

ECONOMIC REVIEW
National Bank of the Republic of Kazakhstan

No. 2, 2022

Astana, 2022

ECONOMIC REVIEW
National Bank of the Republic of Kazakhstan

Published by: National Bank of the Republic of Kazakhstan

Editorial Board

Chairperson of the Editorial Board

Deputy Governor of the National Bank Tutushkin V.A.

Editorial Board Members:

Head, Monetary Policy Department

Head, Financial Stability and Research Department

Head, Balance of Payments Department

Head, Monetary Operations Department

Head, Department of the Development of Financial Organizations

Person responsible for releasing the publication – a staff of the Research and Analytics Center

The point of view and opinions of the authors do not reflect the official standpoint of the National Bank of Kazakhstan and may not coincide with it.

ISSN 2789-3308

ECONOMIC REVIEW

National Bank of the Republic of Kazakhstan

No. 2, 2022

CONTENTS

Improving the Models for Forecasting the Volume of Cash in Circulation in the Republic of Kazakhstan <i>Maidanov S.Zh., Tabarak Y.Zh.</i>	4
Prospects for Infrastructure Investments in the Period of Global Transformations <i>Barmambekova S.A., Assilbekova A.A., Saduakassov B.R., Tursinbayeva G.G.</i>	22

IMPROVING THE MODELS FOR FORECASTING THE VOLUME OF CASH IN CIRCULATION IN THE REPUBLIC OF KAZAKHSTAN

Maidanov S.Zh. – Head, Analysis and Funds Planning Division, Cash Circulation Department, National Bank of the Republic of Kazakhstan

Tabarak Y.Zh. – Chief Specialist-Analyst, Analysis and Funds Planning Division, Cash Circulation Department, National Bank of the Republic of Kazakhstan

The assessment of factors for demand formation is an integral part of models for forecasting the volume of cash in circulation. As part of the study, an analysis of individual indicators and their impact on the change in the volume of use of different denominations of banknotes and coins was carried out by building econometric models.

The research results can be used as an auxiliary tool in predicting the amount of cash in circulation.

Key Words: banknotes, circulating coins, GDP, error correction model, cashless transfers and payments, POS-terminals.

JEL-Classification: C58, E41, E42, E47, E51, E58.

1. Preamble

The National Bank of the Republic of Kazakhstan (the National Bank of Kazakhstan) is the sole issuer of banknotes and coins of the national currency and organizes cash circulation within the territory of the Republic of Kazakhstan. According to the Currency Research methodology, the existing cash circulation model of the Republic of Kazakhstan refers to a centralized model, where the National Bank of Kazakhstan is fully responsible for managing cash in the country from the moment of planning the manufacturing of banknotes and coins to their destruction, as well as for the timely supply of cash to the economic entities [1].

To fulfill these functions, the National Bank of Kazakhstan determines the economy's need for the required number of banknotes and circulating coins (cash) on an annual basis and ensures their production, establishes the procedure for cash storage, destruction and collection [2].

The need for cash is determined on the basis of an analysis of the state of reserve funds (balances) and indicators of cash circulation, where one of the components is the forecasting of future volumes of cash in circulation.

The demand for the national currency banknotes is determined by a number of factors, for example, by the change in nominal GDP, inflation rate, growth rate of real income, population size and seasonal factors¹. Along with quantitative indicators, the demand for cash is dependent on various qualitative indicators that are difficult to measure with the help of data (preferences of the population (cognitive, emotional), emergencies, etc.).

Therefore, the purpose of the study is to identify possible components for improving the methods of forecasting cash in circulation. Realization of this goal involves the solution of the following tasks:

- studying the available literature in the sphere of forecasting the volume of cash in circulation and factors of demand formation for cash;
- analyzing the dynamics of demand for cash in Kazakhstan and in the world;
- determining the correlation between macroeconomic indicators and the volume of cash in circulation by constructing econometric models;
- elaborating recommendations for improving the models that forecast the volume of cash in circulation in Kazakhstan.

¹ Seasonal peaks of the demand for cash in Kazakhstan, just like in most countries of the world, every year falls on the days before public holidays.

The study is structured as follows. The second chapter provides a review of the literature devoted to the analysis of various factors influencing cash. The third chapter describes the data used in econometric models. A discussion of the results of econometric models is presented in the fourth chapter. The conclusion briefly describes the results of the study.

2. Literature Review

A study by the Bank of England [3] examined a number of factors that influence the demand for sterling banknotes. According to the findings in the study, the level of consumption and the level of self-employment in the country have a positive effect on the demand for cash, while an increase in the Bank of England base rate leads to a reduction of banknotes in circulation. In a study by the Reserve Bank of Australia [4], models of the financial crisis are built, which examine the relationship between the global economic crisis of 2007-2008 and the volume of the Australian dollars in circulation. The study revealed that the growth in the amount of cash during the economic crisis is to a lesser extent caused by lower interest rates and an increase in income through the government stimulus measures, and to a greater extent – by an increase in the stock of cash held by the population due to uncertainty in the financial markets.

Assenmacher, Seitz and Tenhofen, in their paper [5] to study the demand for Swiss francs, ran a dynamic cointegrated least-squares regression based on the data from 1950 to 2017. As a result of the study, it was found out that the high yield on government debt securities, the increase in the use of bank cards, as well as the weakening of the Swiss franc against the euro, lead to a lower demand for banknotes. If the increase in the use of bank cards most affects the demand for medium denominations of banknotes, the high yield on debt securities and the weakening of the Swiss franc against the euro most affect the demand for large denominations of banknotes.

Norges Bank (Norway), based on the error correction model, made a forecast of cash in circulation [6]. The model was built for each denomination of banknotes and coins separately, using macroeconomic indicators as explanatory variables. Household consumption, the number of POS terminals were used among the indicators, and interest rates were also considered for large denominations. Household consumption was found to have a positive effect on the demand for small denomination banknotes, while interest rates negatively affect the demand for large denominations. Out-of-sample testing of the model showed fairly reliable results.

In a study by Khalid et al. [7], a vector error correction model (VECM) was constructed to predict the demand for cash in Malaysia. According to findings in the study, there is a negative long-term relationship between the demand for cash and interest rates. The growth of real income and inflation leads to an increase in cash in circulation. Out-of-sample testing of the model for short-term and long-term forecasts showed a low level of cumulative error.

The study by Cabrero et al. [8] assesses the impact of holidays on the demand for euro banknotes on the basis of the autoregressive integrated moving average model, ARIMA, and the structural time series (STS). Based on a daily data, the effect of New Year holidays as well as the demand for cash during a week and a month is examined.

Each central bank of the Eurosystem forecasts cash in circulation independently. Thus, cash forecasting methods differ between central banks. For example, the Central Bank of Spain uses an ARIMA model, Central Bank of France uses a structural time series model, and Central Bank of Belgium makes forecasts based on an error correction model. The Central Bank of Germany uses the following data to build the model: monthly percentage growth of cash in circulation, expert assessment of seasonality (the impact of holidays, etc.), as well as the data on daily changes in cash in circulation [8].

3. The Data Used

Based on the reviewed literature, the endogenous variables of the actual volume of cash in

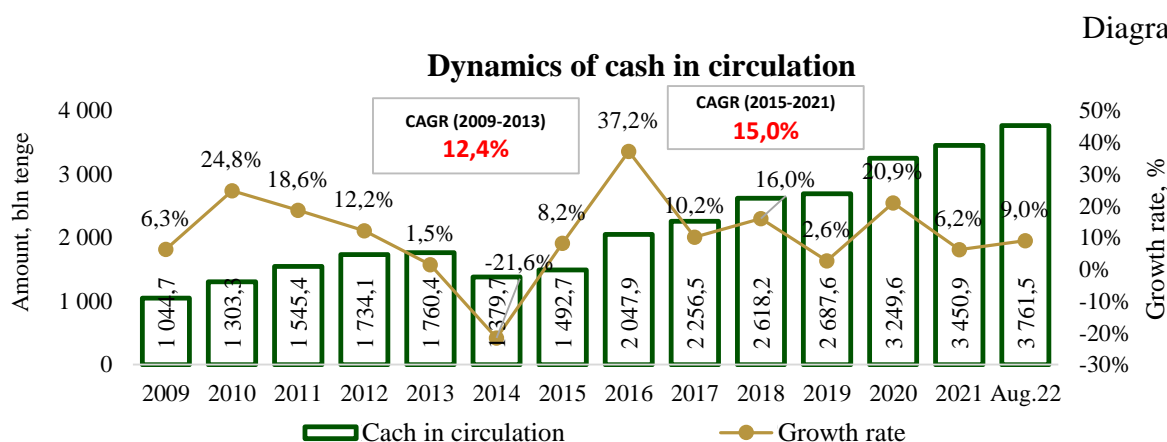
circulation in Kazakhstan, by denominations, for the period from January 2009² to August 2022³ were collected and analyzed.

The following indicators were used as exogenous variables: (1) from periodicals of the Bureau of National Statistics with the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan: nominal GDP, volume of trade, manufacturing, construction, agriculture, forestry and fishery, unemployment rate, inflation rate; (2) from periodicals of the National Bank of Kazakhstan: volume of cashless payments and transfers, deposit rate, and the number of ATMs and POS-terminals.

Along with an assessment of the relationship between macroeconomic indicators and the volume of cash in circulation, an analysis was made of the life cycle of banknotes and factors in the formation of demand for cash.

4. Discussion of Results Obtained

Despite an active development of the cashless payments infrastructure, the dynamics of the amount of cash in circulation in Kazakhstan, except reduction of circulation in 2014 caused by devaluation expectations among the population, demonstrate stable growth. If from 2009 to 2013, the average annual growth rate of cash (CAGR⁴) was 12.4%, during 2015-2021, this figure was 15.0% (Diagram 1).



Note: compiled by the authors

Source: National Bank of Kazakhstan

The growth of the amount of cash is observed in many countries of the world. Despite information in the media that COVID-19 has pushed for cashless circulation, in many countries of the world in the first half of 2020⁵ the volume of cash in circulation increased significantly (Appendix 1). Thus, the growing demand of economic entities for cash during the pandemic prompted the US Federal Reserve System to place an additional order to the annual production volume for 1 billion banknotes [9].

In Kazakhstan, the ratio of cash in circulation and GDP at the end of 2021 was 4.0%. Kazakhstan's indicators are noticeably lower than those in the Russian Federation (10.7%), Eurozone (12.8%) and Japan (23.5%) and are close to the indicators of Sweden (1.1%) – the country with one of the highest indicators of cashless payments, as well as Canada (4.6%), the UK (3.5%), and Norway (1.0%) (Appendix 2).

² The choice of the beginning of the period for analyzing the data on the volume of cash in circulation in terms of denominations is determined by the period of formation of the current nominal range of banknotes and circulating coins in circulation.

³ For quarterly variables analysis – to the 1st quarter of 2022.

⁴ CAGR (Compound Annual Growth Rate).

⁵ <https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020>

According to the results of the opinion survey⁶, the proportion of the population that most often prefers cash payment is about 60%. Among the main reasons for using the cash form of payment, respondents note the request of retailers (29.8%), the lack of Internet at the point of purchase (29.4%) and the habit of paying in cash (25.5%). Also quite often mentioned reasons for choosing a cash form of payment are the lack of terminals at retailers (23.7%), the speed and simplicity of paying in cash (17.8%), the acceptance of only cash by retailers (18.7%), better control of expenses (13.5%).

Seasonal peaks in the demand for cash in Kazakhstan, excluding various force majeure circumstances, every year fall on days before public holidays, the month of December is usually characterized by maximum amounts of cash in circulation (Appendix 3).

Banknotes account for a major share of cash in circulation (approximately 98%). At the same time, according to the dynamics of banknotes in circulation, it can be seen that the volumes of banknotes of small and medium denominations in circulation (500, 1,000, 2,000 and 5,000 tenge) remain at the same level, while the dynamics of volumes of high banknote denominations (10,000 and 20,000 tenge) show a growing trend. Unlike banknotes, the dynamics of coins in circulation, as a rule, shows an even growth.

The difference in the dynamics of individual denominations of banknotes can be explained by their life cycle. There are many factors that affect the duration of the life cycle of banknotes: from the policy of the banknote issuer to the payment properties of banknotes to environmental conditions (temperature, rainfall, location, etc.) [10, 11, 12]. At the same time, due to the greater resistance and durability, the service life of coins is noticeably longer.

One of the reasons for the difference in the lifetime distribution of banknotes around the world is the substrates used in the production of banknotes. In order to increase the service life of banknotes in countries such as Australia, Canada, Malaysia, a polymer substrate is used in the banknote manufacturing. Plastic money is more expensive to manufacture than ordinary money, but its service life is several times longer [13]. A particular advantage of the new material over paper is that banknotes made from it are cleaner, as moisture, sweat and dirt are prevented from being absorbed. According to the estimates made by the English company De La Rue, an average service life of polymer banknotes is three times longer than of banknotes made from paper [10].

In Kazakhstan, all banknote denominations except for the 20 000 tenge denomination banknote (a polymer substrate), are manufactured from high-quality cotton paper.

The duration of the life cycle of Kazakhstani banknotes increases according to the nominal range. Smaller denominations wear out faster than higher denominations. So, according to the methods of describing the Steady State Methods, the service life of banknotes with a face value of 10,000 and 20,000 tenge is on average 30-60 months, which is more than 2 times longer than the life of banknotes with a face value of 500 tenge (no more than 1 year) [10, 11, 14]. The lowest velocity of circulation falls on banknotes of the highest denomination (from 1 to 2 times a year), and the highest – on banknotes of small and medium denominations (from 2 to 4 times, depending on the denomination).

The lifespan of individual banknote denominations can be explained by the attitude of people towards the use of one or another denomination of banknotes. As a rule, banknotes of small denominations are most often used in daily transactions when paying for goods and services and, thus, wear out faster. Larger denominations of banknotes, which people treat with more care, are used less often and usually serve as a means of accumulation. Another confirmation of this conclusion is the results of an opinion survey. According to the survey, the majority of people prefer to save money in denominations of 10,000 and 20,000 tenge (52.8% and 35.7%, respectively), less often – 5,000 tenge (21.0%). Banknotes of 500 (1.8%), 1,000 (4.0%) and 2,000 (6.5%) tenge are practically not considered by the population as a means of accumulation.

⁶ An opinion survey entitled as “Medium-Term Prospects of Using Cash” and conducted by the National Bank during the period from October 2021 to August 2022.

To determine the possible factors in the formation of demand for cash, a regression analysis of the relationship between economic indicators and the volume of cash in circulation was carried out.

According to the international practice, the change in the volume of GDP is an indicator of the change in the socio-economic position of the general public. In turn, improved living standards and the growing business activity can lead to an increase in the use of cash as a means of payment for goods and services. Thus, the correlation of monthly indicators⁷ of the volume of cash in circulation and the short-term economic indicator (an indicator of changes in output indices for basic industries that make up 60% of GDP) of Kazakhstan amounted to 91.9%.

Based on the results of a linear regression using the least squares method, a 1% increase in GDP leads to an expansion in banknotes in circulation by 0.81%.

Moreover, according to reports from the second-tier banks⁸, a major portion⁹ (50-60%) of cash disbursements to the population is carried out via electronic devices (ATMs, POS-terminals, etc.). According to the survey, cash is mainly withdrawn to cover current expenses (78% of the surveyed population); the second most mentioned reason for withdrawing money is the transfer of money to relatives and friends (31.5%), and the third is the repayment of loans through POS-terminals and ATMs (16.5%). At the same time, the population uses cash more often than cashless forms of payment when buying goods in a convenience store (cash – 69.8%, cashless – 62.9%) and when buying in the market (cash – 68.5%, cashless – 52.3%). In all other places where goods and services were purchased, respondents preferred cashless payment.

