PRIVATE INFRASTRUCTURE AND THE MACRO ENVIRONMENT

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Table of Contents

1 / Executive Summary.............................................................................................................3
2 / Strategic Insights.................................................................................................................4
3 / Analytical Framework ........................................................................................................5
4 / Infrastructure Benchmarks and Economy........................................................................6
5 / Demand Fundamentals and the Economy........................................................................7
6 / Capital Structure and the Economy ..................................................................................11
7 / Portfolio Optimization by Macro Scenario.......................................................................14
   7.1 Macro Value Drivers of Core and Core Plus Strategies...............................................14
   7.2 Macro Scenarios and Portfolio Construction.................................................................15
8 / Appendix..........................................................................................................................17

Important Information .............................................................................................................18

Research & Strategy—Alternatives.........................................................................................22

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1 / Executive Summary

— To optimise their strategies, institutional investors are increasingly interested in understanding how private infrastructure may perform throughout a period of market volatility, in an economic downturn, or if inflation and interest rates change. They typically approach this complex question by focusing on the historical correlation between changes to the macroeconomic cycle and total returns for a private infrastructure benchmark. However, for a complex and diverse asset class with limited benchmark availability, historical return analysis is only the tip of the iceberg. Understanding how private infrastructure assets may react to a changing macroeconomic environment is a multifaceted exercise, and depends on the sector of exposure, the underlying contractual structure of the asset, and the strategic approach of investors. Not all infrastructure assets share the same performance characteristics: assets will absorb macroeconomic fluctuations differently, and information provided by benchmarks today is still limited.

— Therefore, in this paper, we try to understand how infrastructure performs in a changing macroeconomic environment with the help of big data, adopting an innovative approach that looks at this question from different perspectives and tries to integrate information provided by benchmarks. Infrastructure may be a new asset class for long-term investors, but it has been around for many centuries. For this project, we identified thousands of data points for fundamental and financial performance. With the help of the data, we analysed the volatility in demand across various sectors. We concluded that infrastructure sectors should be on average less volatile than non-infrastructure ones and should therefore exhibit resilience during economic downturns. Moreover, certain infrastructure sectors have historically demonstrated more stable demand fundamentals, or solid long-term industry growth trends supporting performance.

— As a second step in our analysis, we tried to understand how changes in the macroeconomic environment filter through the capital structure of assets across different sectors, with the help of our database comprising over 300 infrastructure companies. To achieve this, we ran a panel regression analysis of operating performance, capex, leverage and free cash flow, with key macroeconomic variables including GDP growth, inflation and interest rates. The knowledge gained from this analysis supports our view that income may well be predictable across most infrastructure sectors, but that the source of this resilience to changes in the macroeconomic environment may be in different parts of the capital structure. This analysis can be pivotal in driving investment strategies, asset management, and portfolio management. Finally, we modelled four long-term macroeconomic scenarios for the European economy. Based on our return forecast for infrastructure across these scenarios, we tried to define the indicative, optimal strategic portfolio allocation across core and core plus strategies for each scenario when looking at synchronised changes in GDP, interest rates and inflation. We determined that short-term changes in the macroeconomic cycle, such as a recession, are certainly important for tactical investment decisions, but these tend to have more limited repercussions on private infrastructure performance when investing for the long term.

— Our analysis shows that, in the long term and across long-term macroeconomic scenarios, infrastructure investors could benefit from constructing portfolios diversified across core and core plus assets. Core, regulated infrastructure is key to balance systemic risk in a portfolio and to hedge against interest rate changes in the long term, but capital growth potential may be limited. In our base case, we believe that interest rates should remain lower for longer to support economic growth. In this context, an allocation to core plus infrastructure, where assets may still exhibit a predictable dividend component, but also be positioned for some growth, may improve risk-adjusted returns in a portfolio over the long term.

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2 Based on DWS proprietary database, Oxford Economics, Eurostat, Bloomberg, as at January 2019. Past performance is not a guide for future results.

3 Based on DWS proprietary database and methodology, Bloomberg, Oxford Economics, as at April 2019. Past performance is not a guide for future results.

4 Based on DWS proprietary database and methodology, Oxford Economics, as at May 2019. There is no guarantee the forecast shown will materialise.

5 Core Infra = ‘Low Risk’ in MSCI Infrastructure Investment Style Matrix, includes brownfield assets in mature markets, with a significant component of income yield, predictable and regulated revenues, long-term investment horizon, and an investment grade rating profile. Core+ = ‘Moderate Risk’, includes brownfield assets in mature markets with some development risk, relatively predictable revenues and income and capital generally contributing equally to total return.

