumers are the funders of infrastructure. As simple as this may sound, the overwhelming majority of literature on infrastructure financing ignores this fact altogether.

3. Capital theory and measurement of infrastructure

3.1. Capital theory

One of the cornerstones of Austrian economics is the School’s distinctive theory of capital. Austrians such as Carl Menger, Eugen Böhm von Bawerk, FA von Hayek, Richard von Strigl and Ludwig Lachmann have made important contributions from 1871 onwards. These contributions stressed capital heterogeneity, the roundabout nature of production, capital heterogeneity, multi-specificity and the notion of the ‘structure of capital’ as well as the importance of savings and the passage of time. In Austrian version of capital theory (ACT), the role of capital goods is seen as being central to explain human progress in that actors relinquish immediate consumption in order to invest. Actors exchange present goods for future goods based on the ends they hope to achieve. In contrast, neoclassical growth models are based on production functions that assume homogeneous aggregate capital stocks in the absence of time. In this world, consumption and investment take place at the same time, the temporal structure of production is ignored and capital is regarded as a permanent fund, which *automatically* yields profits.⁷

It was Ludwig Lachmann who resisted simplistic notions of a capital stock understood as a permanent fund to yield returns. For him, the stock of capital is a structural pattern of the productive economy.⁸ Capital goods in the extremely complex network, which constitute the real productive structure of a modern economy, are not perpetual, but are always temporary in the sense that they are physically used up or are consumed during the production process. Alternatively, they render obsolete as the productive structure itself is constantly disrupted by new inventions and innovations. The disruptive nature – to speak in Schumpeterian terms – of inventions and innovations is set in motion through the entrepreneurial creation of new knowledge. Evidently, capital is heterogeneous due to its physical properties; a furnace is not a wire. However, it’s the different plans capital goods satisfy that make them truly heterogeneous – a heterogeneity in use. A computer at home might well be treated as a

⁷ Böhm-Bawerk regarded John Bates Clark’s neoclassical concept of capital as mystical. See Huerta de Soto (2008, p. 56).

⁸ Lachmann (1978, p. 4).

capital good for the user, but the same computer performs an entirely different function if applied to control a conveyor belt at the airport. In addition, all complex production processes require many different categories of capital goods to produce final consumption goods. As capital goods cannot be combined in an arbitrary manner, Austrian economists – and entrepreneurs – analyse the degree of complementarity and substitutability of different combinations of production factors. Complementarity is of the essence of capital use and only certain modes of complementarity are technically possible. This is why Lachmann correctly identified the stock of capital as a structural pattern and not a homogeneous aggregate.⁹

Accordingly, in the Austrian diction the term ‘capital goods’ denotes what the entrepreneur subjectively regards as the intermediate stages of the production process. The values of all producer goods at every stage of production derive from the value consumers place on the final goods being produced. The alignment of the production of capital goods with consumer demand is governed by price signals and careful economic calculations of investors based on their expectations. Hence, to truly understand investment in long-term capital goods such as infrastructure, we have to understand the role of entrepreneurial judgement under conditions of uncertainty.

According to Foss et al. (2007), judgement refers primarily to entrepreneurial decision-making when the range of possible future outcomes, let alone the likelihood of individual outcomes, is generally unknown. This aligns with Knight’s understanding of uncertainty compared to quantifiable (probabilistic) notions of risk. There is no market where an entrepreneur can buy judgement to decide on capital project A or B – he himself has to exercise judgement. Hence, ‘judgement primarily refers to the process of a businessman forming estimates of future events in situations in which the relevant probability distributions are themselves unknown’.¹⁰ Any entrepreneur will tell us that this is a very complex statement for something so self-evident. However, in neoclassical models based on homogeneous capital stocks, firms maximise expected profits (based on known probabilities), which reduces the entrepreneurial function of exercising judgement to pick the obviously correct option. Kirzner has made the important point that capital goods are heterogeneous – not because of their objective characteristics, but because they play particular roles within the entrepreneur’s overall production plans.¹¹

Thus, the Austrian idea of heterogeneous capital is a natural complement to the theory of entrepreneurship. Klein (2010) stresses the difference between the controlling function linked to asset ownership and the entrepreneurial function to managing the firm. It was Mises (1949) who said: “[T]hose who confuse entrepreneurship and management close their eyes to the economic problem.’ It’s the investor – the capitalist-entrepreneur in Misesian terms – who decides on the allocation of his capital, thereby exercising his ownership rights. The entrepreneur, be it as an inventor or operational manager, has to be sharply distinguished from investors. The former requires the capital of the latter and cannot be regarded as an

⁹ ‘A theory of investment based on the assumption of a homogeneous and quantifiable capital stock is bound to ignore important features of reality. Owing to its very character it can only deal with quantitative capital change, investment and disinvestment. It cannot deal with changes in the composition of the stock. Yet there can be little doubt that such changes in the composition of the stock are of fundamental importance in many respects, but in particular with regard to the causes and effects of investment.’ Lachmann (1956, p. 6).

¹⁰ It is questionable whether such a probability distribution exists altogether, or whether it is useful to contemplate its existence. Foss et al. (2007).

¹¹ See Foss et al. (2007).

entrepreneur in case he does not bear financial uncertainty. Hence, the Austrian notion of entrepreneurship is invariably linked to investing and the resulting ownership of capital. Klein (2010) is correct to state that Austrians often confound leadership with entrepreneurship. On the other hand, shareholders of blue chip companies probably defy notions of entrepreneurship in a classical sense. We cannot analyse principal-agent theory here, but it is this problem of firms going public that cause their culture and governance principles to change from being entrepreneurially investor-driven to managerial. The (new) principles invariably suffer from a substantial loss of control over their company, as their interests can only be aligned to a limited degree to those of the agents managing the firm.¹² The resulting effects of short-termism, excessive gearing ratios and harmful (often pretentious) M&A transactions are well documented.

3.2. Measurement of infrastructure

Infrastructure can be measured in physical, spatial or monetary units, and all of these methods are applied in economic analysis. Physically, a country's energy consumption needs are typically measured in megawatts. The dimensioning of a data centre or the choice of mobile radio technology follows demand patterns in respect of broadband data capacity and speeds, usually measured in bits and bytes per second. Road and rail infrastructure is often measured in kilometers of roads and rail track or by geographical coverage, e.g. paved road per square kilometre. These are quantitative indicators, but they say little or nothing as to how well different infrastructure assets are able to perform their tasks. Economists love to aggregate, but as Lachmann (1956) pointed out, it makes little sense to 'add beer barrels to blast furnaces nor trucks to yards of telephone wire.' In neoclassical growth models, capital appears as a real aggregate of all capital assets, often referred to as capital stock. This treatment not only contradicts the specific and complementary nature of capital goods, it also ignores the dynamic feature of changing structures due to technical progress.¹³

Performance measurement only makes sense in the context of a particular infrastructure category. The frequency and length of traffic jams indicates how well road networks are able to accommodate rush-hour traffic. Data speeds of fixed broadband telecommunication networks at peak hours depend, *inter alia*, on the capacity of national and international transmission networks. Downtimes in the supply of energy or water may be a result of a lack of maintenance or obsolete equipment. These few examples serve to clarify that quality or performance is not only difficult to capture, but meaningless to combine or aggregate. In the publication *Measuring and Improving Infrastructure Performance*, The National Research Council of the US arrives at the following conclusion:

¹² In most cases, the original principle doesn't bother as he has sold his majority stake. In other cases, the original owner retains a significant share ownership and exerts a firm entrepreneurial grip over his agents, e.g. as in the case of Bill Gates. Family-run companies are successful because their investment horizons and IRR expectations over time are better aligned with the development of the company compared to strategies promoting short-term profits expected by stock markets and institutional investors.