The largest shares of cash withdrawals by business entities are in the sectors of trade (28.4%), construction (13.6%), agriculture, forestry and fishery (9.3%) and the manufacturing industry (7.7%). According to responses of entrepreneurs, on average, about 74.6% of businesses withdraw cash from banks and ATMs for operating activities. Of these: cash withdrawals are made mainly for current expenses – 67%, for settlements with employees and partners – 25.3% and 27.2%, respectively, for repayment of loans through POS-terminals and ATMs – 14.5%.

According to the results of a linear regression using the least squares method, a 1% increase in sales in the trade sector, all other things being equal, leads to an increase in cash by 0.11%, an increase in sales in the manufacturing sector by 1% leads to an increase in cash by 0.17 %, and in the construction sector – by 0.04%. At the same time, the trade sector has the greatest influence on the use of cash among the given exogenous variables and this is also confirmed by the results of the opinion survey (Table 1, Appendix 5).

Table 1

Assessment of Factors Affecting the Growth of Cash in Circulation

	<i>Independent variables</i>		
	<i>(1)Trade, (2)agriculture, forestry and fishery</i>	<i>(1)Manufacturing industry</i>	<i>(1)Construction</i>
Regression coefficient of variable (1),	0.11 (0.01)***	0.17 (0.04)***	0.04 (0.01)***
Regression coefficient of variable (2)	-0.003 (0.003)		

⁷ From January 2010 to August 2022.

⁸ “Report on Cash Operations” in accordance with the Resolution of the Board of the National Bank of the Republic of Kazakhstan dated April 21, 2020 No. 54 “On approval of the list, forms, deadlines for reporting by the second-tier banks and the Submission Rules”, “Information on the sums of cash withdrawals from bank accounts in the amount exceeding 10,000,000 (ten million) tenge in total, carried out during the calendar month by business entities” in accordance with the Joint Resolutions of the Board of the National Bank of the Republic of Kazakhstan dated December 21, 2020 No. 151, the Board of the Agency of the Republic of Kazakhstan for Regulation and Development of the Financial Market dated December 22, 2020 No. 125 and the Order of the Minister of Finance of the Republic of Kazakhstan dated December 22, 2020 No. 1223 “On Approval of the Rules for Cash Withdrawal from Bank Accounts by Business Entities”.

⁹ An average share for the recent 12 months (before September 1, 2022).

Number of observations	164	164	164
R ²	41.3%	11.1%	20.0%
Adjust. R ²	40.6%	10.5%	19.5%
Res. standard error	0.03 (df=161)	0.04 (df=162)	0.03 (df=162)
F-statistics	56.8 (df=2, 161)	20.21 (df=1, 162)	40.5 (df=1, 162)

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Note: compiled by the authors

In addition, in order to analyze the relationship between various indicators in a short and long term and the volume of cash in circulation, an assessment was made in accordance with the Error Correction Model based on the Cusbert and Rohling model [4].

Error correction models are built as follows:

$$\Delta Y_t = a + b\Delta X_t + c(Y_{t-1} - d X_{t-1}) + e,$$

where ΔY_t – is the difference between the current and previous value of a dependent variable;

ΔX_t – the difference between the current and previous value of an independent variable;

Y_{t-1} – the value of independent variable in the preceding quarter;

X_{t-1} – the value of dependent variable in the preceding quarter;

e – a random error.

Model 1 uses the sum of banknotes of small and medium denominations – 500 tenge, 1 000 tenge, 2 000 tenge and 5 000 tenge as a dependent variable (Table 2).

According to the assessment results, model 1 explains 69.8% of variations of changes in the volume of banknotes of small and medium denominations in circulation.

In the short-term perspective, there is a positive relationship between the growth variable for the volume of small and medium denominations of banknotes and the GDP variable, and a negative relationship between the growth variable for the volumes of small and medium denominations of banknotes and the variable for the volume of cashless payments and transfers. This is due to the fact that the growth of cashless payments leads to a decrease in the use of cash, and no change is given when paying by a bank transfer.

Table 2

Model 1: Estimation Results for Regression

	<i>Dependent variable: volumes of banknotes of 500, 1000, 2000, 5000 tenge denominations</i>
Coefficient of the change in GDP	0.19 (0.067)***
Coeff. of the change in the volume of cashless payments and transfers	-0.40 (0.232)*
Coeff. of the number of POS-terminals in the preceding quarter	-0.23 (0.105)**
Coeff. of the unemployment rate in the preceding quarter	-24.00 (6.060)***
Number of observations	61
R ²	69.8%
Adjust. R ²	55.5%
Res. standard error	0.058 (df = 40)
F-statistics	4.868 (df = 19, 40)

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Note: compiled by the authors

In Sweden, one of the most active countries in the world in terms of digitalization of the economy, where until 2018 there was a steady decline in cash in circulation (cumulative average annual decline rate of 7%), in 2018 due to the Riksbank's policy (a low interest rate, announcement of the importance of keeping the krona in cash), the risk of emergencies (power outages, the threat of war) and changes in the preferences of the population, the volume of cash in circulation went

up by 7.2%. The compound annual growth rate of cash in Sweden over the past 5 years is 1.4% (Appendix 6) [15].

In Kazakhstan, since 2019, a two-fold annual growth rate of the volume of cashless operations has been observed¹⁰ (2019 – 13.3 trln tenge, 2020 – 34.6 trln tenge, 2021 – 72.3 trln tenge). At the same time, the growth of cash in circulation in Kazakhstan in 2019 and 2021 amounted to 2.4% and 5.9% (2020 is a shock period due to the COVID-19); while until 2019 (excluding 2014) the compound annual growth rate of cash was 11.5%. Thus, the active development of cashless payments in Kazakhstan since 2019 has been leading to reduction in the growth rate of cash in circulation, but, similarly to Sweden, in the long term, a decrease in the volume of cash in circulation is not anticipated.

A 1% increase in the number of POS-terminals, other things being equal, results in a 0.3% decrease in the amount of small and medium denominations of banknotes in circulation in the long term. The exponential growth in the volume of cashless payments and the number of POS-terminals, which has been observed recently, carries risks of lower demand for small and medium denominations of banknotes.

A 1% increase in the unemployment rate reduces the demand for banknotes of small and medium denominations by 32%, all other things being equal, in the long run. Given that the unemployment rate has remained at the same level (4.8-5.5%) over the past decade, this factor does not pose significant risks for cash in circulation.

A dependent variable in Model 2 is the volume of banknotes of large denominations (10 000 and 20 000 tenge) (Table 3).

According to the estimation results, Model 2 explains 97.7% of variations in the change of the volume of large denominations of banknotes in circulation.

In the short term, there is a positive relationship between the growth in the volume of large banknote denominations and the number of ATMs. An increase in the number of ATMs by 1% leads to an increase in the amount of large banknote denominations in circulation by 1.9%, other things being equal, in the long term. One reason for this dependence may be the increased availability of banknotes as the number of ATMs grows.

Table 3

Model 2: Estimation Results for Regression

	<i>Dependent variable: volumes of banknotes of 10 000 and 20 000 tenge</i>
Coeff. of the change in the number of ATMs	1.11 (0.33)**
Coeff. of the number of ATMs in the preceding quarter	2.32 (0.62)**
Coeff. of the deposit rate level in the preceding quarter	-0.13 (0.06)*
Number of observations	61
R ²	97.7%
Adjust. R ²	88.8%
Res. standard error	0.02 (df = 5)
F-statistics	11.04 (df = 5, 19)
<i>*p<0.1; **p<0.05; ***p<0.01</i>	

Note: compiled by the authors

More over, other things being equal, a 1% growth of the deposit rate¹¹ results in a 10.6% reduction in the volume of large denominations of banknotes in the long term.

The dependent variable in Model 3 is the volume of coins in circulation¹² (Table 4).

¹⁰ The use of payment cards issued by local and foreign issuers within the territory of Kazakhstan.

¹¹ Quarterly average values of bank interest rates on attracted demand deposits, according to the official publication of the National Bank of Kazakhstan “Statistical Bulletin of the National Bank”.

¹² Due to the relatively recent issue of the 200-tenge coins into circulation (in January 2020), the data on the volume of these coins in circulation was not used in Model 3.

Table 4

Model 3: Estimation Results for Regression

		<i>Dependent variable: volumes of coins of 1, 2, 5, 10, 20, 50, 100 tenge denominations</i>
Coeff. of the change in GDP		0.028 (0.012)**
Coeff. of the change in inflation		-0.002 (0.001)*
Numbers of observations		53
R ²		66.1%
Adjust. R ²		55.7%
Res. standard error		0.009 (df = 36)
F-statistics		6.37 (df = 11, 36)
		<i>*p<0.1; **p<0.05; ***p<0.01</i>

Note: compiled by the authors

According to the estimation results, Model 3 explains 66.1% of variations in the change of the volume of circulating coins in circulation.

In the short term, there is a positive relationship between the growth in the volume of coins in circulation and GDP. The relationship between inflation and the volume of coins is negative. As inflation rises, the purchasing power of coins decreases. Therefore, there is a risk of lower demand for coins.

Additionally, in accordance with the D-Metric methodology [16], which allows estimating the structure of the nominal range of banknotes and coins depending on the average daily wage (D), it is worth mentioning that since 2017, the 200-tenge banknote has been in the transition zone between the banknote and coins (D/50 and D/20) until the release of coins of this denomination in 2020. The next denomination, the 500-tenge banknote, has been in the transition zone since 2021, considering if its transfer to the category of coins is possible. Moreover, according to this methodology, due to the decline in purchasing power, coins with denominations of 1 and 2 tenge are not included in the optimal nominal range of coins from 2021 (Appendix 7).

In addition, the dynamics of the amount of coins and banknotes of small and medium denominations (500, 1,000, 2,000, 5,000 tenge) in circulation, adjusted for the percentage of the price index, shows a decrease as the volume of non-cash transactions grows (Appendix 8). Despite an active growth of cashless operations since 2019 (more than a two-fold growth every year), the average amount of one transaction for cashless operations is 12 thousand tenge, which indicates that they are used largely for small daily purchases. The survey¹³ showed the following results of how the amount influences the choice of a cashless form of payment: up to 5,000 tenge - 32.7%, 5,000-14,999 tenge - 24.3%, 15,000-99,999 tenge - 28%, more than 100,000 tenge - 15%. At the same time, according to the results of the survey, given a more frequent issuance of the 2,000 tenge (43.1%), 5,000 tenge (63.2%), 10,000 tenge (51.8%) banknotes by second-tier banks and ATMs, the population note that there is a need for coins and small denominations of banknotes (sufficiency of all denominations of coins is noted by only 52% of respondents, the need for banknotes of 500 tenge was mentioned by 22.9% of respondents, for banknotes of 1,000 tenge – by 12% of respondents [10]).

Based on the assessment of the indicators that affect the change in the demand for cash, and the lack of reliable resources for the forecast of many exogenous variables, the change in GDP can be used as an explanatory variable to predict the volume of cash for the future period. With a forecasted¹⁴ growth of nominal GDP by 60.2% over five years (from 81.3 trln tenge in 2021 to 130.2 trln tenge in 2026), the growth in the amount of banknotes in circulation will account for 31.1% (Appendix 9). The compound annual growth rate of 5.6% demonstrates the possible feasibility of the above hypothesis about deceleration in cash in circulation as cashless forms of payment develop.

¹³ If all answers of the respondent are taken as 100%.

¹⁴ by using an analytical toolkit of De La Rue Co. – De La Rue Analytics.

5. Conclusion

Despite the development of financial technologies, cash is one of the main payment instruments for the population of Kazakhstan. In Kazakhstan, as in many countries of the world, there is an increase in cash in circulation, which was especially noticeable during the “COVID crisis”. Without taking into consideration various shock periods, seasonal peaks in the demand for cash in Kazakhstan and in the world mainly occur on the days before public holidays.

At the same time, the life cycle of banknotes in Kazakhstan differs depending on the denomination. Small denominations are most often used in daily settlements and wear out faster, while large denominations of banknotes are used less often and, as a rule, serve as a means of accumulation and savings.

As part of this study, based on assessment of the impact of various indicators on the volume of cash in circulation, using the error correction model and linear regression by the least squares method, possible factors in the formation of demand for cash are analyzed.

GDP as the main indicator of the level of economic activity and the quality of life of the population has a direct impact on the use of cash in the country. At the same time, among the GDP component sectors, trade has a significant impact on the change in demand for cash, which is confirmed by the results of an opinion survey.

The active development of cashless payments in Kazakhstan leads to a decline in the growth rate of the cash volume. However, similarly to Sweden (countries with one of the highest rates of alternative payment methods), a decline in the volume of cash in circulation in the long term is not expected.

In addition, there is a positive relationship between the number of ATMs and the growth of large denominations in circulation, due to the increased availability of cash as the number of devices grows and larger denominations of banknotes are withdrawn from ATMs. Besides, the growth of deposit rates in the long term leads to reduction of large banknote denominations in circulation.

Despite the possible risk of reduction in the demand for coins with the rising inflation, according to the survey, the population has a need for coins and small denominations of banknotes.

In addition to assessing quantitative indicators that affect the demand for cash, in the context of current trends in the development of payment instruments and rapid technological development, periodic analysis of payment preferences based on a survey of economic entities remains of particular relevance. For example, such surveys have been conducted regularly in the European countries for more than a decade, in particular in Germany – every three years.

Given the degree of influence on the change in the volume of cash in circulation, GDP forecasts can be used as an additional parameter to assess a future demand for cash.

Literature:

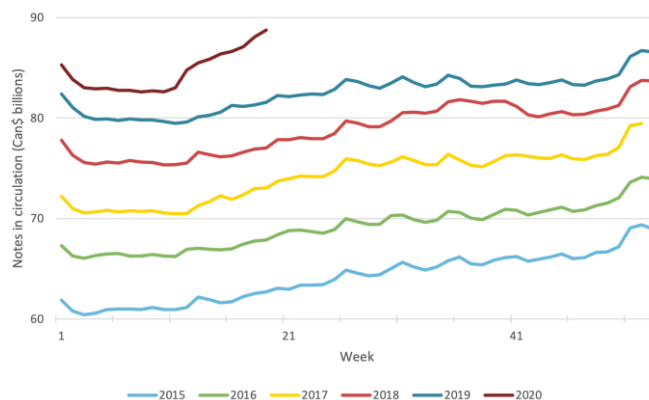
1. Re-engineering currency circulation: an international study of cash handling models. Currency Research, 2015.
2. The Law of the Republic of Kazakhstan dated March 30, 1995 No.2155 “About the National Bank of the Republic of Kazakhstan”.
3. Miller, C., 2017. Addressing the limitations of forecasting banknote demand. [online] Bankofengland.co.uk. <https://www.bankofengland.co.uk/-/media/boe/files/paper/2017/addressing-the-limitations-of-forecasting-banknote-demand>.
4. Cusbert, T. and Rohling, T., 2013. Currency Demand During the Global Financial Crisis: Evidence from Australia. SSRN Electronic Journal.
5. Assenmacher, K., Seitz, F. and Tenhofen, J., 2019. The demand for Swiss banknotes: some new evidence. Swiss Journal of Economics and Statistics, 155(1).
6. Vale, B., 2015. Forecasting demand for various denominations of notes and coins using error correction models. Norges-bank.no. <https://www.norges-bank.no/en/news-events/news-publications/Papers/Staff-Memo/2015/Staff-Memo-12015/>.