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2 / Strategic Insights

Private Infrastructure and the Macroeconomic Environment

<table>
<thead>
<tr>
<th>Private Infrastructure and the Macroeconomic Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Returns &amp; Economy</strong></td>
</tr>
<tr>
<td><strong>Limited Insights</strong>: Our correlation analysis indicates that private infrastructure total returns may provide a fair hedge against inflation, some correlation to GDP growth and limited negative correlation to interest rates. Income return is more resilient than capital return. However, for an asset class with fundamentals changing by market, sector, contract profile and asset, benchmark analysis provides only limited insights.<strong>8</strong></td>
</tr>
<tr>
<td><strong>Demand Predictability</strong>: Demand for infrastructure should be on average less volatile than for other sectors. However, not all infrastructure sectors revealed the same resilience to the macroeconomic cycle. Some sectors have historically shown strong defensive characteristics, while other sectors may be more exposed to a downturn, but may also be supported by solid underlying industry long-term growth trends stabilising demand.</td>
</tr>
<tr>
<td><strong>Essential Services</strong>: Essential services, such as regulated water networks, education and healthcare exhibit solid demand characteristics, i.e. strong long-term annual growth and low long-term volatility.</td>
</tr>
<tr>
<td><strong>Long-term Trends</strong>: Some sectors, such as airports or public transportation are positioned to capitalise on healthy long-term growth trends providing potential for value creation, but may be exposed to some volatility in the short term compared with essential services. For some energy sub-sectors, such as thermal generation based on solid fuels and oil, we observed potential for short-term volatility, coupled with a consistent long-term decline.</td>
</tr>
<tr>
<td><strong>Income Predictability</strong>: We identified long-term dividend stability across most infrastructure sectors. However, the ability to absorb fluctuations in GDP, inflation and interest rates supporting dividend payments, and the source of this flexibility within the capital structure change by sector and contract profile.</td>
</tr>
<tr>
<td><strong>Defensive Sectors</strong>: Regulated sectors including water networks or electricity grids evidenced a solid level of resilience across most parts of the capital structure. Some other sectors, for example airports or healthcare, evidenced an overall long-term neutrality to macroeconomic changes across the capital structure, and flexibility in operating performance and leverage. This may represent a risk in case of a downturn, but also an opportunity for growth in periods of economic expansion.</td>
</tr>
<tr>
<td><strong>Exposed/ Growth Sectors</strong>: Some sectors, including ports, waste management, toll roads and rail freight have demonstrated long-term dividend predictability, but also some exposure to the macroeconomic cycle, particularly for operating performance and leverage. This may represent a risk in case of a downturn, but also an opportunity for growth in periods of economic expansion.</td>
</tr>
<tr>
<td><strong>Long-Term Horizon</strong>: Our return analysis across various macroeconomic scenarios, highlighted that short-term changes in macroeconomic cycles, such as a recession, are important for tactical investment decisions, but may have limited consequences on long-term infrastructure investment performance. Focusing on one variable independently, for example interest rates, provides a limited picture, investors should consider the long-term interplay between macro variables such as growth, inflation and interest rates.</td>
</tr>
<tr>
<td><strong>Portfolio Diversification</strong>: Core assets like regulated networks should be well-positioned to recover inflation and interest rate increases in the long term. We believe core plus assets should recover inflation and outperform in conditions of economic growth. Core and core plus strategies demonstrated complementarity and diversification benefits across all macroeconomic scenarios to maximise long-term risk-adjusted returns.</td>
</tr>
<tr>
<td><strong>Portfolio Optimisation</strong>: In our opinion, core plus strategies remain essential to provide some growth across all scenarios, but particularly in cases that include some economic growth, as such in our base case, or in cases of more modest long-term expansion.</td>
</tr>
</tbody>
</table>

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11 Based on DWS proprietary database and methodology, Oxford Economics, as at May 2019. There is no guarantee the forecast shown will materialise.
3 / Analytical Framework

Due to the limited insights provided by (i) an analysis based on the correlation of macroeconomic variables and total return series for private infrastructure benchmarks, we designed a multidimensional big data approach to understand how infrastructure performs across the macroeconomic environment, based on four additional analytical perspectives.

ANALYTICAL FRAMEWORK
(MULTIDIMENSIONAL ANALYSIS BY SECTOR AND STRATEGY)

Multidimensional Analysis of Infrastructure Performance Within the Macroeconomic Environment

(i) Benchmark Analysis
- Correlation analysis of private infrastructure total returns and key macroeconomic variables

(ii) Demand Analysis
- Long-term volatility analysis of demand by sector
- Identification of sectors with stable demand fundamentals or underpinned by long-term growth trends

(iii) Capital Structure Analysis
- Panel regression of financial performance and macroeconomic variables
- Identification of resilient sectors and of source of resilience in capital structure

(iv) Strategy Analysis
- Identification of key macroeconomic drivers across core and core plus strategies

(v) Portfolio Construction
- Modelling of four long-term macroeconomic scenarios for Europe
- Definition of indicative optimal portfolios for each scenario by strategy for long-term investment

Macroeconomic Environment

| Economic Growth (GDP) | Inflation (CPI) | Interest rates (LT Gov. Bonds) |

Source: Based on DWS proprietary methodology, as at April 2019. For illustrative purpose only. Past performance is not a guide to future returns. This information is intended for informational purposes only and does not constitute investment advice, recommendation, an offer or solicitation.

We looked at (ii) how demand fundamentals have historically performed across different infrastructure sectors, and (iii) how macroeconomic variables are correlated to the financial performance of various infrastructure sectors across the capital structure. We achieved this by running a panel regression of GDP growth, CPI, and interest rates on financial performance of infrastructure companies from 2005 to 2017.

We then examined (iv) the key macroeconomic drivers for different investment strategies, including core and core plus assets. Finally, we modelled four long-term macroeconomic scenarios for the European economy. Based on our return forecast for private infrastructure across these scenarios, looking at changes in GDP, interest rates and inflation with an integrated approach, we (v) defined the indicative, optimal strategic portfolio allocation across core and core plus strategies maximising risk-adjusted returns for each scenario.