¹³ Lachmann (1956) correctly understood the stock of capital as a (changing) structural pattern arising as a result of human action in time. In a dynamic economic system, the value of a given stock of capital is solely determined by the future benefits it renders to its users and never by its historic usage (though patterns of historic usage provide insights for future usage). Capital assets can lose their market value almost instantaneously if new inventions allow for their substitution. In most cases, however, new technologies need time to penetrate markets, which allow 'old' industries to adapt or reutilise their asset base.

No adequate, single measure of performance has been identified, nor should there be an expectation that one will emerge. Infrastructure systems are built and operated to meet basic but varied and complex social needs. Their performance must therefore be measured in the context of social objectives and the multiplicity of stakeholders who use and are affected by infrastructure systems.¹⁴

There are, however, two ways that performance measurement can render useful services to the analyst. For the purpose of measurement, cross-country comparisons of physical/geographical indicators as well as performance-level measurements are useful to illustrate different levels of both industrialisation and wealth. However, this is a dangerous tool from the perspective of a policymaker in a low-income country. The strikingly obvious low levels of infrastructure services in low-income countries can tempt politicians, staff of international DFIs, so-called development professionals and many economists to call for arbitrary public action, as noted in the introductory chapters.

A second means of measurement speaks to the state of infrastructure. The infrastructure asset base needs to be maintained, upgraded or converted to serve alternative uses and to prevent it from deteriorating or becoming obsolete. In this sense, infrastructure grades as evaluated by The American Society of Civil Engineers (ASCE) may provide policymakers important insights as to how infrastructure should be provisioned and which parties should do so. The fact that large parts of American infrastructure have been considered to be in an abysmal state for at least the past decade might suggest that the initial provision of infrastructure was too large to be maintained, or that the economic model of public financing, provisioning and operation has proved inefficient in that the size and quality of infrastructure are not aligned to consumer needs.

Finally, infrastructure can and has to be measured in monetary terms. Initially, infrastructure projects invariably require a business plan and financial model to persuade equity and debt providers of its economic viability. In the case of private financing, revenues need to exceed costs in such a way that the expected return on equity is achieved, debt can be repaid and the asset can be maintained. The core difference between a private and public financing structure is on the revenue side of the analysis. Finance parties very carefully ascertain whether the product of prices times sellable infrastructure service units over time will align with the expected cash-flow patterns on the cost side, i.e. the up-front investment, estimated operating cost base over the lifetime of the asset and the cost of funding. In the case of public funding through taxes, the disciplining effect introduced by the process and negotiation of the finance package is foregone. As important information is not revealed to the public funder, state infrastructure tends to be too much, too big and too costly. During operation, private funders constantly track financial covenants in order to compare actual financial results with target numbers. If revenues are not at expected levels or operating costs are too high, shareholders activate a host of financial and management instruments to rectify the situation, i.e. to realign revenues with the cost base. Again, this information is not available to the public administrator.¹⁵ The losses incurred by the public by this deliberate,

¹⁴ National Research Council (1995).

¹⁵ There is no such thing as a public manager *managing* profit and loss. Without reliable financial information, the public manager cannot economise on public resources. Administrators do not dispose of the necessary tools to manage. They can only administer losses, which are revealed as budget overruns to the public. In the case costs are below budget, numbers also provide no guidance as to the economic viability and cost-effectiveness.

continuous ‘blind flight’ are likely to be enormous. The merits of private funding structures and resulting (appropriate) risk allocation will be explained in greater detail in Chapter 4.

From a macroeconomic perspective, national statistical offices measure aggregated spending levels in the energy and telecommunication sector, on both the consumer and industry side. The deterioration of infrastructure can also be measured in terms of investment requirements, as seen in the case of the US, and gaps in the overall level of infrastructure provision are calculated in nominal and relative terms. If we trust in the methodological soundness of deriving these figures, such reports show the magnitude of the worldwide infrastructure sector and provide for an interesting read. Alas, they are dust in the wind as there is not much to derive from those reports in terms of economic theory – with one exception: all these numbers are based on a country’s existing capital stock (the total physical aggregate of capital assets valued in monetary units at a particular point in time). The accumulation of capital arises as a result of (net) capital formation. The calculation of annual capital formation is an accounting technique that is used to derive annual (accounting) profits, inform shareholders about their firm’s investment needs and provide a picture of financial health as represented by annual financial statements. The valuation and impairment¹⁶ of capital assets rests on standard valuation principles, usually the discounting and aggregation of future cash flows. In order to arrive at national income account statistics, e.g. GDP or gross capital formation, statistical offices aggregate the reported monetary asset values of all private and public entities. If statistical agencies then identify depleting public infrastructure stocks on a national basis, this might raise – amongst others – the valid question of the economic sustainability of past investments in the first place.

4. Financing and funding¹⁷ of infrastructure (technology)

We cannot treat the history of financial markets that developed in tandem with infrastructure in the nineteenth century, nor the different debt and equity instruments employed in infrastructure projects, though an understanding is highly instructive when discussing the infrastructure requirements, particularly in developing countries. Also, we cannot analyse the various forms and instruments of public credit support employed in infrastructure projects. The following two chapters merely highlight two special aspects in conjunction with public financing and ownership of infrastructure that highlight the important role of risk-bearing and funding processes.

¹⁶ Impairment is an accounting principle that describes a permanent reduction in the expected value of a company’s asset. When testing for impairment, the total profits, cash flows or other benefits that are expected to be generated by a specific asset is periodically compared to its reported book value. An asset becomes impaired when its book value is below the newly calculated value (see www.investopedia.com).

¹⁷ In the following, we shall distinguish between financing and funding as most scholars do. Financing refers to the initial provision of debt and equity required to establish infrastructure assets until completion. In contrast, funding refers to the on-going collection of cash flows to finance the operational cost base, taxes, reinvestment, finance cost (interest) and principal debt repayments, and dividends to shareholders for the foreseeable lifetime of the assets. In private infrastructure projects these cash flows are collected as revenues from users, whereas in public projects an array of other funding sources, most prominently tax-based proceeds, complement (or replace) user revenues.

4.1. The ethical dimension of assuming financial risk

Much research has been dedicated to the nature of risk and uncertainty and what the existence of these two phenomena entails for the actions of market participants. Equally abundant literature has been published on ethical considerations in the context of the question whether to provide goods on a private or public basis. Economic theories based on notions of ‘public goods’ and ‘natural monopolies’ provide justification for the role of the state. Until recently, the economic philosophies from Keynes and Hayek appear to represent the boundaries of the public economic discourse. However, relatively little attention has been given to the ethical dimension of risk and uncertainty in the context of funding decisions. Heinemann (2010) notes that ‘[u]p to now, a qualified ethical analysis of the acceptability of financial risk is still lacking’. What are the functions of risk and uncertainty in the market process in general? And what risks and uncertainties do entrepreneurs and financial intermediaries assume in general? Can ethical considerations contribute to make better-informed decisions in the context of funding infrastructure projects and the role of the state?