7. Khalid, N., Harunurashid Thelata, M., Fakhzan Marwan, N. and Abdul Karim, Z., 2017. Forecasting of money demand in Malaysia using neural networks and econometric model. [online] Ums.edu.my. <https://www.ums.edu.my/fpep/files/Norlin.pdf>.
8. Cabrero, A., Camba-Mendez, G., Hirsch, A. and Nieto, F., 2002. Modeling the daily banknotes in circulation in the context of the liquidity management of the European Central Bank. [online] Ecb.europa.eu. <https://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp142.pdf>.
9. Board of Governors of the Federal Reserve System. 2020. The Fed - Revised 2020 Currency Print Order. Доступен на сайте ФРС (https://www.federalreserve.gov/paymentsystems/2020_revised_coin_currency_orders.htm).
10. 2018 Cash Cycle Partnership Seminar. De La Rue. Basingstoke. February 6-7, 2018.
11. Factors to Consider When Calculating Banknote Lifetimes. De La Rue Webinars for Cash Cycle Partnership. June 2017.
12. Modelling euro banknote quality in circulation. Harald Deinhammer, Anna Ladi. ECB Occasional Paper Series No 204 / December 2017.
13. Wakefield, M., Delaney, L. and Finlay, R., 2022. A Cost-benefit Analysis of Polymer Banknotes | Bulletin – December 2019. [online] Reserve Bank of Australia. <https://www.rba.gov.au/publications/bulletin/2019/dec/a-cost-benefit-analysis-of-polymer-banknotes.html>.
14. The Life of Australian Banknotes. Alexandra Rush. Research Discussion Paper. Note Issue Department of Reserve Bank of Australia August 2015.
15. Riksbank.se. 2022. Statistics on banknotes and coins. [online] Available at: <<https://www.riksbank.se/en-gb/statistics/statistics-on-payments-banknotes-and-coins/notes-and-coins/>> [Accessed 29 September 2022].
16. Analysis of the denomination structure of the Polish currency in the context of the launch of the new 500 zloty banknote. Manikowski, A., 2017. [[online](#)].

A Change in the Volume of Cash in Circulation in the World at the Onset of the COVID-19 Pandemic

Canada

Chart 1: Notes in circulation by year

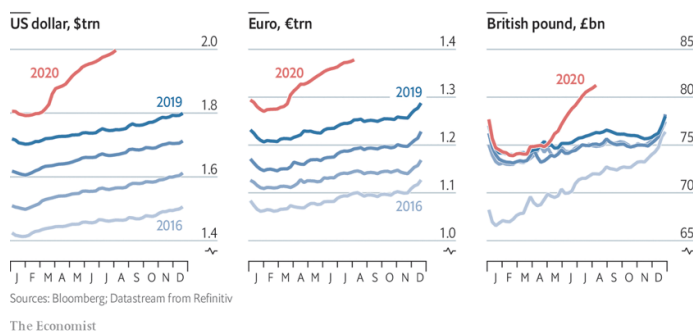


Source: <https://www.cashmatters.org/blog/cash-demand-surged-canada/>

USA, Eurozone, UK

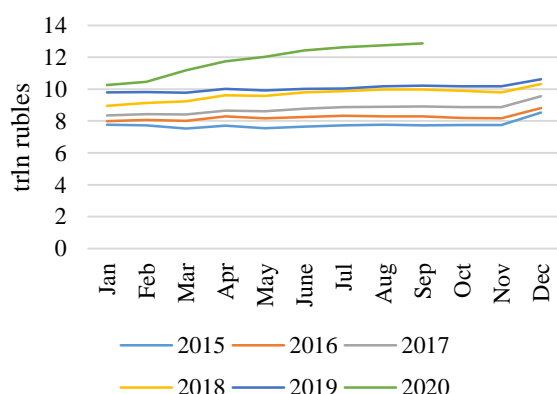
Paper chase

Currency in circulation



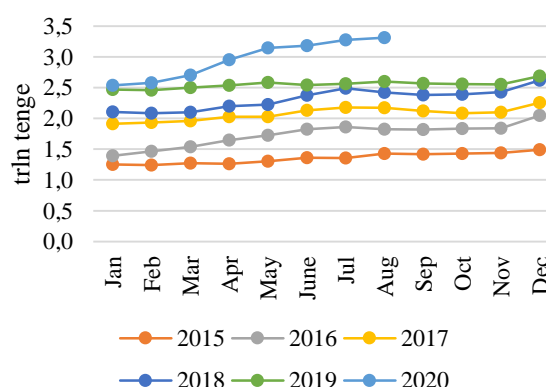
Source: <https://www.economist.com/graphic-detail/2020/08/13/why-cash-has-been-piling-up-during-the-pandemic>

Russia



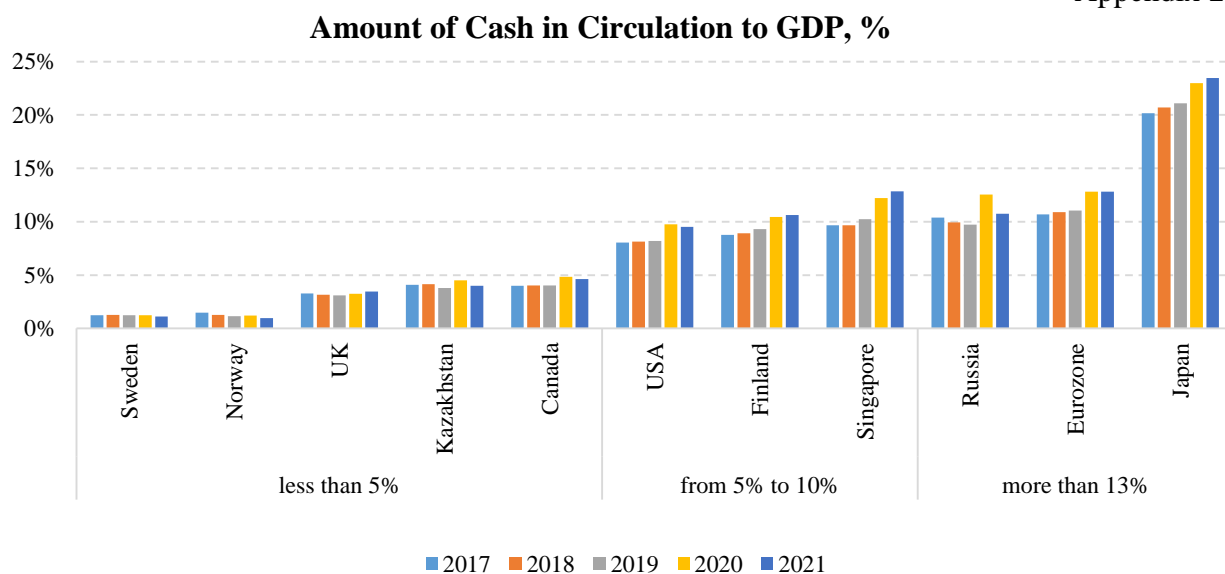
Source: https://www.cbr.ru/Bank-notes_coins/nal/itm_31295/str_nal_dm_20100/

Kazakhstan



Source: National Bank of Kazakhstan

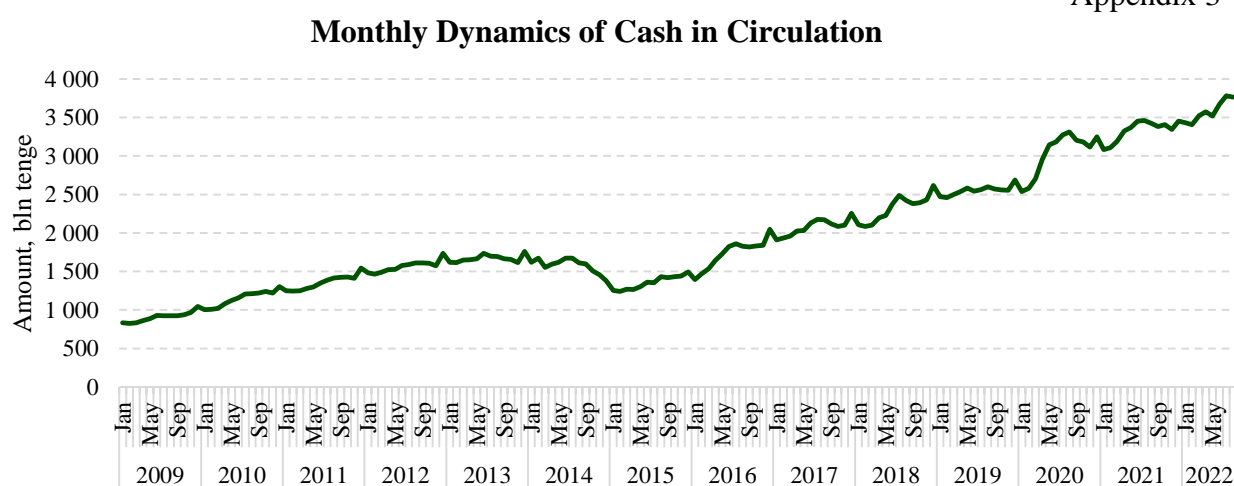
Appendix 2



Note: compiled by the authors

Source: National Bank of Kazakhstan, International Monetary Fund

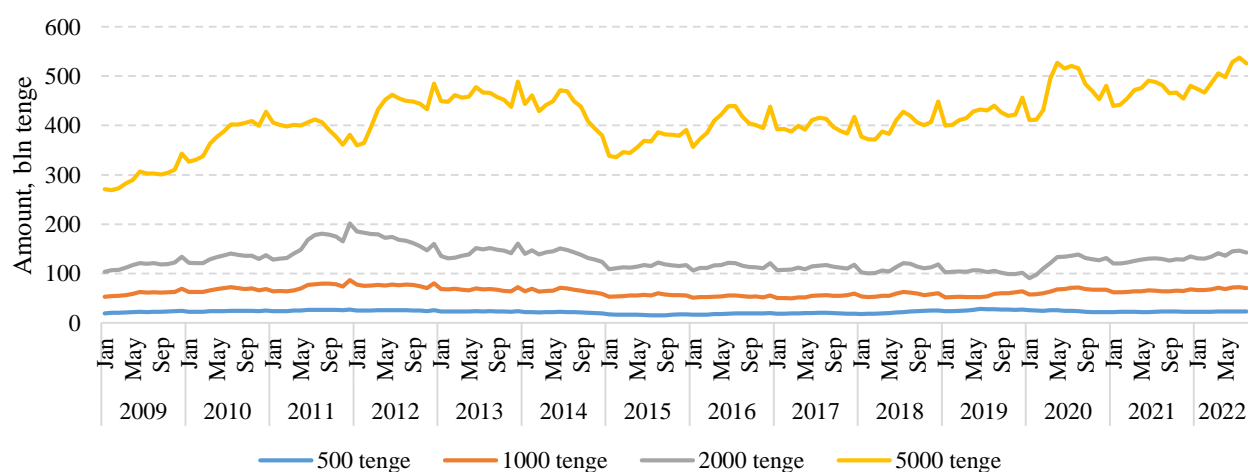
Appendix 3



Note: compiled by the authors

Source: National Bank of Kazakhstan

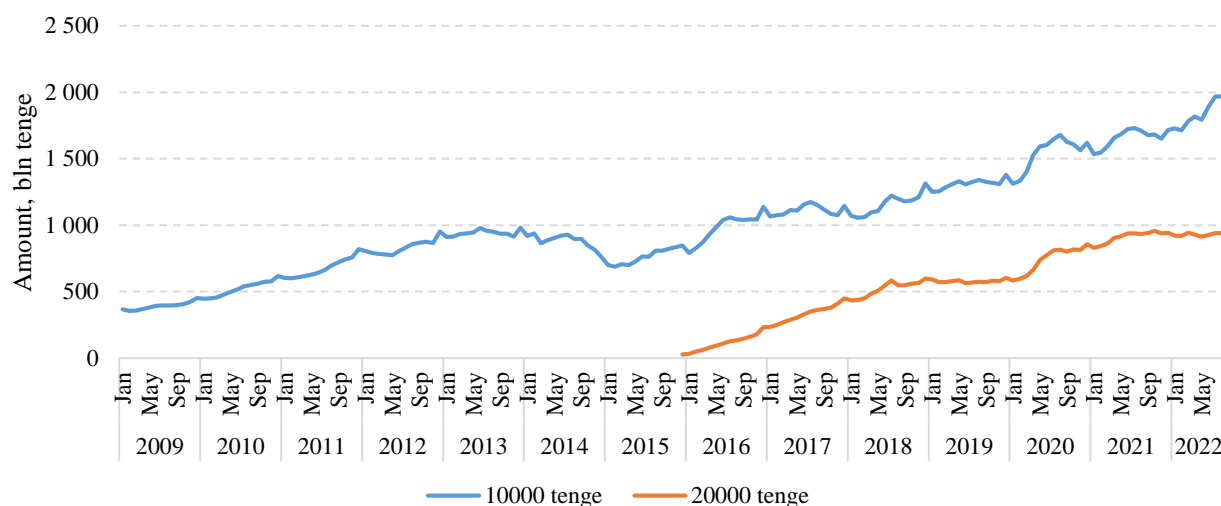
Dynamics of Banknotes of the 500, 1 000, 2 000, 5 000 Tenge Denominations in Circulation



Note: compiled by the authors

Source: National Bank of Kazakhstan

Dynamics of Banknotes of the 10 000 and 20 000 Tenge Denominations in Circulation