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4 / Infrastructure Benchmarks and Economy

Investing in infrastructure offers potential benefits to long-term investors, including the possibility to own real assets that provide essential services and have monopolistic features, supporting long-term performance visibility across macroeconomic cycles. A legitimate starting point to analyse how private infrastructure performance may react to a changing macroeconomic environment is a focus on a historical correlation analysis between private infrastructure performance benchmarks and key macroeconomic variables, including GDP growth, long-term interest rates and inflation. Benchmarks available for private infrastructure performance have historically been limited. MSCI now publishes the “MSCI Global Infrastructure Asset Index”, which provides investors with some indications on the quarterly historical performance of the asset class, but only from 2008 onwards, and supports this analysis.13

CORRELATIONS OF INDEX RETURNS TO CHANGES IN MACROECONOMIC INDICATORS (% QUARTERLY, GLOBAL AVERAGE, 2008-Q1 2019)

The results of this correlation analysis can only be interpreted as a high-level indication, but appear to confirm that private infrastructure performance has historically been relatively resilient to macroeconomic changes. Private infrastructure may provide a fair hedge for inflation, has demonstrated resilience to changes in interest rates, and limited correlation to GDP growth. More in detail, the reliance of income return to the economy appears stronger compared with the capital return component. Income return has provided a good hedge for inflation, and offers some resilience to changes in GDP growth and interest rates. Capital return has historically provided some good protection against changes in inflation and interest rates, but has also demonstrated a moderate exposure to GDP growth, proving potentially more volatile in case of a potential recession, but also providing some return uplift in a growth environment.14

Although this analysis only provides investors with a high-level indication, it also faces two key challenges that limit its use in strategic investment decisions, underpinning the need for additional analysis. First, the index is global, although skewed towards mature regions, and only captures performance over a restricted timeframe, limiting the statistical meaningfulness of our conclusions. Secondly, the analytical insight provided by broad private infrastructure benchmarks may be constrained by the fact that private infrastructure is a diverse asset class, and not all infrastructure assets share the same characteristics from a risk/return perspective. Performance characteristics may vary geographically, by sector, based on the underlying contractual structure of the asset, and the individual asset risk/return characteristics. These factors highlight the need for alternative methods to improve our understanding of how private infrastructure performs in a changing macroeconomic environment.

13 MSCI Global Quarterly Infrastructure Asset Index, “Summary - Period ending March 2019”. It should be noted that the relative strength of unlisted infrastructure in this analysis is in part due to the fact that the MSCI Index is a valuation-based index, while indices used for the listed asset classes are calculated on a transactional base and are therefore inherently more volatile. Past performance is not indicative of future returns.

5 / Demand Fundamentals and the Economy

We begin our analysis of infrastructure demand by focusing on how key demand variables across sectors within the asset class have performed historically. While the availability of infrastructure performance benchmarks is still limited, data availability for infrastructure demand patterns is high, and may trace back several decades. Understanding how demand fundamentals change for different sectors, in the long term and in case of a downturn, is a first important step to support investment strategies, mitigate potential volatility through active asset management, or capitalise on favourable long-term trends to generate value through capital appreciation.15

KEY VARIABLES OF INFRASTRUCTURE DEMAND PATTERNS (ANNUAL CHANGE, %, 2005-2016)


Infrastructure is essential to the functioning of modern economies, and user demand patterns tend therefore to be relatively inelastic. Assets often enjoy monopolistic or quasi-monopolistic market positioning, making it economically unsound, or legally not possible to build competing facilities. Moreover, infrastructure requires a high level of initial capital investment, and this can act as a potential impediment to competitors entering the market. Our analysis demonstrates that historically, demand for infrastructure services has exhibited lower volatility relative to non-infrastructure sectors, such as private vehicle sales or apparel (clothing and footwear), as represented in the chart.16 At the same time, we identified material differences in the demand patterns across different infrastructure sectors, in terms of their volatility, potential exposure to a downturn, and underlying long-term sector growth trends.

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Defensive Sectors: Essential services - including water, healthcare and education stand out for their negligible volatility profile. Importantly, these three sectors have not experienced a downturn in demand over the last decade, and have grown consistently over the long term, at an average of 3.5% per year. Due to the essential nature of these services, access for private investors may be limited and often heavily regulated, such as water networks or large parts of the healthcare value chain. We expect these sectors to continue to provide resilient demand fundamentals in the long term, while also offering scope for investment strategies focusing on achieving some moderate, long-term growth. 17

Growth/ Volatile Sectors: Demand variables historically exposed to comparatively stronger volatility within infrastructure include road and sea transport, an important factor to consider when evaluating an investment in toll roads or ports, impacting both asset selection, asset management and growth objectives.

Toll Roads: Toll roads may be exposed to potential demand volatility in private vehicle and freight traffic. Moreover, there is evidence that freight road traffic has experienced a long-term volume contraction, which may cap traffic volumes in the future. Identifying toll roads with a diversified catchment area, located in prosperous areas, and in strategic locations for traffic flows may support long-term traffic resilience and investment performance. 18

Seaports: Seaport traffic has enjoyed a sustained period of long-term volume growth, driven by supportive global trade and containerization of commodities, a trend that we expect to mature in the future. The sector has been historically exposed to some volatility, and has seen periods of traffic reduction during economic downturns. For ports, more than in any other sector, we believe that asset location is a key driver of long-term performance. Identifying assets in strategic geographical locations for trade routes and supply chains, supported by solid regional logistics infrastructure, exposed to limited competition from other ports, and driven by ownership models supporting flexibility is key for the long-term growth of traffic volumes.