We shall draw a very important distinction at the very beginning. Principally, equity providers are willing to accept uncertainty while debt providers are not, or to a very limited degree only. The development of new technologies, the intellectual process of devising the appropriate commercial plan to enter the market, the setup of a new enterprise and courting equity providers on road shows to raise funding are all actions of fundamentally uncertain nature, hence entrepreneurial. An entrepreneur deliberately faces this uncertainty and bears the resulting commercial risks that are not quantifiable in terms of probabilities. An early-mover entrepreneur makes uncertainty intelligible – he organises the different dimensions for equity providers (investors) to understand the nature of the proposition. This is in line with the definition of entrepreneurship firstly proposed by Knight (1921) that conceives entrepreneurship as judgemental decision-making under conditions of uncertainty. Judgement refers primarily to entrepreneurial decision-making when the range of possible future outcomes, let alone the likelihood of individual outcomes, is generally unknown (what Knight terms uncertainty, rather than mere probabilistic risk).¹⁸

A founder of a new technology company will not have access to bank lending, but only to high-risk equity instruments. The provision of equity is fundamentally forward-looking. In contrast, the entrepreneurial nature of commercial banks tends to avoid uncertainty. In this sense, lenders are not entrepreneurs, but transaction and risk experts. This means that banks only provide funding if they can *avoid* uncertainties, as their credit decisions are fundamentally based on quantifiable risks. In the conventional (plain vanilla) balance sheet funding of an existing firm, the bank’s credit committee takes a view on the financial standing of the sponsor firm (rating), the competitive environment and the industry outlook. Then the bank establishes what maximum leverage factor would be in line with bank’s policies, what are the single obligor limits and the industry-based credit limits, with the two last points seeking to avoid any concentration of risk. To a large extent, credit assessments are of a backward-looking nature. Banks do not provide funding to greenfield projects unless their exposure is backed by collateral or a sponsor’s company guarantee. In both instances,

¹⁸ See Klein (2010). According to Casson (1993), judgement is required ‘when no obviously correct model or decision rule is available or when relevant data is unreliable or incomplete’. Following this definition, commercial lenders do not apply judgement, at least not in the entrepreneurial sense of a single opportunity. Banks’ risk policies are strongly based on portfolio considerations.

lending again relies on existing assets that can be quantified by discounting expected market values.

In the case of project finance facilities for infrastructure projects, the bank will seek to mitigate (and allocate) all risks, except country and technology risk. For this reason, project finance lends itself to mature technologies with experienced contractors who can financially back large projects (and assume turnkey risk) and countries with a rating in line with credit policies.¹⁹ Due to the magnitude of funding and the high leverage factors required, banks will only accept credible sponsors with an established reputation and track record in the particular infrastructure sector. The better the reputation of sponsors, the more mature the technology, and the lower the country risk, the greater the chance higher leverage factors will be accepted by lenders. All banks run complex pricing tools that assess default risk *vis-à-vis* the cash flow profile of the project and the prudential capital reserve requirements. The final pricing, usually calculated as a margin on top of a reference interest rate such as the LIBOR, represents the quantifiable risk premium based on the bank's credit policies and credit appetite.²⁰

Quantifiable risk is not a phenomenon entrepreneurs are concerned with when making an investment decision. Entrepreneurs either dispose of their own resources to invest into a business or have to raise equity from other capital owners. Hence, the notion of entrepreneurship is strictly linked to ownership of equity capital, irrespective of whether the financial capital stems from the original sponsor or other sources such as private equity funds.²¹ Both parties look at the same opportunity, and equity is at stake for both parties, too. In an uncertain world abound with entrepreneurial failure, equity commitments represent the entrepreneurial ambitions *vis-à-vis* the market place and exercise three important functions: (i) they endow the business with the monetary resources to execute the business plan, (ii) they provide important information concerning ownership structure and capital base, both crucial for business partners and potential lenders to assess the opportunity, and (iii) they act as collateral in case of a liquidation scenario. It was Knight (1921) who cautioned us that '[w]e must remember that the two things, uncertainty-bearing and responsible control, are inseparable.'

For investors to support an entrepreneur with equity, two elements play a crucial role in coping²² with uncertainty (i.e. to make an informed judgement in the face of uncertainty).

¹⁹ Whether a bank lends to a particular country very often depends on whether they have established a retail presence in the local market and can provide funding in local currency. In this sense, the bank's headquarter has taken the fundamental decision that they are comfortable with a country's sovereign rating. A local retail and commercial banking presence yields a huge competitive advantage *vis-à-vis* other banks as lending can be provided in local currency.

²⁰ The fact that banks are able to quantify and spread risks across their asset portfolio must not fool us. Despite sophisticated probabilistic assessments, credit and portfolio decisions are still subjective in nature to a significant extent. If that were not the case, banks would not have to compete with each other. However, in the end the quantifiable nature of credit risk leads to a significantly lower risk exposure of banks compared to equity capital. The much higher risk spreads for the provision of equity capital support this observation.

²¹ According to Klein (1999), the Austrian School distinguishes between uncertainty-bearing (entrepreneur-promoters) and ownership (capitalist-entrepreneurs). For Klein, the driving force behind the market economy is the capitalist-entrepreneur who risks his money capital in anticipation of future, uncertain returns. This is a somewhat narrow interpretation of reality in that the capitalist-entrepreneur – nothing else than an equity provider – usually would only consider an investment if the promoter either has already created an assessable value or the promoter contributes his own equity.

²² The verb 'cope' is probably best suited to describe what entrepreneurs do in the face of uncertainty. The notion of somebody being able to *manage* uncertainty contradicts the nature of uncertainty. Men *face* uncertainty as something unexpected can occur at any time. Entrepreneurs *cope* with uncertainty in the context of their

First, the reputation of the promoter is assessed based on his professional track record and knowledge. This also includes soft factors such as the sponsor's business ethics, e.g. his treatment of business partners and employees, and his recognition as an expert in the industry. Second, investors will always require the sponsor to inject their own capital. This is the famous 'skin in the game', which exerts a disciplining effect on the sponsor.²³ In his instructive historic analysis, Eichengreen (1995) makes the point that the funding of US railways in the middle of the nineteenth century was raised relying on personal relationships as a mechanism to overcome information gaps and cope with uncertainty.²⁴

Hence, in order to cope with the uncertain nature of the entrepreneurial opportunity, the participants made heavy use of the two mechanisms described above: soft factors, such as reputation, and skin in the game in the form of capital injections by sponsors. The knowledge in respect of the best financing structure and the institutions to govern the roles and responsibilities of finance parties have emerged (and continue to emerge) as a by-product of transactions. Even for a given transaction that has achieved financial close, the unforeseeable nature of market developments constantly leads to amendments to the contractual structure: existing shareholders leave, new ones join, the tenor of a loan is extended, stand-by equity is called upon, and debt tranches are syndicated or converted into fixed-income instruments. In general, the contractual regime that governs transactions is subject to constant adjustments, depending on changed circumstances on the project, sponsor and lender side. In this sense, the technique of 'project finance' (as other funding mechanisms) is nothing else than a market outcome itself – a result of a long 'learning curve' based on experience collected in hundreds of infrastructure transactions that have finally crystallised in an understanding of how to structure and govern infrastructure projects. Most project finance transactions are based on the Loan Market Association (LMA) standard, an English-law-based legal blueprint tried and tested to which legal and commercial practitioners adhere.²⁵ As a consequence, if an infrastructure transaction cannot be financed based on a purely commercial basis, there are always compelling reasons why this is the case.