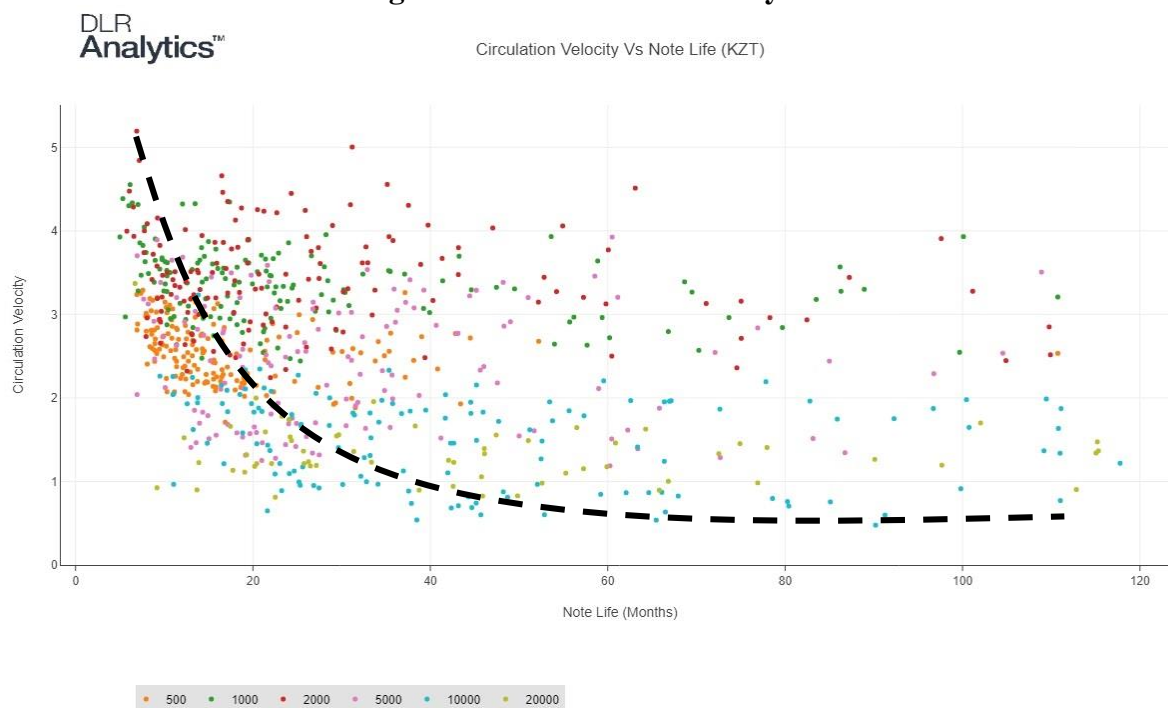


Note: compiled by the authors

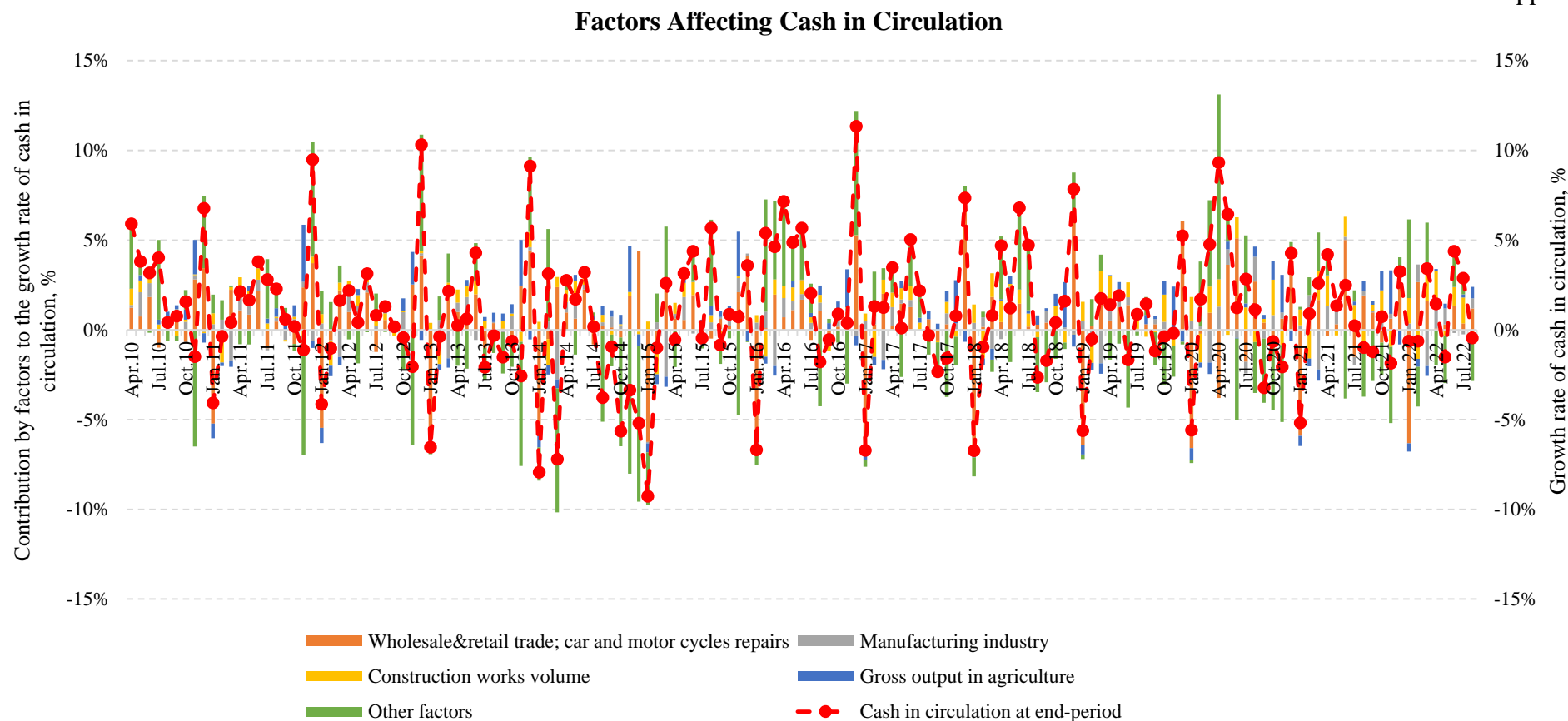
Source: National Bank of Kazakhstan

Appendix 4

Scatter Diagram of Circulation Velocity and Note Life

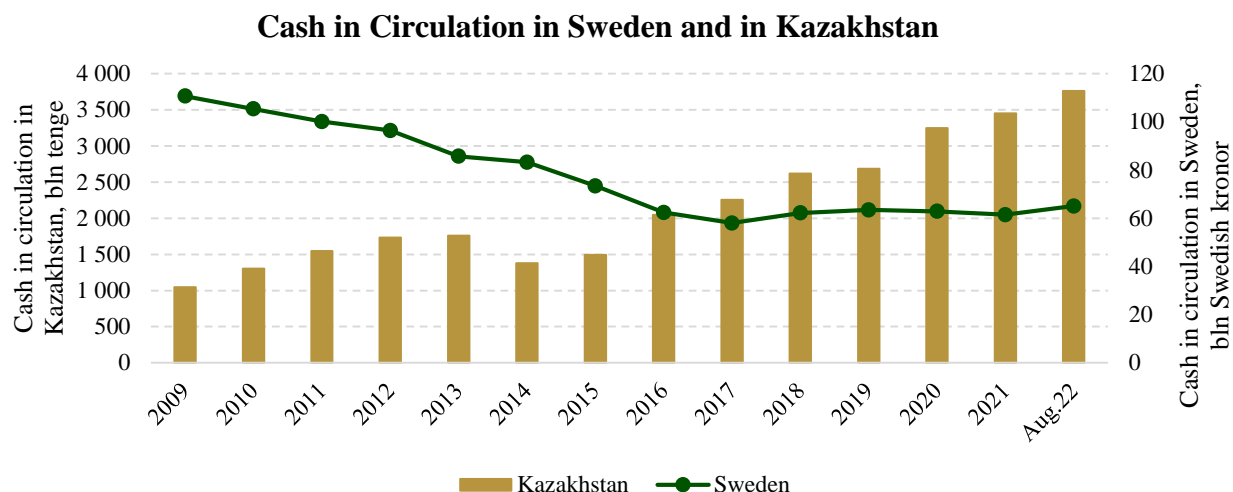


Source: DeLaRue Analytics



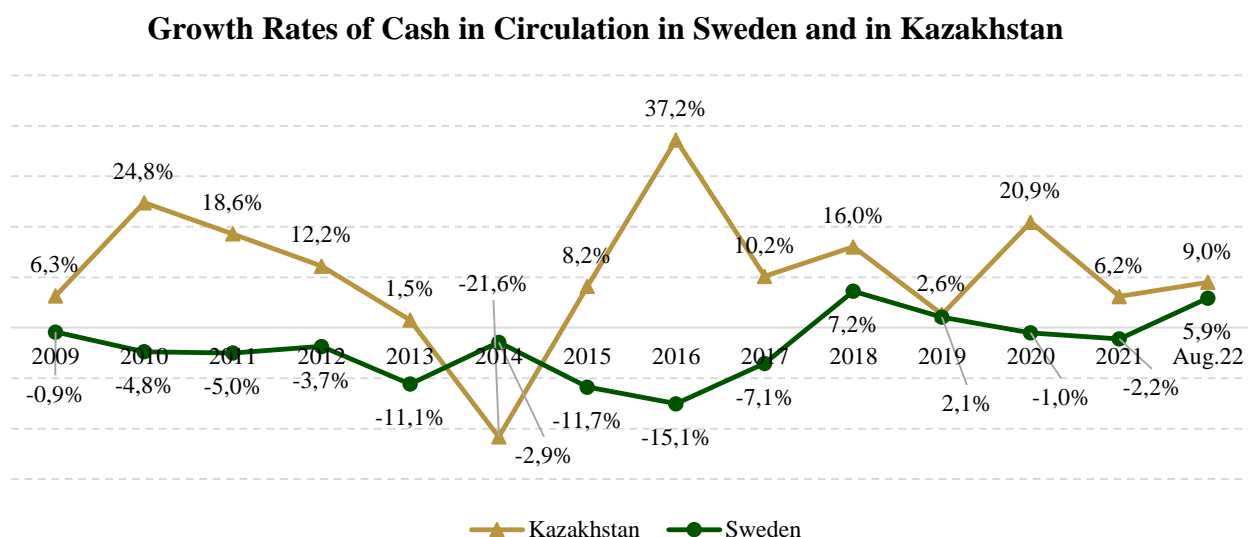
Note: compiled by the authors

Source: National Bank of Kazakhstan, Bureau of National Statistics with the Agency of Strategic Planning and Reforms of Kazakhstan



Note: compiled by the authors

Source: National Bank of Kazakhstan, Riksbank



Note: compiled by the authors

Source: National Bank of Kazakhstan, Riksbank

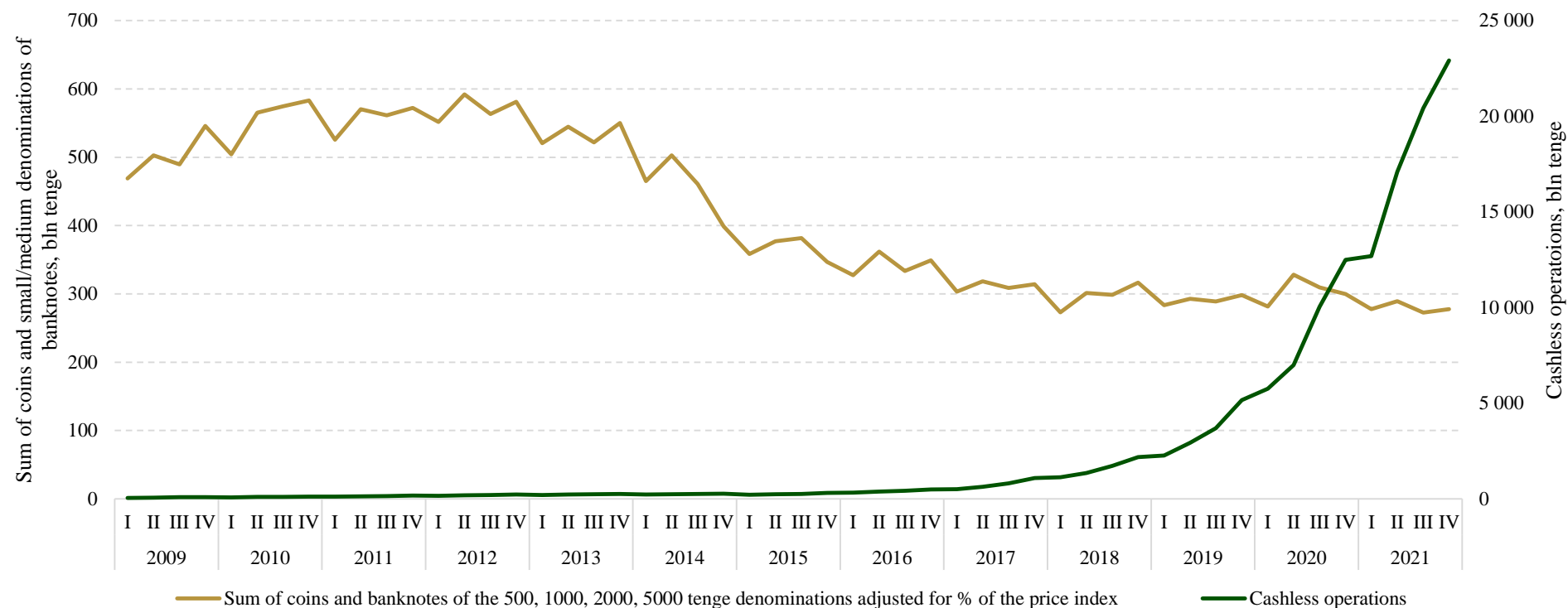
Analysis of the Nominal Structure of Coins in Accordance with the D-Metric Methodology

Set of Denominations	Year	2017	2018	2019	2020	2021	2022, 1 st Quarter	2022, 2 nd Quarter
Coins								
1-coin denomination	D*/5000	1.4	1.5	1.7	1.9	2.3	2.8	3.1
		2 tenge	2 tenge	2 tenge	2 tenge	5 tenge	5 tenge	5 tenge
2-coin denomination	D/2000	3.5	3.7	4.3	4.8	5.7	7.0	7.6
		5 tenge	5 tenge	5 tenge	5 tenge	10 tenge	10 tenge	10 tenge
3-coin denomination	D/1000	7.0	7.5	8.5	9.6	11.3	14.0	15.3
		10 tenge	10 tenge	10 tenge	10 tenge	20 tenge	20 tenge	20 tenge
4-coin denomination	D/500	13.9	14.9	17.1	19.2	22.7	28.0	30.6
		20 tenge	20 tenge	20 tenge	20 tenge	50 tenge	50 tenge	50 tenge
5-coin denomination	D/200	34.8	37.3	42.6	48.0	56.7	69.9	76.4
		50 tenge	50 tenge	50 tenge	50 tenge	100 tenge	100 tenge	100 tenge
6-coin denomination	D/100	69.7	74.6	85.3	96.0	113.4	139.8	152.8
		100 tenge	100 tenge	100 tenge	100 tenge	200 tenge	200 tenge	200 tenge
Banknote/Coin Boundary								
Banknote/ coin	D/50	139.3	149.1	170.6	191.9	226.7	279.6	305.6
		200 tenge	200 tenge	200 tenge	200 tenge	500 tenge	500 tenge	500 tenge
	D/20	348.4	372.8	426.4	479.8	566.8	698.9	764.0

* average daily nominal wage of one worker including small enterprises engaged in entrepreneurship