Sector Supported by Favourable Long-term Trends: Demand patterns in sectors - including postal and telecommunication services, air passenger transport, public transportation and healthcare - seem to be driven by favourable long-term trends.

Healthcare: European population is ageing. Over the next twenty years, by 2038, the share of population over 65 years should reach 27%, up from 20% in 2019 19, driven by sluggish birth growth rates and medical advances improving longevity. An ageing population will have substantial consequences for healthcare services demand.

Airports: The liberalisation of European air transport has played a vital role in contributing to strong air passenger growth over the past decades. 20 In future, European airports should benefit from resilient domestic demand, but European airport hubs interlinked to Asian markets should continue to experience long-haul passenger and commercial revenues growth. Asia’s air-passenger count could more than double by 2035, versus 2018 levels, driven by urbanization, middle-class proliferation, and greater affordability, and is unlikely to be undermined by a potential economic slowdown. 21

Public Transportation: Public transportation is an essential service, and demand has not only grown at a higher rate than private vehicles in the long-term, but has also demonstrated low levels of volatility. 22 Demand for public services, air passenger transport, public transportation and healthcare - seem to be driven by favourable long-term trends.

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17 Based on data from Oxford Economics, Eurostat data, as at 29 January 2019. Past performance is not a guide for future results. No assurance can be given that investment objectives will be achieved.
18 Based on data from Oxford Economics, Eurostat data, as at 29 January 2019. Past performance is not a guide for future results. No assurance can be given that investment objectives will be achieved.
21 Bloomberg, Asia Air Travel Boom, December 2018.
22 Based on data from Oxford Economics, Eurostat data, as at 29 January 2019. Past performance is not a guide for future results.
transport should continue to grow, supported by urbanisation, and sustainability policies aimed at reducing urban congestion, making the sector attractive for future infrastructure investment from a fundamentals perspective.  

**Telecommunication Infrastructure:** The telecom sector continues to enjoy high growth driven by digitalisation supporting demand fundamentals for fibre networks, telecom towers and data centres. This trend is expected to continue, but some assets may be exposed to medium-term technological risk potentially impacting demand.

**Urban Logistics:** Digitalisation continues to drive a rise of e-commerce and the on-demand economy, driving postal services and boosting the need for efficient logistic networks, particularly at urban level. Urban freight delivery is expected to increase by 40% by 2050, driving the need for investment in smart logistics infrastructure.

**Energy Sector Trends:** In the last decade, the energy sector has been underpinned by marked volatility, and has also contracted. This highlights the importance of investing in energy assets that are volume-neutral, either through regulation, such as in the case of networks, or that are backed by long-term contractual arrangements, such as take or pay contracts in the case of thermal generation. However, within the energy sector the picture is fragmented, with some sectors, including renewables, and energy-from-waste, supported by a favourable long-term trend, and other sectors, particularly fossil fuels, positioned on a long-term decline pattern.

**ENERGY DEMAND BY SOURCE (ANNUAL CHANGE, %, 2005-2016)**

Source: DWS, Oxford Economics, Eurostat, 29 January 2019. Here, Europe includes only Austria, Belgium, France, Germany, Italy, Spain and Portugal. For illustrative purpose only. Past performance is not a guide for future results.

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24 Based on Oxford Economics, Bloomberg and Moody’s Investors Service data, as at March 2019.
26 Based on data from Oxford Economics, Eurostat data, as at 29 January 2019. Past performance is not a guide for future results.
Renewables: Incentive mechanisms and falling equipment costs have driven continued renewables capacity increases, and growth is expected to continue over the long term, supported by market conditions, decarbonisation policies and equipment costs for renewables continuing to shrink, particularly across photovoltaic (PV) and battery storage technologies.27

Energy-From-Waste (EfW): Waste volumes are correlated to GDP growth, particularly with regard to industrial production and private consumption supporting the energy from waste industry. The EfW industry is expected to continue expanding in the long term. The European Commission aims to reduce landfill to a maximum of 10% for municipal waste by 2030,28 leading to the gradual closure of landfill sites and thus providing sustainable waste flows towards EfW projects. The revised legislative proposal on waste includes a common EU target for recycling of 65% of municipal waste by 2030,29 However, historical evidence demonstrates that recycling rates can reach a cap that becomes progressively more difficult to overcome, supporting our view of continued, long-term need for EfW.30

Fossil Fuels: Traditional energy sources such as oil and petroleum products have experienced a long-term decline31 particularly driven by climate change policies and rising CO₂ prices. We expect this trend to continue, with the exception of gas, where modest albeit continued growth is expected over the next decade. The implications of these long-term trends represent a threat for midstream oil assets and baseload coal thermal generation.

27 Based on Fitch Ratings and Moody's Investors Service data, as at March 2019.
31 Based on data from Oxford Economics, Eurostat data, as at 29 January 2019. Past performance is not a guide for future results.
6 / Capital Structure and the Economy

Demand shortfalls may translate into revenue volatility, depending on the regulatory framework and contractual agreements in place for different infrastructure sectors. It is therefore important to build an understanding of how fluctuations in demand, also driven by changes in the macroeconomic environment, may filter through the capital structure of infrastructure corporates, - including their operating performance, capex and leverage - and ultimately whether these can affect dividend payments. A better understanding of this dynamic can support investment decisions, portfolio construction and active asset management.