The ethical dimension of private funding, of both debt and equity, is best approached by shedding light on the negative consequences of public credit support or funding. Credit support can either be granted by local governments in the form of treasury guarantees, thereby creating a contingent liability, which presupposes that lenders are comfortable with the sovereign rating, or by a credit-enhancement instrument provided by an Multilateral Development Bank (MDB). For the sake of the argument, let's assume that the World Bank provides a political risk insurance (PRI) for an infrastructure project finance transaction in Mozambique. The PRI policy is a credit requirement of the private banking consortium,

particular market. *Coping* with uncertainty is facilitated by incentive mechanisms, often of contractual nature, which exercise disciplining behaviour and rule out irresponsible actions.

²³ Usually, sponsor equity is a mix of monetary capital and sweat-equity, i.e. time, labour and collateral.

²⁴ 'Where contract enforcement was problematic and information was difficult to verify independently, the markets made heavy use of such links. Friends and associates vested their confidence in individual financiers with reputations for honest dealings, who signalled their commitment by putting their own funds at risk. [] Local farmers, bankers, merchants, landowners, contractors, and manufacturers subscribed the majority of New England's early railway shares. Not only did such individuals have favoured access to information, but they stood to benefit from the transportation links. [] That these projects were relatively modest (they connected Boston with nearby Portsmouth, New Hampshire, or Providence, Rhode Island) facilitated the local mobilisation of capital.' Eichengreen (1995).

²⁵ The Loan Market Association was established in 1996. See www.lma.eu.com.

which was not comfortable with the low sovereign rating of the country given the magnitude of lending and the long tenor of the loan. Furthermore, the MDB has agreed to provide itself a tranche in the form of a junior loan facility with a significantly longer tenor than that of the commercial banking syndicate, thereby reducing the average loan life of commercial lenders. As a result, the involvement of the MDB reduces the risk premium (and capital reserve requirements) of the lenders and improves the IRR of the investors.

We cannot analyse the vast literature of what might present a moral justification for certain ethical claims. However, we can determine the consequences that arise as a result of the above funding structure: foregone entrepreneurial opportunities of local participants, stifling of the development of the institutional framework and artificially low pricing financed by international taxpayers. In essence, any ethical claim must be rooted in an understanding of man's wellbeing and the freedom to subjectively choose the most suitable course of action.²⁶ In an uncertain world, this claim extends to future entrepreneurial opportunities impeded by public planning and interventionism. In this context, economic policies deal ultimately with values and choices (ethics is the attempt to understand values).²⁷ Public policies in the form of the above illustrated credit enhancement instruments are likely to render (unintended) consequences of an unethical nature in that they destroy economic opportunities – thereby negatively affecting the wellbeing of the local population – and cement inefficient or coercive local politics and institutions. We will briefly illustrate six channels through which the (future) wellbeing is impeded.

The first effect is the stifling of local entrepreneurial opportunities. Local populations want to buy flat-screen TVs, smart phones, cars and housing. They want to educate their children and invest in their health. And they make plans to achieve their goals. In the eyes of the MDB development expert, this happens painstakingly slow (or not at all), but this does not provide for a justification to leapfrog bottom-up development. Local entrepreneurs offer transport, provide power through generators and arrange access to water. It's doubtful whether national and international public funding is able to plan the infrastructure required to accelerate the development process. In a report on 'Financing Development' issued in 2013, the World Bank states: 'Given the scarcity of bank lending for infrastructure, the development of non-bank financing for infrastructure is now emerging as the new imperative. International financial markets present a largely untapped pool of capital to finance infrastructure, and institutional investors have the potential to provide an additional source of long-term finance.' The question is why this untapped pool is not already financing infrastructure. The authors are referring to infrastructure bonds that, however, would only comprise projects from countries with a minimum sovereign rating. The hope that institutional investors will inject capital into infrastructure in non-rated markets is very optimistic at best.

Second, large subsidised infrastructure programmes bear the risk of creating institutional frameworks that run counter to the existing institutional arrangements of the resident population. All success stories in emerging markets such as in China and South Korea are

²⁶ Broadly, ethical claims can be based either on utilitarian or rights-based moral theories. Hansson (2003) purports that neither of the two approaches have the means to deal adequately with the moral problems of risk.

²⁷ In the aftermath of the subprime crisis, a vibrant discussion of the ethical nature of fractional reserve banking and ZIRP policies has kicked off. See Bagus and Howden (2013), Block and Davidson (2011), Barnett and Block (2009).

based on local capital and institutions.²⁸ Research suggests externally driven interventions are unlikely to fundamentally alter patterns of social interaction in a community, and that institution-building is a slow and necessarily indigenous process. Scholars have argued that norms of social interaction are an outcome of long-run evolutionary mechanisms.²⁹ Among the problem-solving capacities of existing institutional networks are powerful contractual enforcement mechanisms, including the enforcement of non-collateralised credit contracts.³⁰

Third, capital markets present a particularly important set of institutions for economic development. Financial institutions such as banks assume the role of intermediating between local savings and investment. The monetary system represented by central banks and regulatory bodies play a crucial role for a stable economic framework. In many sub-Saharan countries, these institutions are mainly working in favour of governments. High inflation inhibits long-term funding and the development of a local credit market with longer debt maturities (which are required to fund infrastructure). Risk premiums are very high and make borrowing prohibitively expensive. Restricted access to hard currency is a daily problem for entrepreneurs engaged in import and export markets. International investors are unable to tap into local credit markets and are unwilling to assume the exchange rate risk of highly volatile currencies. For these reasons, the promotion of capital market development was actively encouraged by international organisations and standard setters such as the IMF, the World Bank, and the OECD.³¹ Countries can benefit from international best practice in developing their financial sectors. The savings base, however, can only come from the local population. Subsidised international lending in hard currency circumvents the local capital base and stifles the development of local credit markets.

Fourth, it's a recognised fact that interventions abet corruption and rent-seeking behaviour of politicians, bureaucrats and management of public and private enterprises. Moyo (2009), who has launched a much-discussed attack on international (aid) interventions in her book *Dead Aid*, stresses that international interventions breed dependency and further stifle local initiative.

A fifth category refers to dangers of moral hazard and adverse selection on the part of the construction companies. Credit enhancement leads to lower credit pricing, longer tenors and higher leverage factors, all of which increase the net present value of sponsors' equity, but present significant risks of building over-dimensioned and underutilised infrastructure at the expense of taxpayers. Managers of construction companies will be tempted to present big-bang type of infrastructures (moral hazard) or propose (more costly) technologies not suitable to the local market (adverse selection).

Finally and sixth, credit enhancement mechanisms or the funding of infrastructure projects increase the credit exposure of the taxpayer in MDB member countries that will

²⁸ The conduciveness of the cultural environment for economic development has begun to be recognised by scholars. See Jones (2006): 'It is simply a fact that ethnic groups differ in their economic performance []. There was an embarrassing gap between the market-related successes of East Asia and the failure of the interventionist policies recommended to unfortunate regions like sub-Saharan Africa.'