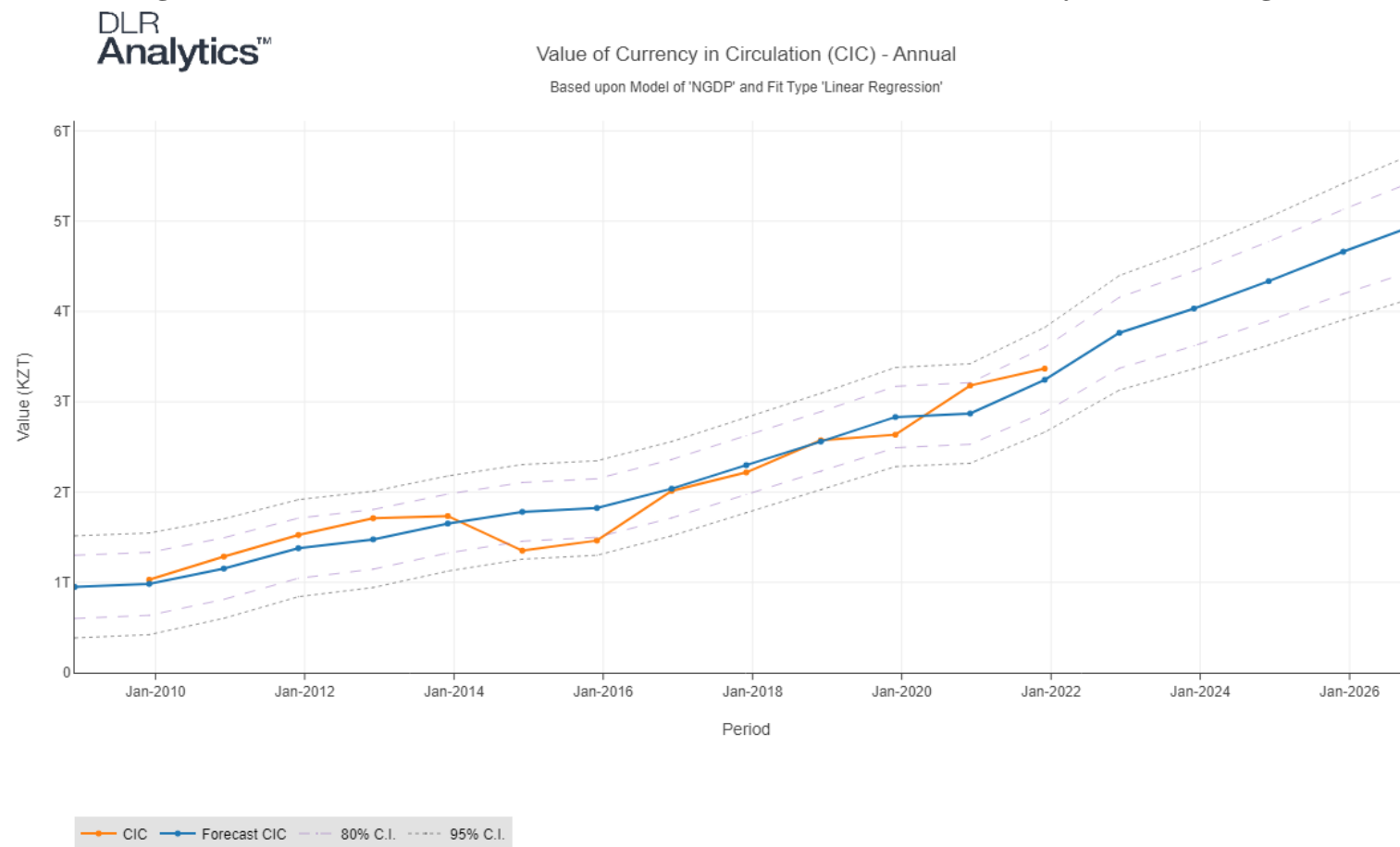
Note: compiled by the authors

Source: National Bank of Kazakhstan, Bureau of National Statistics with the Agency of Strategic Planning and Reforms of Kazakhstan

Dynamics of the Change in Volumes of Coins/Small Banknotes and Cashless Operations

Note: compiled by the authors

Source: National Bank of Kazakhstan, Bureau of National Statistics with the Agency of Strategic Planning and Reforms of Kazakhstan

Forecasting Volumes of Cash in Circulation Based on the Use of a GDP Forecast by the Linear Regression Method

Source: DeLaRue Analytics

PROSPECTS FOR INFRASTRUCTURE INVESTMENTS IN THE PERIOD OF GLOBAL TRANSFORMATIONS

Barmambekova S.A. – Head, Strategy Division, “National Investment Corporation of the National Bank of Kazakhstan” JSC

Assilbekova A.A. – Manager, Strategy Division, “National Investment Corporation of the National Bank of Kazakhstan” JSC

Saduakassov B.R. – Expert, Strategy Division, “National Investment Corporation of the National Bank of Kazakhstan” JSC

Tursinbayeva G.G. – Expert, Risk Management Department, “National Investment Corporation of the National Bank of Kazakhstan” JSC

In the environment of high inflation, more and more institutional investors are showing interest in private infrastructure. Strong demand for this class of assets will intensify competition for low-risk, high-yield projects. In addition to the prerequisites for existing attractiveness, the paper discusses investment properties and shows the dynamics of development of the private infrastructure market, including assets under management, the volume of capital raised and deals, as well as performance indicators in the context of strategies and regions. Despite the conventional wisdom that infrastructure protects against inflation, not all infrastructure assets exhibit inflation hedging. Therefore, when investing, assets should be examined for inflation protection at the project, industry and country levels in terms of regulation of indexation aspects. The paper also discusses promising areas of investment in the context of strategies and regions. The final part provides an overview of the main players in the private infrastructure market.

Key Words: private infrastructure market, asset class strategies, assets under management, inflation hedging, service-producing industries, promising areas.

JEL-Classification: G110, G230.

Infrastructure Overview

In 2021, total assets under management (“the AUM”) of an alternative class of assets (“the AI”) in the global economy exceeded 13.3 trln US dollars, where private capital accounts for the largest portion (40%), followed by hedge funds (33%), real estate (10%) and infrastructure (6%) (Diagram 1). From 2011 to 2021, infrastructure was the fastest growing asset class with an annual growth rate of 13%, followed by private debt (11%) and private capital (9%). According to Preqin, by 2026, the total assets under infrastructure management in the world will reach 1.87 trillion US dollars, or 8% of the total AUM AI. Asset class is likely to outpace private real estate in terms of AUM (Diagram 2).

Private infrastructure is sought after by many investors due to its stability in the time of an economic turmoil, which was confirmed during the Global Financial Crisis in the late 2000s. Investing in infrastructure as an asset class has the following benefits:

- portfolio diversification – a low correlation with other classes of assets and public markets, especially in the long term;

- lower volatility – less exposure to short-term market fluctuations;

- a stable cash flow stipulated by a long-term contract;

- protection from inflation (inflation hedging) through regulation, concession agreements or contracts with interest rates that are increasing in line with the inflation rate or above it;

- low maintenance costs (for secondary or operating assets);

- durability, these assets, as a rule, are less exposed to technological obsolescence and have a long service life.

Diagram 1

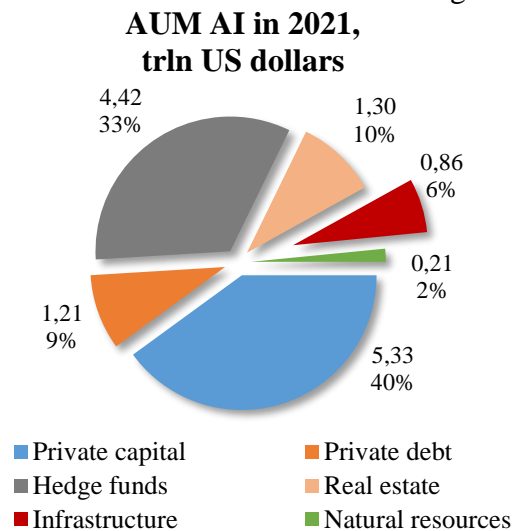
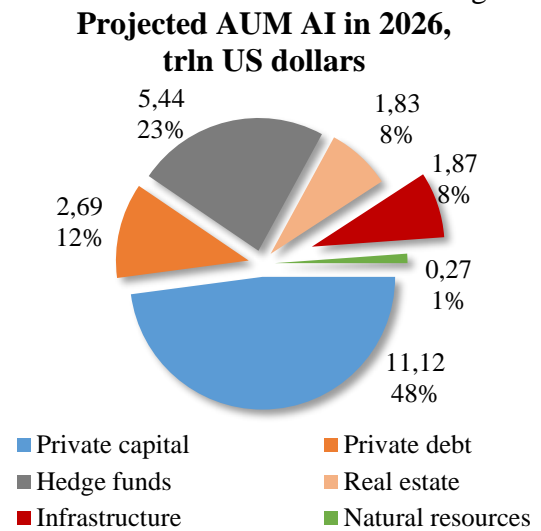


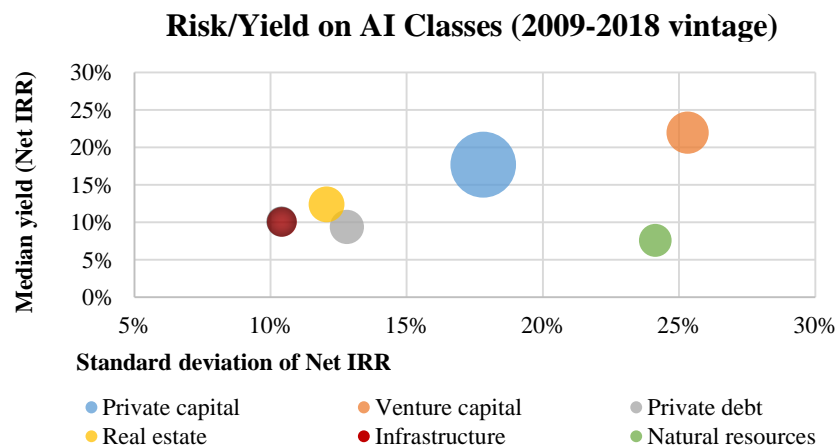
Diagram 2



Source: Preqin data

The long-term performance of the infrastructure shows its benefits in terms of diversification. Thus, compared to other asset classes such as private capital and private real estate, infrastructure had the lowest standard deviation with a median return of 10% (2009-2018 vintage). This asset class is closest to the transition point to the efficient yield frontier (2009-2018 vintage) (Diagram 3). The infrastructure is more attractive to those investors who are willing to reduce portfolio volatility while maintaining yield equivalent to that of the stock market.

Diagram 3

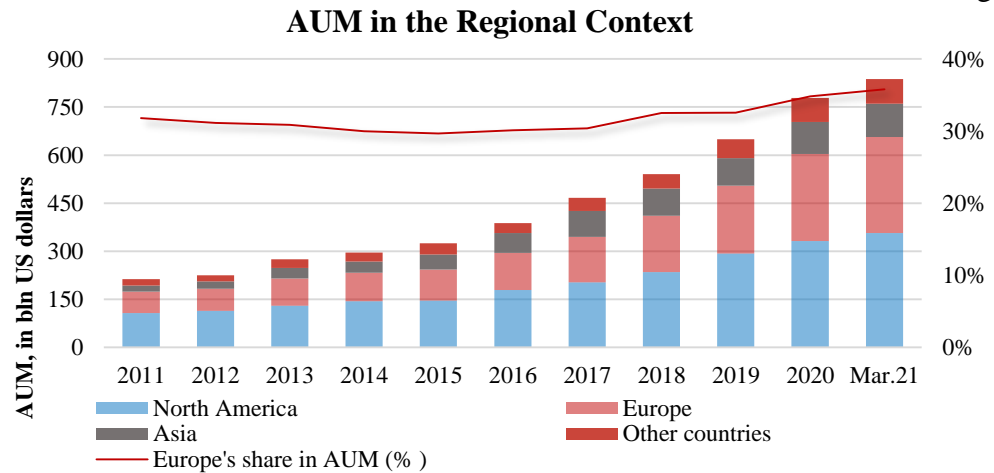


Source: Preqin data

It is worth mentioning that the median distribution of sovereign funds for infrastructure amounts to 7.3% while an average volume of commitment equals 156 mln US dollars.

As of March 2021, the regional breakdown of the AUM asset class was as follows: North America 43%, Asia 13% and other countries – 9%. The share of Europe in the total amount of AUM infrastructure was 36%, which is by 6% more than the share of the end of 2017. Overall, there has been strong growth across the region (Diagram 4). Thus, the growth of AUM in Europe in the period from 2015 to 2020 was 20%, while in North America this figure was 18%.

Diagram 4



Source: Preqin data

Although private infrastructure strategies are similar to private real estate strategies (Debt, Core, Core-plus, Value Added and Opportunistic), risk profiles of the strategies of the two assets differ significantly. In both real estate and infrastructure, the term “Core” describes the least risky type of strategy, focusing on high quality assets with a stable cash flow. At the other end of the risk spectrum is the Opportunistic strategy, which is close to the Distressed strategy in real estate. The Opportunistic strategy for both asset classes is focused on increasing the value of assets through capital works and construction, i.e. high-risk projects.

The initial leverage may vary depending on the strategy. Thus, the Core strategy can attract borrowed funds at the initial stage of the project due to the stability of cash flows. Projects with a riskier Value Added strategy can be refinanced if the value of assets increases after completion of works (Table 1).

Table 1

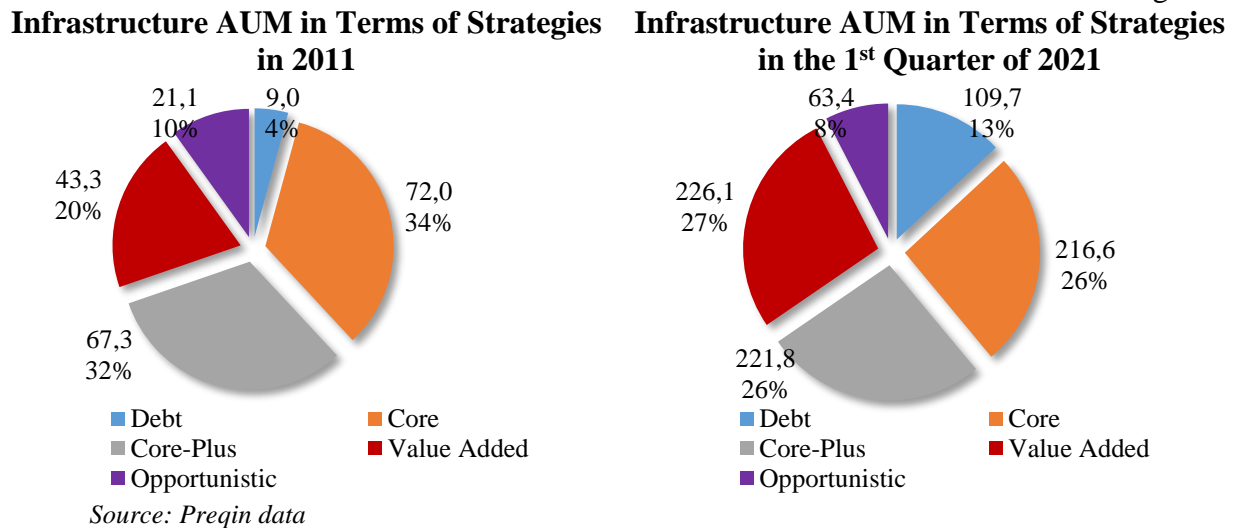
Private Infrastructure Strategies

Core	Assets with stable revenues, significant cash returns and a high degree of inflation hedging, built into the terms of the contract. Do not require additional investments for development.
Core-plus	Compared to the Core strategy, it has a higher risk/reward profile during development, construction and early operations. However, in the long run, the asset acquires the property of the Core strategy. The strategy has a more abrupt “J-curve” than Core.
Value Added	It has characteristics of the Core strategy, but additional value can be created through improvements, repairs, expansion of production facilities, or conversion of existing assets. Profitability is determined both by money income and by growth in value.
Opportunistic	The strategy is related to new construction (Greenfield) or development of the current asset. The strategy has a high risk compared to the acquisition of an existing asset, but at the same time, a potential return is much higher than in other strategies. Investments under this strategy are sensitive to fluctuations in commodity prices. In addition, there is a high level of uncertainty about future revenue and demand. Profitability is determined by the growth in the value of the asset.
Greenfield	Projects that create new assets from scratch. The implementation period takes a long time and is classified as high-risk.

Debt	The strategy is based on the provision of liability financing, including loans, bonds, mezzanine financing and convertible bonds. Profitability is provided by the current return on the asset.
General	The fund that includes all main strategies depending on investment opportunities.

A large portion of growth over the last 10 years (at March 2021) has been observed on the Debt and Value Added strategies. What is more, the latter has outpaced the Core-plus in terms of AUM in 2021 and became the largest strategy with the share of 27% (Diagram 5).