Our big data analysis is based on a series of panel regressions of key financial metrics including EBITDA margin, capex, leverage, free cash flow (FCF), on key macroeconomic variables, including GDP growth, CPI inflation and interest rates (10 year government bond rates) from a database including over 300 global infrastructure corporates.

### EXPOSURE OF FINANCIAL PERFORMANCE TO CHANGES IN KEY MACROECONOMIC INDICATORS (BY INFRASTRUCTURE SECTOR, 2005-2017)

<table>
<thead>
<tr>
<th>Panel regressions on changes in GDP, CPI and interest rates</th>
<th>EBITDA Margin</th>
<th>Capital Expenditure</th>
<th>Leverage (Net Debt/EBITDA)</th>
<th>Free Cash Flow (FCF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Networks</td>
<td>Resilient</td>
<td>Resilient</td>
<td>Neutral</td>
<td>Resilient</td>
</tr>
<tr>
<td>Subsidised Renewables</td>
<td>Resilient</td>
<td>Neutral</td>
<td>Neutral</td>
<td>Resilient</td>
</tr>
<tr>
<td>Water</td>
<td>Resilient</td>
<td>Neutral</td>
<td>Neutral</td>
<td>Neutral</td>
</tr>
<tr>
<td>Airports</td>
<td>Neutral</td>
<td>Neutral</td>
<td>Neutral</td>
<td>Resilient</td>
</tr>
<tr>
<td>Telecom Infrastructure</td>
<td>Resilient</td>
<td>Exposed</td>
<td>Neutral</td>
<td>Neutral</td>
</tr>
<tr>
<td>Private Healthcare</td>
<td>Neutral</td>
<td>Neutral</td>
<td>Neutral</td>
<td>Neutral</td>
</tr>
<tr>
<td>Rolling Stock Leasing</td>
<td>Neutral</td>
<td>Neutral</td>
<td>Neutral</td>
<td>Neutral</td>
</tr>
<tr>
<td>Waste Management</td>
<td>Exposed</td>
<td>Neutral</td>
<td>Neutral</td>
<td>Neutral</td>
</tr>
<tr>
<td>Toll Roads</td>
<td>Exposed</td>
<td>Exposed</td>
<td>Resilient</td>
<td>Neutral</td>
</tr>
<tr>
<td>Ports and Port Services</td>
<td>Exposed</td>
<td>Neutral</td>
<td>Exposed</td>
<td>Neutral</td>
</tr>
<tr>
<td>Integrated Utilities</td>
<td>Exposed</td>
<td>Neutral</td>
<td>Exposed</td>
<td>Neutral</td>
</tr>
<tr>
<td>Rail Freight</td>
<td>Exposed</td>
<td>Exposed</td>
<td>Exposed</td>
<td>Neutral</td>
</tr>
</tbody>
</table>

Notes: *FCF for “Ports and port services” exposed to changes to exports/imports. Source: DWS’s proprietary database, Bloomberg, Oxford Economics, April 2019. Based on DWS proprietary methodology. Relative ranking based on panel regressions of data between 2005 and 2017 of fundamental macroeconomic variables (inflation, GDP, interest rates – 10 year government bond rates) with a database of financial indicators for listed infrastructure companies. Resilient = financial indicator resilient to change in macro variables, Neutral = no statistical relationship between macro variables and financial indicator, Exposed = positive relationship between financial indicator and macro variables. Past performance is not a reliable indicator of future returns.

Based on our regression analysis between macroeconomic indicators and the financial performance of infrastructure companies, we can highlight the following key observations:

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**Dividend Predictability:** Regulated networks, subsidised renewables and airports proved to be the most defensive infrastructure sectors when it comes to income return, underpinned by their regulated nature or subsidised contract profile. Other sectors demonstrated no meaningful, historical long-term statistical relationship between changes in free cash flow and key macroeconomic variables, supporting our expectation for long-term dividend predictability. Although these sectors may not benefit from a regulatory framework providing the same level of protection to changes in the macroeconomic environment, they have highlighted a number of strengths across the capital structure, supporting dividend payments. This includes the ability to stabilise revenues through contracts, flexibility to reduce operating costs, and the ability to adjust capex and leverage to preserve value generation.34

**Operating Performance:** A demand shortfall, driven for example by a recession, can impact revenue generation. In the absence of a supportive regulatory framework, a take-or-pay contract or sufficient operating expenditure flexibility, this may lead to a reduction in EBITDA margins. At the same time, a favourable long-term economic environment may support stronger operating performance in sectors where regulation or the contractual structure may not act as a cap on growth. Based on our panel regression analysis, we have clustered sectors in three different groups.

For (i) resilient sectors, the EBITDA margin moves independently from changes in macroeconomic variables, for (ii) neutral sectors, we did not identify any meaningful statistical relationship between the economy and EBITDA performance, and for (iii) exposed sectors we identified a meaningful correlation of the EBITDA margin and macroeconomic variables.