²⁹ See Bowles and Gintis (2004).

³⁰ See Udry (1994).

³¹ Local bond markets have often been developed by governments in cooperation with international institutions, with a view to facilitate the placement of longer dated government paper at local banks to finance large fiscal deficits. Such directed lending to government by banks as a captive domestic audience is a form of financial repression that gives rise to an excessively close connection between government and banks. Such and other policies withdraw scarce saving capital from credit markets and prevent local capital markets from developing. See Laeven (2014).

eventually lead to increased taxes or higher public indebtedness. The recourse-nature of MDB credit instruments is nothing else than a bailout mechanism. The taxpayer not only funds potential failures and too costly or oversized infrastructures that are not aligned with local demand, but also finances a return on sponsor equity that wouldn't have arisen based on risk-adjusted credit pricing and a commercial collateral structure. From an ethical perspective, this is certainly an undesirable result.

All six repercussions have a common denominator in that international development professionals overestimate their knowledge and expertise and what they can realistically achieve. In *The Tyranny of Experts*, William Easterly (2015) warns against indulging in the fatal conceit that top-down policy programmes know better how to achieve economic development than plans initiated by the local population. Nobel Prize laureate Angus Deaton, in his response to Easterly, also damns the technological illusion that development is an engineering problem. But he also makes the valid point that 'we are not completely ignorant about the effects of policies, especially of harmful policies'. The knowledge of experts can assist to shape better policies and design better technical solutions. Yet, he warns that:

Aid undermines the contract between government and the governed that is essential for successful development. If, as is the case in a substantial number of the world's poorest countries, many of which are in sub-Saharan Africa, the state can meet most of its funding from foreign aid agencies, it can safely ignore the demands of its own citizens.³²

A powerful industry of highly paid experts has been created. Many funding mandates of lending institutions and private equity providers are – to a large degree – built on public credit mitigation instruments. Based on the well-intentioned hope that benefits trickle down to the poor population, international funding is designed to circumvent the pitfalls of inefficient and corrupt governments.³³ However, the nature of entrenched interests often leads to the same result that the ultimate beneficiaries are government officials. It's a vicious circle of detrimental effects that few risk to criticise. Lack of infrastructure is attempted to be cured by subsidised credit, which stifles local initiative and in turn materialises in the form of immature capital markets and institutions, and, consequently, results in calls for more subsidised credit, thereby reinforcing inefficient and corrupt structures in government and public enterprises. Pragmatic policymakers might see a trade-off between a positive developmental impact (which is questionable) for the entire population and the unavoidable promotion of the interests of a few. From an ethical perspective and given what we have discussed in this chapter, that's indeed a tough call to make.³⁴

We conclude that market-based financial risk-bearing supports two important ethical virtues inherent to the free market system. Not to overestimate one's powers and knowledge

³² See Deaton (2015).

³³ In line with the mentioned development stages approach, donor countries had launched ambitious projects based on direct investments and conditional loans extended to governments. After this first wave of *development* assistance had failed to stimulate economic development, the industry moved on and adopted a stronger focus on the financing side (which has bred an entire industry of finance professionals employed by the tremendously bureaucratic MDBs and DFIs).

³⁴ Some publications entertain notions of global public goods. This extends the questionable concept of 'public goods' to the world. Yet, no method has been established to ascertain the social gain or collective utility by providing goods publically.

is the first virtue. Policymakers have to apply utmost scrutiny to justify their decisions to intervene, in particular they have to be able to explain on which basis they derive the conviction that a public policy approach yields better results than a local, decentral action. Malinvestments in infrastructure come at an enormous cost, which have to be borne by the taxpayer and the local population in the form of foregone opportunities. The second virtue is the assumption of responsibility for one's action. A market solution ensures that financial risks are allocated to those parties who are capable of and willing to bear those risks by pledging their ownership capital, vouch with their reputation and lend at prices that reflect market risks. It ensures that potential losses or residual risks shall not be borne by any other parties than the ones involved in the transaction. It's often read that 'competition is not an end in itself'; irrespective of the results the ethical dimension proves that it actually is.

4.2. Disciplining effects and constructive stress

Linked to the virtue of taking responsibility and assuming financial risks (and uncertainties) is the benefit of the 'disciplining character' of the commercial funding process, which arises as a corollary due to the distinct nature of the involved funding parties' commercial interests. We will explain this by providing the following example: An international petrochemical company (the sponsor) has agreed to build a liquid fuel storage facility close to the harbour in a Kenyan coastal town to stabilise the supplies to its petrol station network and wholesale customer base. The sponsor has agreed to provide an off-take agreement based on the investment grade rating of their company on a take-or-pay basis. A large international construction company (the EPC provider) with an investment grade rating will deploy the infrastructure on a turnkey basis. Lenders have expressed interest and a syndicate of three banks has signed a mandate with the sponsor to fund the project at a debt to equity ratio of 65 %:35 % based on limited-recourse funding principles. In line with market practice, the lenders' final credit approval is subject to a satisfactory outcome of the due diligence process and all project parties agreeing to a 'final lenders financial base case'. With the help of international consultancies renowned for their expertise in assessing storage facilities, lenders will verify the underlying assumptions of all subject matter areas, i.e. regulatory, environmental, commercial, technical, geological and social, and the financial viability of the cash flow profile as proposed by the sponsors (based on the quotes of the EPC provider). During the due diligence process, the fundamentally different nature of the commercial models of sponsors, lenders and EPC providers will exercise 'constructive stress' on the three parties.

Typically, lenders will attempt to allocate all market and construction-related uncertainties to the sponsor and EPC provider to the greatest possible extent. The EPC provider has agreed to a performance bond of 10 % of the construction cost as well as to market-standard liquidated damages to cover for construction delays. However, after the due diligence process has been completed and the lenders have applied more conservative assumptions than the sponsor based on their expert's advice, the debt service cover ratio – the project's ability to meet debt service at every point in time during the repayment period – turns out to be below the minimum requirements of lenders.³⁵ The sponsor argues that a

³⁵ On average, default debt service cover ratios (DSCR) range between 1.2x to 1.3x times the debt service during the repayment period depending on the risk profile of the project.

higher off-take price is not commercially viable given the prevailing low oil spot price, but is contemplating stand-by equity facilities and the execution of hedging instruments. Furthermore, the sponsor has suggested reducing the initial size of the storage facility, so that the investment costs decrease from \$150 million to \$100 million. The lenders' technical advisor and EPC provider both confirm that additional storage tanks added at a later point in time would not result in technical inefficiencies and undue cost increases. The lenders indicate that the additional risk mitigants and reduced funding size would satisfy their credit requirements.