Diagram 5



With the increase in capital flowing into the strategy, the Value Added strategy had the highest share of idle capital (dry powder) of any strategy in AUM as of March 2021 (Diagram 7). However, since 2021, the Core strategy has started to raise more capital than the Value Added strategy. Among strategies, Opportunistic has a higher level of risk than any other strategy. Nevertheless, profitability of the latter is about the same as that of the Core strategy, and lower than that of the Value Added strategy. Thus, the strategy is below the efficient frontier (Diagram 8). Preqin is skeptical about future prospects of the Opportunistic strategy.

Diagram 7

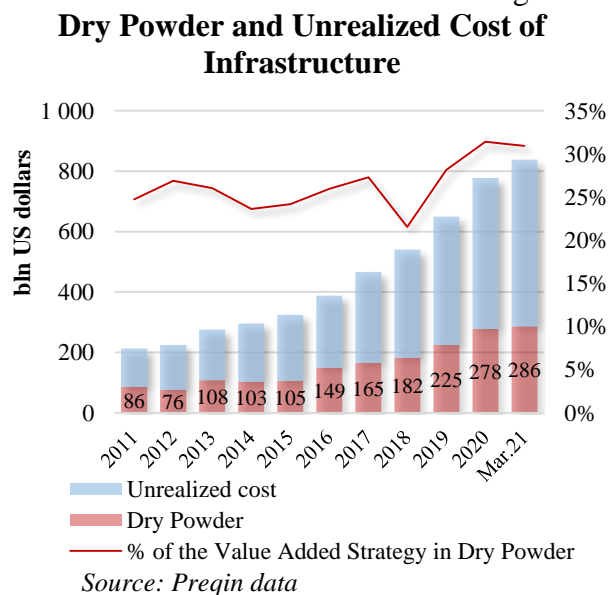
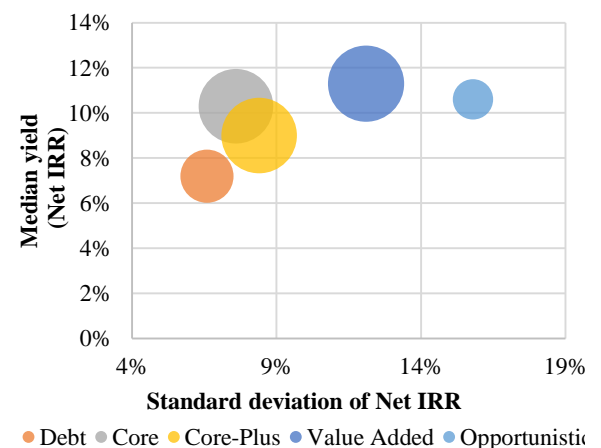


Diagram 8

Risk/Return on the Infrastructure in Terms of Strategy (2009-2018 vintage)



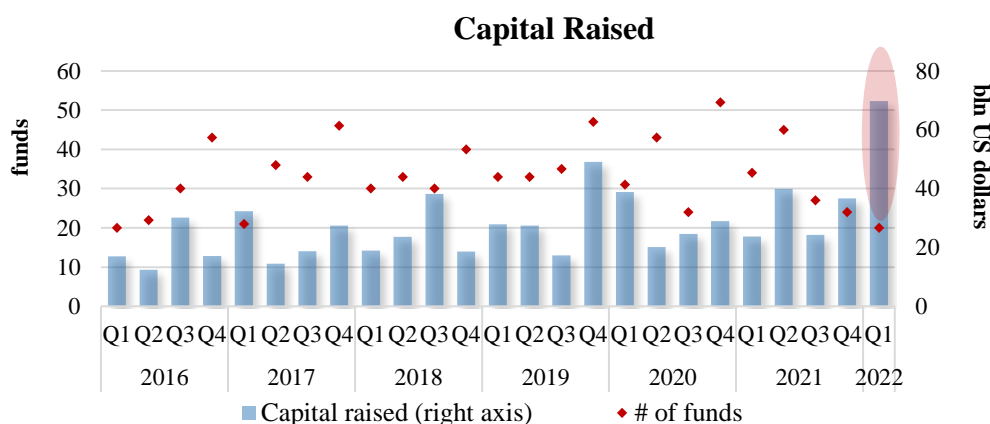
Private infrastructure should be included in the portfolio due to a low correlation with other asset classes, historically strong performance in a high inflation environment and low growth, which is currently expected by most market analysts. In terms of strategies, preference should be given to the Core, Core-plus and Value Added strategies, which are at the efficient frontier of profitability.

Capital Raising, Deals and Cash Flow

From 2016 to 2021, the global average rate of annual capital raising in infrastructure was 8%. As projected, capital raising will grow to 160 bln US dollars in 2026 from 125 bln US dollars on a year-on-year basis in 2021. The first quarter of 2022 was the most active quarter in terms of raised capital owing to large sums of raised capital of such mega-funds as KKR and Stonepeak IV equaling 17 and 14 bln US dollars, respectively. The total capital raised amounted to a record 70 bln US dollars, which is by 42% more than in the previous peak Q4 2019. Preqin thinks it's likely that a strong quarter will be followed by a few quieter quarters.

Apart from the record volume of capital raising, it is noteworthy that monies were raised by 20 funds only. Such a high concentration has not been observed since the first quarter of 2016 (Diagram 9).

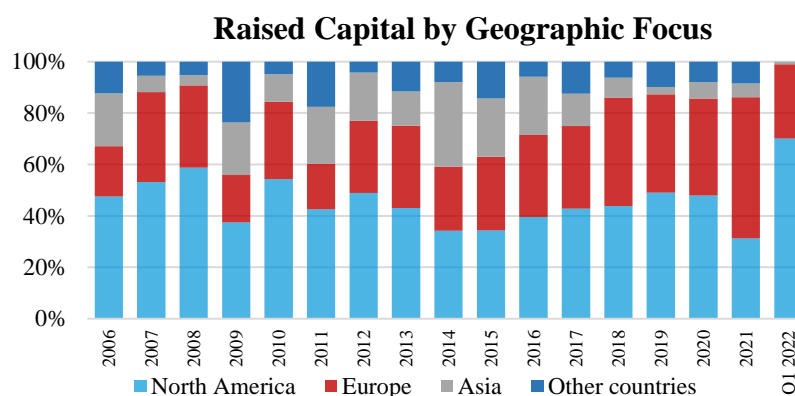
Diagram 9



Source: Preqin data

In the first quarter of 2022, the funds oriented at North America raised a large portion of capital and accounted for 50% of the total number of funds, which completed capital mobilization (Diagram 10). The funds focusing on Europe account for 40% of all funds that completed a deal and 29% of aggregate capital raised. Funds oriented at Asia raised a bit more than 700 mln US dollars.

Diagram 10



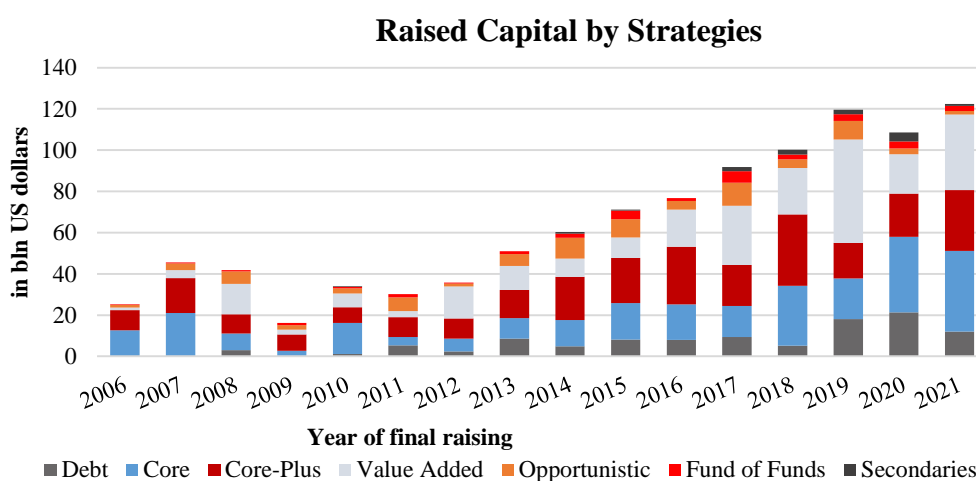
Source: Preqin data

Preqin notes visible differences across countries in terms of the industry focus. In Europe, renewable energy sources are central to infrastructure investment due to the priority given to climate change policies. In general, in recent years, this topic has been the main driver for the growth of raised capital in Europe.

Top ten companies in the private infrastructure market are mainly focused on North America (Brookfield Asset Management, ISQ, Ares Management, USA BioEnergy, Blackstone Group, Goldman Sachs Asset Management). The First Sentier Investors manage the largest fund oriented at Europe. The China International Capital Corporation is a large company with the accent on Asia. EQT raises capital to the funds with geographically diversified focus.

In 2021, the capital raising in accordance with the Core and Core-plus recovered to 56% from the minimum of 31% in 2019, when the Value Added strategy was the most popular among investors. Activity in the capital raising in accordance with the Opportunistic strategy started to go down from 2012. In 2021, this strategy raised less than 2% of the total capital, or 1.8 bln US dollars (Diagram 11).

Diagram 11



Source: Preqin data

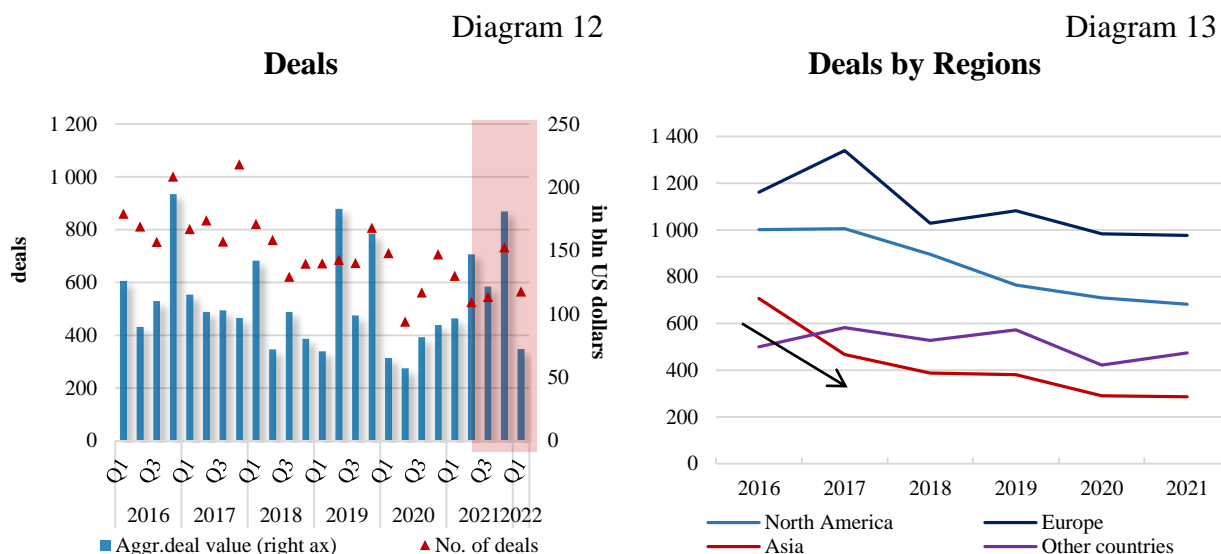
The popularity of Opportunistic strategy has declined as other strategies are more attractive in terms of risk-adjusted returns. Therefore, according to Preqin, the prospects for the Opportunistic strategy in relation to the infrastructure asset class are uncertain.

As of October 2021, in terms of the number of private infrastructure funds, the market is dominated by the Core-plus strategy with 101 funds (out of a total of 339 funds), followed by the Core (77), Opportunistic (56), Debt (47) and Value Added (41) strategies. In 2021, the strategy showed the strongest growth in terms of the number of funds. It should be noted that until 2020, the Debt strategy was the second largest in terms of the number of funds. However, in subsequent years, the strategy lost ground: to the Core strategy in 2020 and the Opportunistic strategy in 2021.

In 2021, the number of funds oriented at Asia grew to the largest extent, from 21 funds in January 2021 to 36 funds in October 2021; this may reflect favorable long-term economic growth prospects in the region.

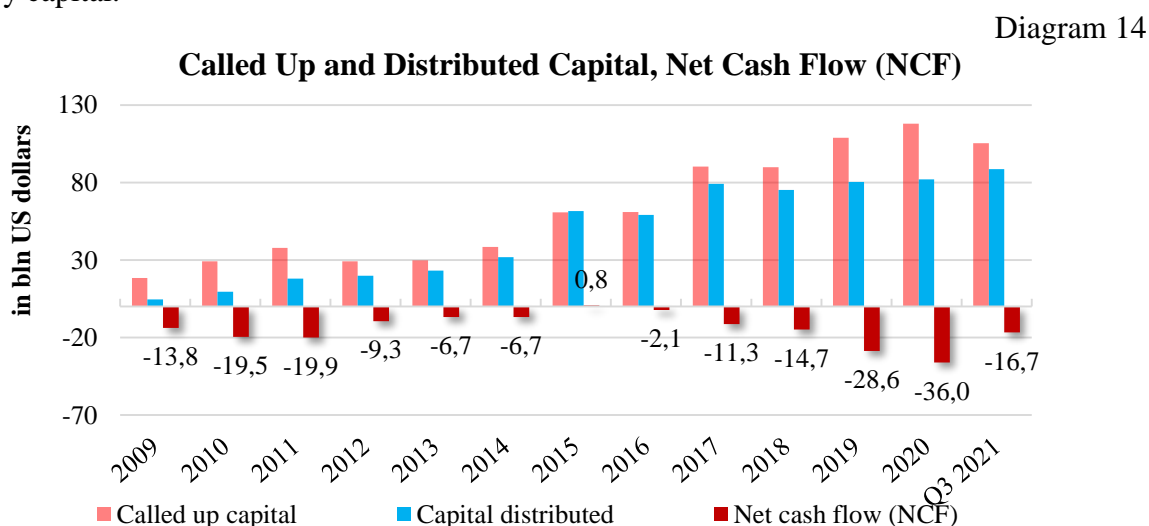
Active fundraising should be also reflected in the growth of deals. At the end of 2021, infrastructure deals, in terms of total value, reached the level of activity that existed before the onset of the COVID pandemic. Thus, in 2021, the indicator amounted to 547 bln US dollars, which exceeds the volume of a previous all-time high observed in 2016 (520 bln US dollars). Notable deals with infrastructure assets in 2021 were Kansas City Southern (transport sector) – for 31 bln US dollars, Western Power Distribution (utilities) – £14.4 billion, Suez (other) – 15.5 bln euros, Aramco Oil Pipelines (energy sector) – 12.4 bln US dollars, Autostrade per L'Italia (transport) – 9.3 bln euros, and QTS Realty Trust (telecommunications) – 10 bln US dollars.

In recent years, there has been a downward trend in the number of deals in the infrastructure sector. From 2016 to 2021, the number of deals decreased from 3,429 to 2,430. North America and Europe lead the way. Despite initial gains, deals are falling in Asia (Figures 12 and 13), which Preqin believes is due to the region's policies and initiatives.



According to Preqin, top ten active buyers in terms of deals during the period from 2015 to the 3rd quarter of 2021 include Foresight Group, China Everbright Environment Group, Equitix, Brookfield Asset Management, Engie, NextEnergy Capital, Macquarie (MIRA), CPP Investment Board, InfraRed Capital Partners and Greencoat Capital.