**Resilient Sectors:** Regulated networks, including water networks with Regulated Asset Base (RAB) models, subsidised renewables and telecom infrastructure proved to be historically the most resilient sectors in terms of operating performance. Looking at regulated networks, Regulated Asset Base (RAB) models enable a tariff-setting mechanism that provides a volume-neutral, regulated return to investors based on the value of the RAB and a regulated rate of return (WACC), while at the same time inflation and most operating costs can also be recovered, stabilising operating performance.

While RAB models are supportive for operating performance stabilisation in case of demand changes, we identified a negative impact on tariffs driven by the correlation between the reduction in the risk-free interest rates across Europe, and the average reduction in WACC rates, determined by a corresponding reduction in the debtrate return component over the last decade.

Historically, subsidy schemes for renewable energy projects have focused on feed-in tariffs mechanisms, supporting long-term revenue stability. In this regard, we recognised that in certain European jurisdictions subsidy schemes have proven less predictable than initially expected, exposing investors to regulatory risk, and leading to some retroactive tariff changes affecting operating performance. Going forward, incentive mechanisms will increasingly be based on auctions and contract for difference (CfD) mechanisms, leading to a greater correlation of revenues with market conditions and energy prices. While these mechanisms may potentially introduce more volatility in the performance of subsidised renewables, we see them as an improvement in terms of regulatory risk reduction.35

The operating performance of telecom infrastructure has been driven by the long-term nature of underlying contract arrangements providing inflation-indexed cash flow visibility, and by the strategic nature of assets in the context of a strong digitalisation trend driving demand growth and providing a source of resilience to the macroeconomic cycle.

**Neutral Sectors:** Airports, private healthcare, and rolling stock leasing demonstrated no particular statistical relationship with changes in macroeconomic variables. Private healthcare companies have historically benefitted from the essential nature of services stabilising demand, and adequate levels of operating expenditure flexibility.

For airports, aeronautical activities are normally regulated, providing a source of resilience to price changes and inflation, but assets can be exposed to changes in passenger volumes, also impacting retail revenues. Nevertheless,
airports are supported by a favourable long-term passenger growth trend, and by adequate operating expenditure flexibility to mitigate potential revenue shortfalls driven by short-term economic downturns.

The operating performance of rolling stock leasing companies has proven particularly predictable for passenger rolling stock, supported by inflation-linked medium-term or long-term contracts with rolling stock lessees, such as for rolling stock leasing companies (ROSCOs) in the United Kingdom. ROSCOs own coaches, locomotives and freight wagons that run on the rails, which they lease to train operating companies, in accordance with franchise concession agreements. At the same time, the operating performance of freight rail has proven to be historically more volatile, thereby exposing freight rolling stock leasing - where contracts are generally short-term - to a potentially more volatile operating performance.

Exposed Sectors: The analysis demonstrated that the operating performance of waste management, toll roads, ports and integrated utilities was more exposed to the potential volatility of the macroeconomic environment, particularly to GDP growth, without having sufficient operating expenditure flexibility to fully offset revenue declines. Waste management revenues tend to be exposed to short-term contract volatility from industrial waste clients, while concessions for domestic waste tend to be more predictable, although historically margins have observed a declining trend. For toll roads, while the tariff component is regulated and typically linked to inflation, assets are still exposed to potential traffic volatility, with heavy vehicles traffic having historically proven more volatile than private vehicles in a downturn.

For ports, operating performance can vary substantially based on location and business model. On average, ports operate on the basis of a diversified stream of medium-term contracts, and the revenue profile for ports in non-strategic locations has historically proven to be particularly sensitive to trade, including both import and export dynamics. At the same time, ports in strategic locations were supported by stronger resilience to changes in the macro environment.

For integrated utilities, the regulated network business segment proved to be historically resilient to changes in the macroeconomic environment. However, over the last decade, non-regulated businesses, including thermal power generation, trading and retail sales were more exposed to market volatility.

Capex and Leverage: Capex and leverage flexibility can help absorb the pressure generated by a downturn on operating performance, preserving dividend payments. At the same time, the ability to invest can be a powerful tool to grow a business providing value to investors. Our analysis identified at least one source of flexibility or resilience across the capital structure in any infrastructure sector analysed, with the exception of rail freight, which has proven to be the most exposed sector to changes in the macroeconomic environment within our database.

Regulated networks, including water, demonstrated a resilient capex and leverage profile, with capex representing a building block of the RAB remuneration model. While this protects regulated networks from the volatility of the macroeconomic cycle, it also represents a potential limit to their flexibility to scale back investment programmes quickly if needed, or to accelerate investment to pursue growth. Other sectors that proved particularly independent in setting their capex or leverage targets from fluctuations in the macroeconomic environment are healthcare, waste management, airports and ports, where capex can represent a source of flexibility and support business expansion. 36

Looking at the cost of debt, the long-term tenor of debt for infrastructure assets provides an element of protection against changes to interest rates, although on average core, regulated infrastructure tends to be comparatively more leveraged and therefore potentially more exposed to long-term changes in interest rates. However, the credit quality profile of infrastructure companies, generally in the investment-grade space, provides an important buffer against increases in interest rates.

36 Based on DWS’s proprietary database, Bloomberg, Oxford Economics, April 2019. Past performance is not a reliable indicator of future returns.
7 / Portfolio Optimization by Macro Scenario

In this section, we identify the key long-term macroeconomic drivers for core and core plus strategies, examining how, when analysed independently (7.1), changes in GDP growth, interest rates and inflation drive value generation for these two strategies. Finally, (7.2) we model four long-term macroeconomic scenarios for the European economy, approaching changes in GDP, interest rates and inflation in an integrated way. Based on our return forecast for infrastructure, we try to define the indicative, optimal strategic portfolio allocation across core and core plus strategies across these scenarios.