The above-illustrated funding process can easily take one to two years, often longer, but this time is well spent³⁶. Ultimately, the project parties not only accomplish to agree on the funding schedule and a market-based allocation of the various risks and uncertainties, but also create the psychologically important buy-in of all parties.³⁷ In long-term project finance transactions, construction, supply, off-take and concession agreements, are used to align incentives and deter opportunistic behaviour by any party involved in the project. The variety of project risks is allocated to those parties best suited to appraise and control them, for example, construction risk is borne by the contractor and the risk of insufficient demand for the project output by the off-taker.³⁸

A second – very likely – scenario could have resulted in the following structure: based on their mandate to foster economic development in sub-Saharan Africa, the multilateral development institution IFC agrees to provide a junior loan facility based on which the debt-to-equity ratio decreases from 65 %:35 % to 55 %:45 %. This allows the project to roll out the initially planned full size of the facilities at an investment amount of \$150 million. Another scenario would be that the European EPC provider approaches the host country's Export Credit Agency (ECA) to provide a commercial risk insurance based on their high credit rating. As for the second scenario, this instrument also deters the project parties from finding a purely commercial solution. The creative process of structuring a funding solution according to the specific risk patterns of the project is disrupted. Instead of constructive stress engendering its virtues, in both cases taxpayers are now exposed to project risks.³⁹

The above-described disciplining nature of private funding processes is further reinforced by 'constructive stress' between the project parties all acting in unison to achieve financial close. The inherent conflicts that arise as a result of the stakeholders' divergent commercial interests⁴⁰ create a tension between parties, which is a well-known phenomenon among project finance practitioners and trusted upon as a mechanism to align the different

³⁶ When projects based on limited-recourse finance principles are structured the first time in a particular country, the legislation required to accommodate the deal is often drafted in parallel. In those cases, the process until reaching financial close easily takes five years and longer.

³⁷ Project parties often work together for ten and more years. Reaching financial close and successfully operating the financed infrastructure create lifetime relationships and provide for the basis of future projects.

³⁸ See Sorge (2004).

³⁹ To the knowledge of the author of this paper, economic research has not dealt explicitly with the disciplining effects rendered by market-based infrastructure financing processes *vis-à-vis* government (supported) funding structures. Research on the disciplining nature of markets seems to be confined to specific macroeconomic topics, for instance variations of national interest rate spreads in the context of the fiscal discipline imposed by the European Monetary Union on their members, and regulatory questions, e.g. the structure of the national regulatory framework governing the finance industry. However, a microeconomic analysis from the viewpoint of transaction participants shall yield important theoretical and practical insights. For instance, budget deviations of purely privately financed infrastructure projects could be empirically assessed and compared to those of government projects.³⁹ Likewise, maintenance cost and reinvestment levels could be analysed.

⁴⁰ Those commercial interests often find their expression in so-called mandates. See Chapter 5.

incentives of project parties. We have to be clear that a market-based risk allocation does not prevent projects from failing. Private parties face the same uncertainties governments do. The major difference between government-supported structures and private funding is that, in the latter case, those uncertainties are borne by the parties most suitable to cope with them (and who are willing to pledge their equity injections). Second, as a consequence of a market-based risk allocation, projects invariably undergo an exercise in rightsizing. With ‘rightsizing’ we shall describe the process that ensues in purely commercial funding transactions due to fundamentally different commercial models and interests of the involved parties. In most cases, the rigid risk-mitigation requirements of lenders in tandem with the generally conservative nature of commercial lending leads to a recalibration of cash flows on a lower level. The sponsor and EPC provider are required to adapt their costing estimations and revenue forecasts resulting in a smaller project than the one initially proposed by the sponsor.

In the case of government funding, bureaucrats do not dispose of the knowledge and tools to replicate the results, which purely arise as a consequence of commercial project parties mitigating risks and uncertainties. In contrast, the much-hailed PPP schemes always involve private contractors and commercial lenders, but public off-takes, implicit and explicit sovereign guarantees and less rigidly challenged construction contracts greatly relax the concerns of the involved parties. Hence, risks that private project parties would have sought to mitigate by contractually allocating risks to the project participants according to their ability to bear them, are now offloaded to the state’s balance sheet. In addition to the distorted incentive structure, the likelihood of building a too large and costly infrastructure is high. Rightsizing infrastructure is best assured if the user-pays principle guides the financing and funding process. Ministries, and particularly PPP bodies, have an intrinsic interest to successfully complete transactions and are unlikely to create the constructive stress required to achieve the best solution. Public offices are likely to agree to projects that would have been unacceptable for parties in a private transaction. If we read articles from European and American journalists in public media, as well as reports from professional bodies such as the ASCI, that see their countries’ infrastructure as crumbling, we might eventually conclude that they are right without recognising the reasons and who is to blame.

The entire literature on infrastructure funding suffers from one fatal flaw: the accomplishment of funding for an infrastructure project is erroneously regarded as a discrete decision. By reducing the complex process of achieving financial close, which easily takes more than a year, to a simplistic yes-no question ignores the disciplining character of private capital, be it debt or equity, and the merits of constructive stress in achieving a favourable outcome, that is an infrastructure project with appropriately allocated risks and uncertainties to the project’s stakeholders given their respective mandates. More research is required to investigate the virtues of private funding from a process perspective.

4.3. Technology and financing structures

Finance professionals in lending institutions have to understand the technological specifications if they are to fund an infrastructure project. To assess credit risk, all finance parties have to analyse in detail the maturity of a specific technology, the lifetime of use given the specific asset class and their susceptibility to technical failures. The first step is to conduct a technical due diligence for lenders’ finance transactors to be able to present a funding opportunity to their credit committees, where it will be finally assessed whether the

respective asset is in line with risk appetite and the mandate of the institution. It is important to understand that the mandate of a bank varies widely based on in-house technical expertise, past experience with different assets classes and the degree to which certain market risks are borne. Only once credit approval is obtained can legal and commercial agreements, which will govern the allocation of risks and responsibilities between the project parties during operational life, be drafted and negotiated.

In times of rapidly changing technology cycles, profitable markets quickly become contested. Assets are bound to lose their value or become obsolete as a result. Furthermore, meta-technology trends such as digitisation of the economic system affect all sectors. Driven by the pace of technological diffusion and increasing degrees of interconnectedness between economic sectors, we witness an ever more complex division of labour with underlying dynamics that no individual or institution is able to fathom. Given these dynamics, it appears increasingly questionable for state institutions to engage in long-term infrastructure projects as they neither dispose of the knowledge, nor the incentive mechanisms required to guide their economic decisions. The tremendous success of mobile telephony across the globe is the sole function of international competition for the best technologies and commercial solutions in all areas of the value chain: semiconductors, radio technology (from 2G to now 5G), long-distance data transport, data compression, spectrum utilisation, traffic management, billing platforms (prepaid), end-user devices and many more.