In the 3rd quarter of 2021, a negative net cash flow was lower than in 2019 and 2020 (Diagram 14). The reduction in called up capital and increase in distributed capital compared to previous years is a good opportunity to reallocate capital to more profitable areas of infrastructure. However, given the high level of funds raised in the fourth quarter of 2021, it will take some time to deploy capital.

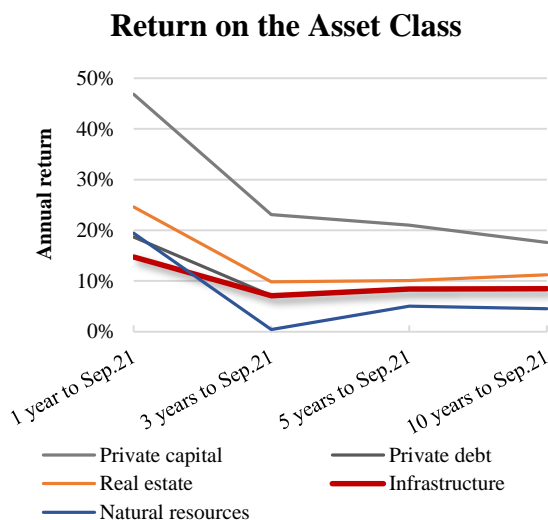


Investments should be made into funds with a large amount of capital, experience and a well-established deal-finding system in the US and Europe, given the regions' commitment to upgrading traditional infrastructure, decarbonizing the economy, transforming energy, investing in telecommunications and ESG. Moreover, large and well-known companies are likely to have more leverage to index inflation when formulating the terms and conditions of deals.

Profitability

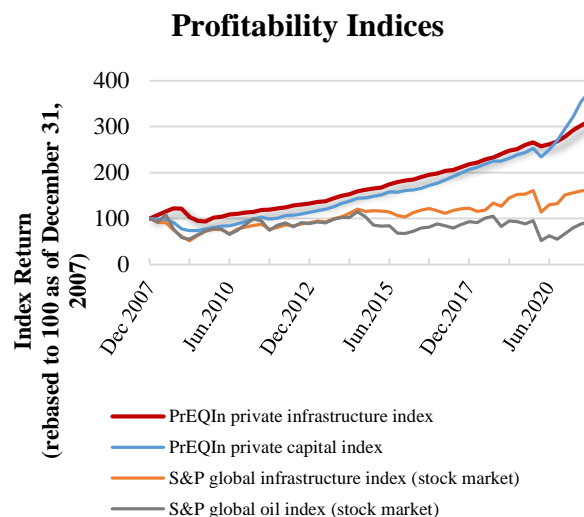
Private infrastructure demonstrated high annual returns in September 2021 – 14.7% IRR, which is significantly higher than the returns for 3, 5 and 10 years (8.5%) (Diagram 15). The index increased significantly in the third quarter of 2020. The growth of the index in the first quarter of 2021 was the highest on record. In the next two quarters, the index demonstrated a 3% rise in each quarter (Diagram 16).

Diagram 15



Source: Preqin data

Diagram 16



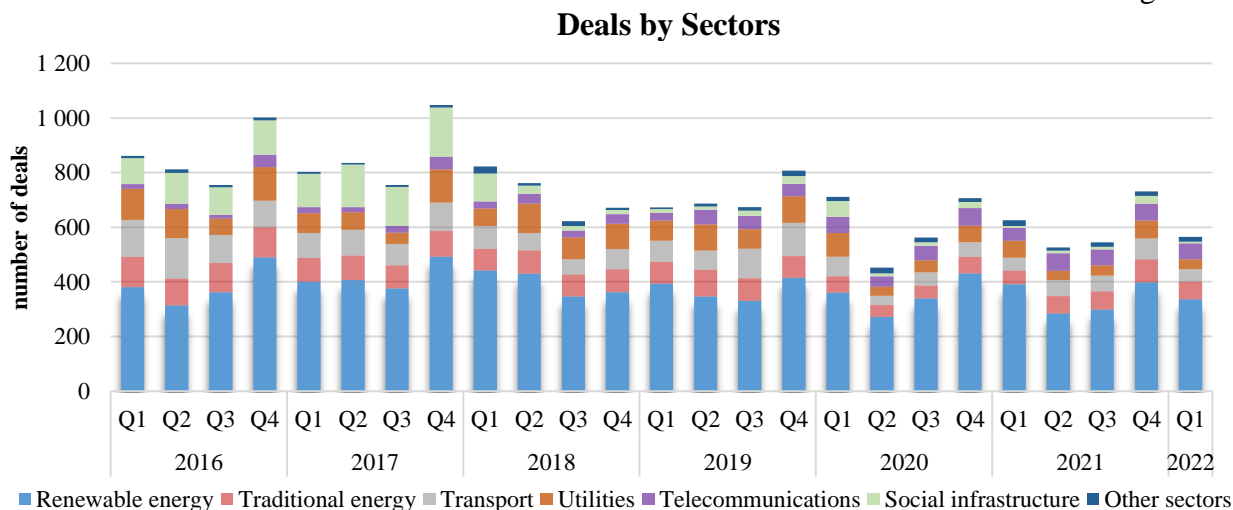
The result of 2021 may attract the attention of investors. However, the 2021 performance should not be the basis for long-term asset class expectations, given rising interest rates.

Infrastructure investments must be timely as there is an element of “first-mover advantage”. Given the current low performance of traditional asset classes, private infrastructure will attract the largest number of investors, which, in turn, will increase competition for low risk and high return assets. In this regard, over time, the return on the asset class will be declining due to rising prices.

Sectors

In the 1st quarter of 2022, compared to the 1st quarter of 2021, the total volume of deals was low (Diagram 17), despite the high raising volume (Diagram 9). Given this fact and the relatively high level of idle capital (68% AUM as of September 2021), a primary objective for managers is to deploy capital.

Diagram 17



Source: Preqin data

In terms of industries, deals related to renewable energy sources are prevailing. Given the geopolitical instability, most likely, the main portion of deals will continue to be carried out by the industry due to Europe's pursuit of energy security.

Telecommunications represent another sector that continues to increase its share of the deals market. Competition among the market players is growing for deals related to data centers, telecommunications towers and fiber optic assets.

Investments in transport infrastructure began to fall since 2016, a peak year in both the number and value of deals. During the pandemic, the sector had declined dramatically, especially in sub-sectors such as airports, railways and seaports. In 2021, the railway and toll roads sub-sectors grew quite a lot in terms of deals volume. The value of railway deals rose significantly in 2021 after the Canadian Pacific Railway acquired 100% of Kansas City Southern – the owner and operator of railroads across North America – in a 31 bln US dollars deal completed in September 2021. This deal was the largest in the transport sector. Toll roads have been the cornerstone of private infrastructure investments for many decades. With their stable cash flow, roads are becoming an increasingly attractive alternative to the low-yielding bond market. The ability to increase fares in line with the general price level provides protection against inflation. Historically, the vast majority of deals in the toll road sector took place in Asia.

According to the International Energy Agency, the transport industry accounts for about 60% of total oil demand and about 25% of global CO₂ emissions. Reducing emissions directly depends on the transition to electric vehicles, which, in turn, is an investment opportunity for managers, namely the construction of a network of charging stations. Demand for electric vehicles continues to grow, especially in Europe and China, thanks in part to government subsidies.

Despite the popularity of renewable energy sources, telecommunications, and transport, investment in this or that country should be made after examining the country for regulatory, procurement, and bureaucracy issues. Avoid investing in countries with high political uncertainty.

Infrastructure and Inflation

The relatively long-term nature of investments in infrastructure, as well as stable and reliable returns, are key factors in the attractiveness of this asset class. Another important advantage of infrastructure is protection against inflation. According to a Preqin survey, investors named inflation hedging as the third most important reason for investing in infrastructure, after diversification and access to reliable sources of income. For example, pension funds have long-term liabilities that are often indexed to inflation. However, it should be noted that not all infrastructure investment sectors could protect against inflation. Besides, the lack of sufficient historical data during the periods of constant price increases, as in the 1970s, makes it difficult to draw reliable conclusions about a positive correlation. However, according to the CBRE study, the infrastructure generated stable and positive real returns when invested for more than five years. In another study, during a period of feeble growth and high inflation, both publicly traded and private infrastructure outperformed the equity market.

In terms of sectors, traditional industries such as large utility companies and oil and gas pipelines have a stronger positive correlation with inflation through regulation or long-term contracts. Digital infrastructure and transport, which are usually not as regulated as traditional industries, are less immune to inflation. There is a strong correlation between the average revenue growth of private infrastructure companies and changes in inflation in the USA with a one-year lag, which is due to the specifics of regulation in a particular country. For example, the UK water regulator Ofwat uses actual inflation for the previous two years, while regulated companies in the USA are waiting for the next filing with regulators to request a rate increase.

Contract infrastructure projects – renewable electricity generation, concession-based toll roads, social infrastructure and some port operators – show a strong inflation hedging capacity, too. As a rule, energy networks in countries with a strong regulatory system have the most reliable protection against inflation, while transport and energy assets are more dependent on specific factors that stimulate inflation. Even in the sectors such as fiber optics where there is no apparent

hedge against inflation, growth in the industry due to the increased demand for digital data and higher capital investment is partly offsetting price pressures.

When investing, inflation hedging should be explored at the sector and/or project level as not all infrastructure assets demonstrate inflation protection.

Asset Class Forecast

It is estimated that the current total infrastructure investment gap in the world is 15 trln US dollars. Bridging this gap will require both public and private investment. According to a Preqin survey, 85% of fund managers believe that the transition to decarbonized energy production is the main driver of private infrastructure investment, followed by “upgrading of the obsolete economic infrastructure” (52%), “priority among the most economically viable investments” (33 %) and “access to financial resources in addition to public investment” (30%).

The main topics under discussion related to infrastructure investments are the energy transition and digital infrastructure, as well as the increased need to replace obsolete facilities. The largest growth is expected in investments into the European infrastructure, driven by demand for energy resources. Overall moderate growth is expected in North America and the rest of the world. Much of the US social infrastructure is dominated by public capital; recently, a law was passed providing for 1.2 trln US dollars in federal capital to upgrade end-of-life infrastructure and adapt to the demographic growth. However, analysts note that this figure includes previously allocated but unspent capital, emphasizing the government’s lower incentive to invest compared to private wealth managers. Thus, it is expected that the adoption of the draft law will not lead to a significant reduction in investment opportunities for private capital. Taxes, subsidies, and legal restrictions also discourage private investors from participating in public-private partnerships (PPPs), as each country has its own policy regarding such projects. The draft law could increase the budget deficit by 256 billion US dollars over ten years. This gap can be closed through private investments. In the UK, for example, there are more opportunities in social infrastructure as the government invests along with private investors.

Infrastructure in the Fossil Fuel and Transition Energy Sector. McKinsey estimates that by 2030, 57% of the world’s electricity supply will come from renewable energy sources. The main sources will include solar energy (27%), wind (47%) and biomass/hydropower (26%). In high-income countries, almost 90% of total private investments into energy generation is in renewable energy sources. In middle- and low-income countries, private investments in non-renewable energy sources still account for about half of total private capital in the energy sector. Geopolitical instability since early 2022 has accelerated changes in the energy market. The US has designated key energy technologies – solar panels, thermal insulation, transformers, electrical grid components, heat pumps, electrolyzers, fuel cells and platinum group metals – as a matter of national security. For example, Biden invoked the Defense Production Act in June to increase domestic production of these materials. Tariffs on imports of solar panels from Southeast Asia have been waived for two years to secure supplies and keep costs down. Tariff waivers are expected to act as an interim measure for the rise of the US solar energy.

In Europe, reducing dependence on Russian fossil fuel is an extremely important issue. First, it means prioritizing alternative pipelines, terminals, storage, and carbon capture and storage opportunities. With three of the largest terminals in Europe, the UK is now the distribution hub for liquefied natural gas (LNG), increasing imports from the US and Qatar and exporting further to mainland Europe. However, there are not enough storage facilities in the UK, and there are not enough LNG terminals in the European countries. Second, responding to the disruption in the energy market will require accelerating the deployment of renewable energy sources, investment in which is dominating in Europe. While the UK plans to expand wind power capacity, Germany is aiming for a low-carbon and nuclear-free economy in all sectors, moving towards solar and wind energy. Since 2018, more than half of infrastructure deals have been in the renewable energy sector, according to Preqin. Nevertheless, the average size of investments in the sector is small but tends to grow: the share of the sector in the total amount of capital invested in the infrastructure

increased from 11% in 2020 to 25% in Q3 2021. Moreover, it was noted that older solar and wind equipment is practically obsolete, requiring proper disposal and recycling in accordance with the principles of sustainable development, which is especially important for large, reputable managers. This fact is also likely to encourage the creation of new business models, especially for infrastructure funds with the Value Added strategy.

Renewable energy technologies require high initial capital costs but these are offset by lower operating costs compared to fossil fuel extraction. While governments are prioritizing renewable energy spending, according to the International Energy Agency, about 70% of clean energy investment should be financed by private capital with government incentives. As a rule, energy resources provide an average level of protection against inflation, since the contracts are pegged to market prices. Contract escalators in renewable energy projects can also be in the form of feed-in tariffs (cost-based pricing).

Digital, Telecommunications Infrastructure. Investments in data centers (DPC), telecom towers and fiber optic assets are carried out by real estate funds, but they also have features of infrastructure assets. The development of artificial intelligence, machine learning and the increase in the pace of data creation will increase the demand for data centers. In particular, small facilities located closer to end users are gaining popularity, which reduces the data transfer time and diversifies the customer base, reducing dependence on large customers, who often have the resources to build their own data centers. Fifty percent of data center capacity is located in the US, 40% – in Europe and the Asia-Pacific region. The location of a data center also depends on the availability of cheaper energy, especially renewable sources. Demand is growing in Central and Eastern Europe, Indonesia, Thailand, Vietnam, South America and Nordic countries (Scandinavia), the latter being attractive in terms of availability of renewable energy sources and free-cooling capabilities. Investment opportunities also arise because developing countries do not have sufficient infrastructure and therefore send their data abroad at high cost. The largest amount of capital in the data center is invested through the Value Added and Core-plus strategies. For data center projects, inflation is hedged with contract escalators, which are typically 1-3% in the US and thus provide a medium level of protection.

Investments in telecommunications are driven by the spread of 5G networks and are made mainly in North America and Europe. Companies are increasing the intensity of existing telecom towers by placing denser antenna arrays. Telecommunications tend to have a low level of private investment. According to the Global Infrastructure Center, private investment in this sub-sector is only 4% of total private capital in 2010-2020. To meet the growing demand, investments in the network must increase by 100 bln US dollars per year. Capital expenditures in the sector are low, contracts may include built-in escalators, which are typically 1-3% in the US or are indexed to international cell tower operators. The Value Added strategies in this sector involve increasing bandwidth and download speeds. The market is highly concentrated, but stable regular cash flows and high barriers to entry make such assets an attractive investment opportunity.

In the fiber subsector, investment opportunities are concentrated in Western Europe. However, it is estimated that more than half of developing countries do not have digital connectivity due to a lack of affordable and reliable internet. Private investors are showing increased interest in digital infrastructure, with high-capacity cable projects funded in Africa, and submarine cables planned to be laid from India across the Arabian Peninsula to Europe. Typically, a shared digital infrastructure (towers and fiber optic cables shared by multiple service providers) reduces physical investment and asset duplication. However, this segment provides a low level of inflation protection and is not explicitly linked to inflation. Thus, contracts usually do not have escalators and are for a longer period. Tariffs for short-term fiber contracts may be indexed over time.