7.1 Macro Value Drivers of Core and Core Plus Strategies

<table>
<thead>
<tr>
<th>KEY INFRASTRUCTURE LOGN-TERM VALUE DRIVERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>(ASSUMPTIONS BY STRATEGY AND MACRO VARIABLE)</td>
</tr>
<tr>
<td>GDP Growth (Real)</td>
</tr>
<tr>
<td>Core</td>
</tr>
<tr>
<td>Core Plus</td>
</tr>
</tbody>
</table>

Source: Based on DWS proprietary methodology as at June 2019, analysing long-term historical correlations between infrastructure strategies, sectors and macro variables. Past performance is not a guide to future returns. There is no guarantee the forecast shown will materialise. Forecasts are not a reliable indicator of future returns. Forecasts are based on assumptions, estimates, views and hypothetical models or analyses, which might prove inaccurate or incorrect.

Core Strategies: In the short term valuations for core assets, such as regulated networks, can be exposed to changes in interest rates. These assets provide investors with a bond-like dividend yield component, and a change in interest rates can make bond yields look more or less attractive compared with the dividend yield of regulated networks. A decrease in bond yields may make an investment in core infrastructure comparatively more attractive, supporting valuations in the space, while an increase in bond yields may cap valuations for core assets. Although with a time lag, most regulatory frameworks allow assets to use inflation-indexed user tariffs, and to recover increases in interest rates. Therefore, in the medium term, income for core assets should recover changes in inflation or interest rates through the regulatory framework, helping to protect valuations from interest rate increases.

We did not identify any meaningful direct correlation between changes in GDP and income for core infrastructure. Income and valuations for core assets should therefore be protected in the case of an economic downturn. However, income and valuations do not benefit from periods of economic expansion, and valuations may be exposed to investors focusing on growth assets rather than core infrastructure during periods of economic growth.

Core Plus Strategies: Core plus strategies tend to focus on brownfield assets, in sectors that are contracted in the medium-to-long term. Core plus strategies may also focus on brownfield, regulated assets, but these would include a development component. Core plus infrastructure can include assets that provide cash flow visibility to support income returns, but that also have potential for some capital appreciation. In our analysis, core plus infrastructure income has evidenced ability to recover inflation in the long-term, while it has shown only limited ability to absorb fundamental changes in interest rates in valuations. At the same time, income for core plus assets has demonstrated potential to grow at a multiple of GDP growth, supporting income and driving valuations in periods of economic growth, generally associated to rising interest rates. Growth may help offset the potential impact of increasing interest rates on valuations in the long term.

37 Any forecasts provided herein are based on DWS’s opinion at time of publication and are subject to change. This information is intended for informational purposes only and does not constitute investment advice, recommendation, an offer or solicitation.

38 Core Infra = ‘Low Risk’ in MSCI Infrastructure Investment Style Matrix, includes brownfield assets in mature markets, with a significant component of income yield, predictable and regulated revenues, long-term investment horizon, and an investment grade rating profile. Core+ = ‘Moderate Risk’, includes brownfield assets in mature markets with some development risk, relatively predictable revenues and income and capital generally contributing equally to total return.
7.2 Macro Scenarios and Portfolio Construction

In the long term, any investment may go through different phases in a macroeconomic cycle, including a recession, periods of stronger economic growth, as well as changes in interest rates or inflation. Short-term changes in the macroeconomic cycle, such as a recession, are important factors for investment decisions, but tend to have historically shown more limited repercussions on private infrastructure performance when investing in the long term, particularly when in excess of ten years.

In our view, infrastructure investors should mainly focus on long-term investment strategies rather than only on tactical investment decisions based on short-term macroeconomic factors. More importantly, it may be misleading to focus independently on specific changes in macroeconomic variables, such as inflation or interest rates. Changes to GDP growth, inflation and interest rates are interdependent, and it is important to look at them with a combined approach.

**Macroeconomic Scenarios**: To develop an understanding of the combined long-term effect of changes in GDP growth, interest rates and inflation on strategic portfolio allocation across infrastructure strategies, we have sensitised the impact of four theoretical, distinct, long-term macroeconomic scenarios in Europe over ten years using our forecasting model calibrated to these scenarios.

In our “Base case”, we have modelled moderate, albeit resilient growth in Europe, with limited inflationary pressures, and long-term interest rates remaining lower for longer. This scenario may not exclude a short-term recessionary period, but overall expects real GDP to be in line with the average growth experienced in the last decade.

**LONG-TERM MACROECONOMIC SCENARIOS (ASSUMPTIONS BY SCENARIO)**

<table>
<thead>
<tr>
<th>Macro Scenario (10Y)</th>
<th>GDP growth (Real)</th>
<th>Inflation (CPI)</th>
<th>Interest rates (10Y Govt. Bond)</th>
</tr>
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<tbody>
<tr>
<td>Goldilocks</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Base Case</td>
<td>Moderate</td>
<td>Low/Moderate</td>
<td>Low/Moderate</td>
</tr>
<tr>
<td>Secular Stagnation</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Stagflation</td>
<td>Low</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>

Source: DWS, Oxford Economics as at May 2019. Notes: F=forecast. Past performance is not a guide to future returns. There is no guarantee the forecast shown will materialise. Forecasts are not a reliable indicator of future returns. Forecasts are based on assumptions, estimates, views and hypothetical models or analyses, which might prove inaccurate or incorrect. This information is intended for informational purposes only and does not constitute investment advice, recommendation, an offer or solicitation.