Any project proposal has to be made intelligible for finance parties to assess risks and rewards. This task falls to the financial model, the project's cash flow projection aggregating inputs from all project parties, e.g. commercial, technical, tax, environmental and financial. The financial model is then sensitised to its robustness to absorb adverse events, e.g. longer construction periods, higher operational costs or market shake-ups. The following selection of categories largely determines the risk profile and funding patterns of infrastructure projects:

Table 1: Lender Credit Policy and Risk Mitigation Instruments

Risk Category	Lender Credit Policy	Mitigation Mechanism
Technology Risk	Mature technology with proven track record	Renowned EPCs; performance bonds and liquidated damages
Market Risk	No (or limited) pricing/revenue risk	Off-takes, e.g. take-or-pay contracts, feed-in tariffs
Sovereign Risk	Rated countries only	Sovereign guarantees from governments or MDBs
Tenor	Maximum tenors based on technology and country	MDBs provide funds exceeding commercial lender tenors
Legal/Regulatory Risk	Market with mature institutional environment	Political risk insurance from public or private underwriters
Environmental/Social Risks	Due diligence based on World Bank principles	Equator principle-based assessment, social impact study

Source: Own classification

Except sovereign risk, all other risks are fundamentally determined by the specific technology that, in turn, determines usage patterns of buyers. By way of illustration, project funding in telecommunication projects rarely exceeds a seven-year tenor and involves complex contractual mechanisms to shield lenders from market risk due to the competitive nature of ever-changing ICT markets. In contrast, energy generation projects usually require funding tenors between fifteen and twenty-five years, sometimes longer depending on technology, but are less complex on the revenue side as energy utilities provide binding off-take contracts that protect lenders from market risks.⁴¹ It's generally easier to raise funding for short tenors of ICT projects compared to those requiring twenty-year tenors. This is one of the reasons why mobile telecommunication networks were so successfully rolled-out in even the poorest countries and attracted private equity funding easily. In energy generation – and particularly energy distribution – finance is still largely provisioned by public funds or supported by state guarantees. Water and sewerage infrastructure, to mention the worst example, is still largely seen as a natural monopoly, a view that inevitably excludes market players from implementing technological innovations and intelligent funding mechanisms.⁴²

Curiously, most economists appear to evade deeper examinations of technology questions and chitchat about the rather intangible concept of innovation. On a holistic level, the concept of innovation may well help to gain a better understanding of the dynamics and disruptions of markets, however, to understand the specific underlying drivers of change, investment patterns and financial solutions, it is entirely useless.

We have seen that financing and funding solutions are a function of technology. We will now turn to a second problem that is regularly excluded from the economic discourse when

⁴¹ The practice of public utilities providing such long-term guarantees to power generation plants is critical for many reasons, but is about to come to an end. More decentralised, flexible and cost-effective technologies based on gas and renewables are in the process of challenging the old utility concept of a monopolised energy provider based on centralised distribution networks and humongous nuclear and coal generation plants.

⁴² The funding for both, electricity and water markets, is still a function of public budget considerations around the world. By decoupling funding (user-pay-principle) and financing (investments) a rational, sustainable allocation of resources remains unattainable.

discussing the merits of public versus private funding: the preservation of long-term asset values. When the public acts as a finance provider for infrastructure projects, its representatives are not guided by the same incentives as entrepreneurs are. The core commercial incentives of entrepreneurs are profit-seeking and asset-value generation. Shareholders always have to strike a fine balance between dividend disbursements and reinvestment as to secure or improve the company's market position and, hence, its long-term asset value. If the public runs infrastructure, the decision-taking responds to entirely different incentive mechanisms based on availability and allocation of tax proceeds, priority in terms of political agenda, public borrower's indebtedness levels, national versus regional interests etc.

By way of example, we assume that a public service provider's revenue collection meets the requirements to cover operational and maintenance costs, unlike other public utilities plugging holes continuously. In such a situation, an investment proposal into a technology, which would improve service levels drastically and yield a future-proof technological solution leading to a more economic usage of resources, would most certainly be procrastinated until the responsible public manager presents a more compelling case based on deterioration of assets, technical failure, customer complaints etc. The public does not follow long-term profit motives, neither does it record asset values and conduct impairment tests to testify the recoverability of assets. Hence, public managers are ignorant in terms of asset values and the timing of reinvestment cycles. Finally, no shareholder is available to force the management of the utility to evaluate the merit of investment projects or to undertake fundamental technological shifts.

In a private entity, incentives lead to entirely different courses of action. To illustrate the dynamic interplay of finance solutions, technology implementation and shareholder incentives, we will present the case of Seacom, a South Africa-based telecommunication company that started off in 2007, constructing the first privately owned and funded submarine cable on the African continent.⁴³ At that time, international connectivity to access the Internet content hubs in Europe and the US was monopolised by South Africa's public operator Telkom operating the only submarine cable. As a consequence, user-experiences were appalling and international bandwidth prices prohibitively high. A private equity-led consortium in cooperation with commercial lender Nedbank, a listed South African bank, developed a funding solution along project finance principles based on long-term revenue off-takes from international carriers desperate for affordable bandwidth in order to provide their local subscriber base with affordable data products. It's not an exaggeration to say that this one project not only had a revolutionary effect on the development of African telecommunication markets, but also sparked intense competition following the roll-out of three additional submarine cables along African coasts.

The debt financing provided by Nedbank was based on a seven-year tenor with a high-risk premium, which was due to the fact that this was the first project of kind and there was no experience that could have been drawn from similar projects. After not even four years of tremendous market success, Seacom's shareholders approached Nedbank to replace the expensive, inflexible project finance structure with a revolving credit facility for Seacom to

⁴³ The author of this paper has been involved in all stages of the project. First, consulting as commercial and technical advisor during the initial due diligence process, then as Nedbank's lead transactor in the subsequent refinancing.

introduce new technologies to accommodate their further market expansion. Nedbank could have insisted that Seacom fulfils its obligations under the project finance contract before discussing new strategies and technology implementations, but given Seacom's success and the principle commercial funder's interest to retain long-term client relationships, Nedbank conceded to a flexible credit instrument from which the borrower could draw funds at will – as long as agreed upon financial and commercial covenants were met.

One of the new technologies implemented by Seacom (and all other carriers in the market) was a dense wavelength division multiplexing (DWDM) system enabling the bidirectional use and the manifold multiplication of capacity of a single strand of fibre. A multiplexing device splits the optical laser signal in up to 96⁴⁴ signals by assigning each signal a different wavelength. In effect, one fibre is transformed into multiple virtual fibres, thereby greatly increasing the capacity of the existing network without touching the actual submarine cable buried in the seabed. Within a few years the resulting capacity increase had two major market effects. First, on the demand side, the once-expensive, scarce international connectivity is now being offered at a fraction of the former price, making data bundles more affordable for subscribers. Second, telecommunication carriers and other data-hungry enterprises not operating an own submarine cable are no longer forced into signing long-term off-takes contracts to secure international bandwidth, but now lease capacity on a short-term basis and receive more bandwidth at ever decreasing prices each time contracts are up for renewal.⁴⁵ At the moment, the aggregated capacity of international bandwidth available will exceed demand for years to come, effectively leading to a situation where the marginal cost of an additional gigabyte sold is zero.

Shareholders of Seacom, cognisant of the disruptive nature of DWDM, have again changed course to protect long-term shareholder value. Facing the danger of being reduced to a data commodity supplier subject to ever decreasing margins, in 2015 Seacom's board decided to complement their business model by offering fibre connectivity to businesses in large South African cities to capitalise on their unique market position of owning a submarine cable. Nedbank and Seacom undertook another refinancing exercise, converting the five-year revolving credit facility back into a longer-term debt instrument. A three-year grace period on principal repayments was agreed upon to accommodate the high short-term investment outlays required to roll out the infrastructure and quickly capture market share in an already competitive market.