Smart Cities. Projects in smart cities involve the implementation of artificial intelligence and big data analysis in infrastructure management to ensure the safety and efficiency of the services provided. Smart cities can be seen as an opportunity to add value to other infrastructure projects by providing data on how the demand and pressure on infrastructure is changing, allowing

better planning capabilities and timely response to asset development, modernization and maintenance needs. It is expected that by 2030, the total size of the smart city market will be approximately 7 trln US dollars, and the average annual growth will be 24.2%. McKinsey expects the public sector to own the majority of smart city applications (70%), but most of the investment (60%) could come from private investors.

The smart city infrastructure consists of three tiers. The first is the technological base: computers, sensors and devices connected by a high-speed communication network. The second tier consists of specialized applications that parse the raw data to send alerts, analyze or trigger an action, requiring collaboration between application developers and infrastructure engineers. The third tier is the user base: cities, companies and the public that make the best decisions based on data. Effective implementation of smart city technologies depends on the state of existing infrastructure, which is known to be aging in developed countries. Therefore, given the observed increase in the number of projects to modernize existing infrastructure and develop new projects, it is assumed that smart cities have a large untapped capacity. In general, cities in China, East Asia, Western Europe, North America, and a few cities in the Middle East have a strong technology tier. However, an analysis of the most developed cities, such as Amsterdam, New York, Seoul, Singapore and Stockholm, showed that even in these cities there are still only two-thirds of the necessary technological base for the complex deployment of smart cities. Thus, there are still many opportunities for investment in smart city infrastructure.

Transport Infrastructure. Toll roads have the potential to grow as tourist demand is directed towards closer, easier to travel destinations, but not those that can be reached by plane. Toll roads are an attractive asset as they provide regular cash flows and rates are indexed annually to inflation. Some European toll roads are indexed to inflation. However, predicting traffic demand can be tricky. Roads are capital intensive both as greenfield projects and as modernization projects. Toll roads dominate as secondary projects: there are more deals in regions of the world (excluding North America, Europe, Asia-Pacific), but in Europe such projects are more expensive. Most of the road and bridge projects are implemented in Asia, in particular in India. In the US, there is a large gap of more than 3 trln US dollars between existing and required investments in roads.

The manufacturing of electric vehicles increases the need for charging infrastructure, which could be an additional opportunity for toll road operators. According to the International Energy Agency, sales of electric vehicles doubled in 2021 to 6.6 mln. Electric vehicles make up nearly 10% of all vehicles sold worldwide. Sales tripled in China, increased by 65% in Europe and more than doubled in the US. In developing countries, electric vehicles are still not available due to their high price. In China, electric vehicles are subsidized. Sales in Europe are driven by tighter CO₂ emission standards. Growth in the US is driven by the increased production by Tesla. Since sales in developed markets are growing rapidly, there is a need to increase the number of charging stations. According to the European Automobile Manufacturers' Association (ACEA), 70% of charging stations in the EU are located in just three countries: the Netherlands, France and Germany. The infrastructure for servicing electric vehicles has a great potential to help reduce dependence on fossil fuel and solve the problem of environmental pollution. However, the demand for charging stations depends on the manufacturing of electric vehicles, which is currently complicated by the shortage of essential minerals (nickel, cobalt, lithium) and, consequently, rising prices.

Investing in road and railway transportations is becoming increasingly important as retail consumers rely more and more on online shopping. Efficient delivery is one of the main factors for staying competitive in e-commerce. Moreover, in the real estate asset class, the location of storage facilities is primarily determined by the capacity of the transport infrastructure. On the other hand, McKinsey analysts see potential in unmanned aerial vehicles and delivery robots on the roads to deliver packages from distribution centers, the so-called "last mile" warehouses, which may also require the creation of parking spaces for such robots.

As of 2016, North America had the longest railway network with 612,000 km. There are only 328 thousand km of railways in Europe. The largest upturn in this sector is shown by China,

where production capacity increased by 80% between 1995 and 2016. Much of the investment comes from the public sector, and investments are likely to be driven by the introduction of electrified high-speed rail to reduce carbon emissions. In terms of intercity rail infrastructure, the Eurozone provides more competition for rail network operators. Investment opportunities in this sector are determined by modernization of assets (network and rolling stock) and the provision of additional services/customer care. In general, railway transport companies are publicly or privately owned. In the UK, services are provided by private operators, in Japan the national railway company is privatized and divided into 7 companies. In the United States, virtually all railroad infrastructure is owned by freight companies. Thus, the railway industry has price control due to high barriers to entry and can provide a moderately high level of inflation protection.

The development of new airports, expansion and maintenance of the existing infrastructure of air harbors require 2.4 trln US dollars of investment. As air travel demand recovers to pre-pandemic levels, passenger demand will put increased pressure on airport infrastructure. Airports Council International has estimated that the Asia-Pacific region will need about 1.3 trillion US dollars (54% of the total required capital) by 2040, driven by the rapid growth in passenger traffic in the region. Europe's needs of 427 billion US dollars represent 18% of the global total for 2021-2040. It is expected that more than half of these investments will be directed to the modernization of passenger terminals and infrastructure upgrades. North America will need about 400 bln US dollars (17%), most of which will be directed to modernization, since existing airports already provide sufficient geographic coverage in the region. According to forecasts, the Middle East will need about 151 bln US dollars (6%). The needs of Latin America and the Caribbean represent an investment of about 94 bln US dollars, of which, according to an estimates, 41 bln US dollars will be needed for new airports. Africa's needs exceed 32 bln US dollars, with investment in new airports accounting for almost 40% of the total. As a result, a significant proportion of new projects will be required in developing countries. The specifics of inflation hedging in projects in this sector are due to the high level of government regulation and, consequently, monopoly control over pricing, which provides medium-high protection against inflation.

The development of seaport infrastructure is a capital-intensive project, requires a long time and, therefore, long-term planning. The investment is driven by the fact that the transport and logistics sectors are undergoing a profound transformation: new fuel, autonomous transport and cargo handling, self-organized logistics, new business models, etc. Investment will also be driven by the need to adapt to new weather extremes brought about by the climate change. Moreover, due to geopolitical instability, the global maritime supply chain has been significantly disrupted, and port congestion in China and the United States is exceptionally high. Delayed deliveries from China to Europe lead to a lack of containers to transport European goods to the US. In fact, prior to this failure, the gap between called up and invested capital in the US was about 250 bln US dollars. Investments in ports provide a medium level of protection against inflation, especially in large ports-logistics centers, which have more control over pricing.

Utility Services: Water Supply, Waste Management. Public investments dominate in investments in water supply and water disposal infrastructure, while private investors invested only 4% of capital in this sector in 2010-2020. The overall potential for such investments is low. In Europe, 47% of the population are served by private service providers, in North America – 23%, and in Asia – 20%. In the US, sewage and water systems are largely publicly owned, while in the UK the sector is privatized along with telecommunications, airports, gas and electricity. Although the water supply sector is a natural monopoly, it is difficult to expand competition. However, the demand for investment is driven by the population growth, industrialization and growing agricultural needs. According to Preqin, infrastructure fund managers have identified water as a key aspect that will drive ESG investment in the future along with renewable energy sources. The number of global water infrastructure deals has dropped to 20, and their total value is less than 2 bln US dollars. Before the pandemic, in 2019, more than 100 deals were concluded for a total of 13 bln US dollars. In this regard, investments in water supply are expected to increase. The most active countries in the field of water management in terms of the number of deals are the US

(secondary projects), India (greenfield projects), China (secondary and greenfield projects) and the United Kingdom (secondary projects). India and China have the largest population size and a large agricultural sector that needs to be supported. The value of deals is highest in the US (approximately 17 bln US dollars) and the UK (approximately 13 bln US dollars). As most projects in Europe and North America are secondary and infrastructure is becoming obsolete getting to the end of its life, the types of projects funded are expected to change. Private investment can accelerate innovation in water treatment and recycling. On the other hand, seawater desalination is less attractive as it is the most expensive method of obtaining fresh water in terms of both capital and operating costs compared to other alternatives, in part due to high levels of energy consumption. Water supply as a sector provides a high degree of protection against inflation, since prices are indexed to inflation and the rate of return is regulated by the government. Direct inflation protection is provided in the UK, Italy, and Western Europe and Australian utilities. Indirect hedging is provided by the US, Canadian and Spanish regulated utility services.

Electric Grid Retrofit. Even with the sufficiency of electricity generated from fossil fuel and renewable energy sources, energy delivery is also important and requires innovation to ensure a stable electricity supply. Along with general modernization, the increase in the number of electric vehicles on the roads and expansion of the network of charging stations will also require the strengthening of existing electrical grids. According to the ACEA, the total volume of investments in modernization of distribution systems (transmission of medium and low voltage electricity from substations to end consumers, excluding transmission from power plants to substations) in the European Union alone will be 363 bln euros by 2030, of which 175 bln euros – for the total modernization (smart meters, network upgrades, digitization, storage, sustainability), 80 bln euros for renewable energy generation systems, 67 bln euros for electrification of buildings and homes, and 41 bln euros – for infrastructure for electric vehicles. In the US, power outages have increased due to aging grids and harsh weather. In Asia, networks are funded by governments, but the increasing demand will also require the involvement of private investors. The global smart meter market is estimated to grow by 11.5% year on year. The digitization of power grid infrastructure in the Asia-Pacific region is expected to grow by 15% year on year, driven by investments in China and India. The growth is conditioned by government tax subsidies and incentives for smart meter manufacturers. Regulated electricity and transmission companies can expect a permitted rate of return that can be fixed for 1-3 years and adjusted upwards later.

The conclusion is that sector-level priorities should be given to investments with high and medium-high levels of protection against inflation – regulated networks and water supply, toll roads, airports, main pipelines and railways. Medium (mobile towers, data centers, ports, energy and renewables) and low (fiber, satellites and power) sectors should be decided after a separate study of the protection level of each fund and project.

Infrastructure Funds

It is noteworthy that at present there are more funds with the Opportunistic strategy in the market – 46 (42%). Projects under this strategy require significant capital expenditures and are therefore considered more risky, making them less attractive to investors. Therefore, managers are likely to find it difficult to achieve the target size of the fund. Nowadays, such large managers as BlackRock, Macquarie, Energy Capital Partners, and Goldman Sachs have funds open for raising capital and operating under the Opportunistic strategy. Target fund sizes are generally less than 7.5 bln US dollars, with only 2 managers aiming to raise 25 bln US dollars. At present, funds open for capital raising mainly invest in developed countries.

Currently, one of the largest funds open for investment is Brookfield Infrastructure Fund V with a General strategy and a target size of 25 bln US dollars, which includes investments in roads, canals, airports, power lines, etc. that are not included in the Core, Value Added, Opportunistic and Greenfield strategy. In previous funds, the manager raised capital under the Value Added, General and Core strategies with a wide geographic focus and return (IRR) equal to 11-17%.

The Global Infrastructure Partners initiated the 5th fund with the Value Added strategy and a target volume of 25 bln US dollars. The manager's previous funds have focused on developed market energy services primarily in the US.

The BlackRock raises capital to the 4th fund as part of the Global Opportunistic strategy with a target size of 75 bln US dollars. The Fund is likely to be focusing on investments into the energy sector. In fact, the manager has already raised two specialized global funds of renewable energy sources with the Core strategy.

The Macquarie Group launches the Macquarie Infrastructure Partners VI worth up to 7 bln US dollars. The Fund is oriented at North and South America Фонд and the Opportunistic strategy. The manager has previously raised special funds for European investments in the information technology, commercial services, and manufacturing, media and telecommunications sectors (IRR of 9-15%).

The Partners Group is another manager with a market experience that raised capital (до 5 bln US dollars) to the direct infrastructure investment fund in the US with the Value Added strategy. The return of previous manager's funds with the Value Added and General strategies was 8-16% IRR.

The Energy Capital Partners raises capital to the 5th fund with the Opportunistic strategy and a target volume of 4 bln US dollars. Notably that previous funds of the series had been focusing on the Core strategy in North America.

Goldman Sachs also launches a fund with the Opportunistic strategy and a target volume of 4 bln US dollars. The manager's previous funds were specializing in infrastructure projects of North America and Europe.

The European Diversified Infrastructure Fund III managed by the First Sentier Investors was also launched in the market. The target size of the fund is about 3.8 bln US dollars. The fund within the series is focused on Europe and resources are invested in accordance with the General strategy.

Apollo raises capital worth 3.5 bln US dollars into the Apollo Infrastructure Opportunities Fund II with a focus on the Asian and US markets.

The CI Energy Transition Fund I of 3.5 bln US dollars and the Core strategy managed by the Copenhagen Infrastructure Partners is oriented at projects in Asia, Australia, North America and Western Europe in the energy sector, AgTech and CleanTech.

The list of managers broken down by strategies with the fund's target size of more than 500 mln US dollars is show on Diagram 17.

Infrastructure Funds

(performance-linked size of the fund ≥ 500 mln US dollars, Source – PitchBook)



Conclusion

With a large gap between called up and invested capital in infrastructure, this asset class is the fastest growing. Although the asset class is mainly regulated and financed by governments, the

private capital participation in infrastructure projects to realize investment opportunities is beneficial for governments in terms of alleviating the burden on the budget.

According to the analysis, promising opportunities are observed in the Core-plus and Value Added strategies, the latter of which is the largest strategy in terms of assets under management in 2021. The Opportunistic strategy is less popular among investors, most likely due to a high level of risk and a low return.

Europe is in need for additional investments in order to transform the energy sector and to restructure the existing energy infrastructure because of geopolitical instability in the region.

The Asian market is considered to be emerging. Although the region's infrastructure market requires large investments and has a potential for growth, an active participation of the government in the market contributes to the crowding out of private investment. As per Preqin projections, the Asian infrastructure investment will stagnate relative to Europe and North America.

According to the study, investors in developed countries prefer to invest in local projects or projects in neighboring countries with similar economies. Moreover, investments considered as Core in developed countries are classified as Opportunistic in Asia despite the fact that the projects have the same strategic characteristics.

Infrastructure investments provided a stable positive real income when investing for 5 years or more. During a period of weak economic growth and high inflation, both publicly traded and privately owned infrastructure outperformed the equity market. However, when investing in infrastructure, inflation hedging should be explored at the sector and/or project level, as not all sectors demonstrate inflation protection. Therefore, a thorough analysis of the terms and conditions of contracts and regulatory restrictions that determine the mechanisms of inflation indexing is required.

In the existing macroeconomic environment, when inflation in developed countries has reached a multi-year high and the economic activity has slowed down, infrastructure projects attract many investors, thereby increasing asset values. However, investments should be diversified not only by regions and sectors but also by vintage. Historical data shows that funds that raised capital immediately after the economic downturn have performed better than in other periods.

Literature

1. The 2022 Preqin Global Infrastructure Report.
2. Preqin Quarterly Updates: Infrastructure Q1 2022.
3. Preqin ESG Report: Europe's Energy Transition – On a Wartime Footing.
4. Infrastructure as an Inflation Hedge – Look No Further? CBRE, 2022.
5. Preqin. Sector in Focus. Data Centers – the Essential Infrastructure Powering Digital Lives, 2021.
6. Preqin. Sector in Focus. Telecom Towers, 2021.
7. Private Markets Rally to New Heights. McKinsey Global Private Markets Review, 2022.
8. World Energy Outlook 2021. IEA.
9. Global Electric Vehicle Outlook. ACEA, 2022.