In the “Goldilocks” scenario, European economies should benefit from stronger economic growth, but also from low interest and inflation. The “Secular Stagnation” case would involve a decade of modest economic growth, interest rates and inflation, including a potential short-term recession. The “Stagflation” case would involve sluggish economic growth in the long term, coupled with sharp inflation and interest rates increases, and would not exclude recessionary periods.39

**Optimal Portfolio Allocation**: Based on our return forecast for each long-term macro scenario, we have determined the indicative, optimal strategic portfolio allocation across core and core plus infrastructure strategies.40

Our conclusion is that across all projected scenarios, to aim to maximise risk-adjusted returns, investors may wish to focus on building portfolios that combine the complementary characteristics of core and core plus infrastructure assets, driving long-term cash flow visibility and capital appreciation potential. Results are only indicative, but demonstrate the importance of portfolio diversification when investing for the long term.

39 Based on DWS proprietary methodology as at May 2019. This information is intended for informational purposes only and does not constitute investment advice, recommendation, an offer or solicitation.

40 Based on DWS proprietary methodology as at May 2019. This information is intended for informational purposes only and does not constitute investment advice, recommendation, an offer or solicitation.
In a maturing investment environment, investors may approach portfolio allocation in a conservative way, focusing on core infrastructure assets that provide long-term cash-flow visibility, but not on the fact that entry valuations for core infrastructure may be comparatively high and long-term growth potentially limited. At the same time, in times of buoyant GDP growth, investors may focus only on investing in core plus infrastructure.

Our analysis reveals that core assets may provide an essential support to reduce residual portfolio risk in all scenarios, including scenarios involving solid GDP growth, such as in the “Goldilocks” scenario.

**INFRASTRUCTURE AND LONG-TERM MACRO SCENARIOS (INDICATIVE OPTIMAL PORTFOLIOS)**

![Infrastructuure and Long-Term Macro Scenarios Diagram](chart)

Source: DWS proprietary methodology as at May 2019. For indicative purposes only. Past performance is not a guide to future returns. There is no guarantee the forecast shown will materialise. Forecasts are not a reliable indicator of future returns. Forecasts are based on assumptions, estimates, views and hypothetical models or analyses, which might prove inaccurate or incorrect. This information is intended for informational purposes only and does not constitute investment advice, recommendation, an offer or solicitation.

At the same time, an allocation to core plus infrastructure contributes to improving risk-adjusted returns across all scenarios. Core plus infrastructure remains an important component of long-term private infrastructure portfolios, as well as across scenarios involving a downturn, such as in the “Secular Stagnation” or “Stagflation” cases. Core plus strategies would represent a substantial component of portfolios in our “Base Case” or in the “Goldilocks” scenarios, where interest rates would remain lower for longer, and core plus assets would benefit from supportive long-term growth. Core strategies would have limited capital growth potential, but may still help balance systemic risk of a portfolio.  

In a “Stagflation” case, core infrastructure would be a long-term hedge against spikes in inflation and, importantly, interest rates, but an allocation to core plus infrastructure might still contribute to improve long-term risk-adjusted returns.

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41 Based on DWS proprietary methodology as at May 2019. This information is intended for informational purposes only and does not constitute investment advice, recommendation, an offer or solicitation. Forecasts are based on assumptions, estimates, views and hypothetical models or analyses, which might prove inaccurate or incorrect.
# Appendix

## Calendar Annual Performance

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<tr>
<td>MSCI Global Infrastructure Direct Asset Index</td>
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<tr>
<td>- Total Return</td>
<td>15.5%</td>
<td>18.0%</td>
<td>15.2%</td>
<td>13.1%</td>
<td>11.9%</td>
<td>1.9%</td>
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<td>MSCI Global Infrastructure Direct Asset Index</td>
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<tr>
<td>- Capital Return</td>
<td>11.1%</td>
<td>14.0%</td>
<td>10.1%</td>
<td>7.4%</td>
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<td>1.0%</td>
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<tr>
<td>- Income Return</td>
<td>4.0%</td>
<td>3.6%</td>
<td>4.8%</td>
<td>5.4%</td>
<td>5.7%</td>
<td>0.9%</td>
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## Rolling Annual Performance

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<td></td>
<td></td>
</tr>
<tr>
<td>- Total Return</td>
<td>12.0%</td>
<td>18.0%</td>
<td>16.0%</td>
<td>15.3%</td>
<td>13.2%</td>
<td>11.7%</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Capital Return</td>
<td>7.7%</td>
<td>13.5%</td>
<td>11.5%</td>
<td>10.6%</td>
<td>7.3%</td>
<td>6.0%</td>
</tr>
<tr>
<td>MSCI Global Infrastructure Direct Asset Index</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Income Return</td>
<td>4.1%</td>
<td>4.0%</td>
<td>4.1%</td>
<td>4.3%</td>
<td>5.6%</td>
<td>5.4%</td>
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