To analyse the likely behaviour of public stakeholders in a similar project setup, let us ask the following three questions. Is it realistic to assume that a public service provider would follow the same course of action as the one forced upon Seacom's shareholders by the twist and turns of technological progress and market pressure? Would public managers take the risk of fundamentally altering the operator's market strategy and request for additional public funds when the company is actually doing very well? And finally, would the public service provider's shareholders, i.e. the taxpayers, benefit equally from a commercial lender's credit review process, resulting in a suite of negotiated commercial agreements that

⁴⁴ Current state of technology. Both the multiplexing capability and the data capacity per wavelength undergo rapid innovation cycles.

⁴⁵ It's only a matter of time until spot markets for international bandwidth – as there are for voice telephony minutes since twenty years – will further relax the need for binding contracts.

enable the borrower to implement its strategy and yield a risk-mitigating monitoring regime imposed by commercial lenders?

There are no grounds based on which we can rule out the possibility that a public service provider successfully manages a public entity. That said, considering the fundamentally different incentive mechanisms at work in private and public entities, a firm triple *no* seems well-justified. Public entities have a ‘commercial’ bias for the creation of new infrastructure opposed to ensuring operational excellence and perform a market-driven lifecycle management. Furthermore, the political and organisational nature of a public entity is unable to benefit from the disciplining nature shareholders exert, not least due to the fact that public entities lack reliable information about market values of their assets. If at all, incentive systems of public managers work towards maintaining an asset above its useful life, which in practice regularly leads to draining public funds into obsolete infrastructure. Lastly, the competing nature of public funds is always at danger to lead to decisions guided by short-term political objectives opposed to intrinsic motivations of shareholders to capture new markets and increase asset values.⁴⁶

The Seacom case has exemplified the strong technological nature of strategic and finance decisions. The characteristics of infrastructure investments and the respective custom-fit funding solutions differ fundamentally from each other, often within the same sector, too. We conclude this section by stressing the illuminating fact that public utilities, particularly in the energy and telecommunication sector, always were vertically integrated companies. State-protected monopolies led to severe inefficiencies borne by the taxpayer. Vertical integration successfully ensured that the utilities’ monopoly-based market power would stretch across all elements of the value chain, i.e. from production at the earliest stage to provision of end-user services. As a consequence, technological progress in the telecommunication⁴⁷ industry was virtually absent between the early twentieth century and the late 1980s. Innovation efforts by external supply chain providers are simply not incentivised if markets for final consumer products are not exposed to competition. In contrast, the technology revolution, ignited by hundreds of successful companies in the ICT sector during the last twenty years, was solely based on entrepreneurs striving to develop new technologies and products satisfying consumer demand.

5. Conclusion: The institutional dimension

Infrastructure is as much a result of as a basis for economic prosperity and human wellbeing. It rightfully attracts the interest of policymakers, lending institutions, entrepreneurs and consumers. They are among the most complex investment projects due to their long-term and costly nature. Ultimately, users of infrastructure services have to fund the initial investment, operation and financing cost. To ascertain the financial feasibility of infrastructure projects, stakeholders have to understand the nature of market institutions. So, when we assert that public infrastructure funding will fail as a panacea for economic development, then we do so

⁴⁶ Though the managerial setup of stock-listed companies also leads to short-termism.

⁴⁷ Apart from the invention of fax-services, technological progress would manifest itself solely in smaller user devices, from operator-based, bulky wall-mounted phones over smaller ones equipped with a dial-plate to phones with number keypads.

based on the observation that policymakers, public lenders and macroeconomists exhibit an incomprehensive understanding of the market process and how its underlying institutions assist action in society through time.

Generally, all market action is guided by social institutions understood as regular pattern of behaviours exercised by different groups of market actors. Actors only follow specific patterns of behaviour if they can attribute a benefit to the expected outcome – very often based on experience. Hence, institutions constitute a form of knowledge capital that allows market participants to reliably coordinate and align their actions, expectations or plans with some measure of success.⁴⁸ Foss and Garzarelli (2007) distinguish between internal and external institutions. The latter are of codified nature, i.e. formalised institutions such as property right frameworks, company acts or financial market legislation that govern the latitude of individual actors. Internal institutions provide structures that facilitate human action, for instance the specific organisation of a firm. The better codified institutions align with internal institutions, the more reliably market actors can pursue their entrepreneurial plans. In financial markets, all players are guided by what is called a ‘mandate’. Mandates constitute an intra-firm behavioural framework that set out the limits of individual decision-making based on the risk profile and expectations of shareholders. When project participants negotiate the terms of an infrastructure deal, their specific mandate determines return expectations, asset class, exposure levels, acceptable political risk and the form of engagement, e.g. some banks prefer to act as lead arrangers, others only participate in syndicated structures. The assessment of country risk, generally following rating agencies, assumes a filter function at the outset of a decision process and excludes many markets from being considered (unless credit-enhancement instruments are available).

Comparatively low levels of infrastructure can be reliably ascribed to both institutional shortcomings and lack of economic resources. Formalised institutions in many countries are not sufficiently mature as to allow private finance providers to assume the long-term entrepreneurial risks associated with infrastructure projects. At the same time, the absence of privately financed infrastructure in itself demonstrates an insufficient economic base. Low economic wealth levels and weak formal institutions in most cases are two sides of the same coin (and the reason that countries are trapped in poverty and stagnation). From a dynamic perspective, however, formal institutions arise with economic progress fuelled by entrepreneurs actively shaping the institutional environment according to their needs. In this sense, institutions – just as infrastructure – are themselves a result of the market process. Thus, we dare to contend that if sufficient users were able to pay for the services and the savings base could accommodate long-term infrastructure investments, entrepreneurs would already have created the formal institutional environment to attract the funding required for the implementation of their plans.

The merits of efforts by multilateral development banks to help create crucial formal institutions, e.g. property right frameworks or capital market regulation, are widely shared. If the legal framework can be aligned with international best practice, private investors will be more inclined to pursue opportunities. However, this does only tackle one of three problems. The second issue, as discussed, lies in the fact that user-based revenues very often appear to be insufficient to support long-term and costly investments in infrastructure. Instead, it has become fashionable for policymakers to blame low levels of infrastructure on funding gaps,

⁴⁸ Foss and Garzarelli (2007).

which, at the same time, provides for a justification to leapfrog the market process. This leads us to the third problem. The pursuit of public projects means that the superior knowledge of entrepreneurs is not utilised and that the disciplining effects of market-based financing processes cannot unfold. We have given examples to demonstrate the dynamic – and fundamentally unforeseeable – nature of the market process and how financial market participants adopt their actions in line with their mandate. To raise infrastructure finance and agree on a funding structure is not a discrete event, but a complex process during which important information that guides actors in the pursuit of finding a commercial structure in line with their respective mandates is generated. The fundamentally distinct nature of mandates of commercial lenders, equity providers and construction companies engenders the necessary disciplining effects for the parties to agree on the technical, commercial and financial layout of the project. In addition, the resulting legal documents spell out obligations and undertakings, such as reporting mechanisms or events of default, that regulate the behaviour of project parties until final debt repayment. Funding solutions of infrastructure projects are not a shelf product, but determined, to a significant extent, by technical features. However, new technological developments always put pressure on existing entrepreneurial plans and affect funding structures. Private finance institutions are best able to meet the resulting entrepreneurial requirements in a timely and mutually beneficial fashion as exemplified by the Seacom example. In the end, for the solutions achieved to be socially and economically viable, individual human action will have to conform with generally accepted ethical principles that guide our behaviour.

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