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^{1*}**Bekbaeva A.E.,**

master's student, ORCID ID: 0009-0002-8213-5859, e-mail: a.bekbaeva2001@gmail.com

²**Keser E.,**

MBA in Economics, ORCID ID: 0000-0003-0360-7492, e-mail: emrekeser1987@gmail.com

¹Kazakh-British Technical University, 050000, Almaty, Kazakhstan

²Isik University, Istanbul, Turkey

THE INFLUENCE OF MACROECONOMIC FACTORS ON THE TOTAL ANNUAL VOLUME OF INVESTMENTS IN PPP PROJECTS

Abstract

The article analyzes the influence of macroeconomic factors on the investment attractiveness of PPP projects. The purpose of this article is to conduct this study to identify the degree of influence of external macro-economic factors on the volume of attracted investments. Methodology of the paper is quantitative, regression analysis. Analysis results show that there is a moderately strong relationship between dependent and independent variables. In conclusion, this study will help both the state and private investors, as well as project managers, since the increasing investments leads to the region competitiveness, that ensures high and sustainable rates of socio-economic growth.

Kew words: project management, PPP projects, macroeconomic factors, regression analysis, investments, national economy.

Introduction

Budget limits, high levels of national debt, and lack of sufficient funds are often identified as a cause of developing countries search to find alternative ways to finance their infrastructure needs [1, 2, 3]. Macroeconomic stability is often considered as a significant factor for implementing PPP projects [4, 5, 6, 7, 8]. Macroeconomic situation and financial state of a country affects the progress of the implementation of alternative source of funding, PPP projects. Analysis of such external aspects such as the public debt of the country, population density, real GDP per capita, annual inflation in the country, international reserves of the country is devoted to this study. The reason these factors were chosen is that according to research in the field of macroeconomics and project management that was mentioned in this study, these factors influence the volume of investment with a high probability, and with great influence, they also help in assessing the economic health. Due to the difficulty of expressing a qualitative indicator in numerical form, and including in the regression, qualitative factors were chosen.

The purpose of this research is to understand independent factors, such as macroeconomic indicators effect dependent factor, which is Total investment in PPP projects. Total investment in PPP projects is measured as the sum of all investments directed to the implementation of the PPP project. Independent factors in this case are represented by public debt of the country, population density, real GDP per capita, annual inflation in the country, international reserves of the country.

The objective of this research is to analyze what effect each of the independent variables has on the amount of investment using regression.

There has been limited scholarly attention devoted to this field in the practice of Kazakhstan. This paper brings original contributions to the Private-Public Partnership projects. The paper demonstrates the applicability and practicability of the regression analysis in analyzing the impact Kazakhstan's macroeconomic factors.

Main provisions

Here are the hypotheses of this research proposal:

It is assumed that inflation (Inf) will negatively affect the volume of the total investment in PPP projects, which is confirmed in most of the earlier works [9]. Population density (Density) and Real GDP per capita (percapRealGDP) should have a positive impact on the amount of investment [10]. Countries with significant public debt (TD) will more actively use the PPP mechanism [11]. The hypothesis of a positive relationship between the activities of the public-private sector and the value of international reserves is also proposed (ReserveInt) [12].

Literature Review

A review of the literature determining the impact on PPP activity in recent years found that it only covered macroeconomic indicators and did not disclose industrial characteristics. In the economic literature, there are various approaches to assessing the factors that influence the attraction of investment in the national economy. Various researchers use in their works quite popular indicators of capital flows, such as economic openness, market capacity, per capita income in real terms and GDP per capita.

Despite the fact that qualitative indicators have an advantage over quantitative indicators, difficulties arise with their inclusion in regression. The problem of conducting mathematical-statistical and empirical analysis arises, often due to the difficulty of expressing a qualitative indicator in numerical form. In addition, discrepancies in the numerical expression of the same qualitative indicator for constructing an econometric model lead to different, and more often than not, inadequate results.

The factors that were chosen in this article are quantitative and mentioned most often in foreign articles, analysis of them will be implemented on Kazakhstan's case. Overall, the works selected by the researchers can be separated into two clusters: analysis considering the impact of a single indicator on the effectiveness of the use of the PPP mechanism, and analysis evaluating the overall effectiveness of several indicators.

Osey-Kyei studied factors that attract investments in PPP projects, conducting a survey from PPP experts, and found out that top important factors include political support, government's positive attitude towards the investments from private partners, political stability that are greatly affected by macroeconomic state of the country [13].

Work analyzing the effects of single factors is primarily concentrated on assessing the effects of debt of public, less attention is paid to the effects of inflation rate. In their work, M. Han et al. and L. Alessi et al. It was concluded that PPP mechanism can implement the allocation of investment among several partners, thus, there can be a positive relationship between public debt levels and activities of PPP [11].

Economist M. Hammami et al. and S. Banerjee et al. Developing countries have been studied as case studies and use almost the same set of macroeconomic variables [9]. According to the study of M. Hammami et al. Population density and size of population have been found to be important predictors of PPP activity, because a mechanism is more common in countries where population is dense [10]. He also concluded that countries that have large amount of budget deficits tend to use PPP mechanisms than resource-rich countries. The latter is due to less stringent budget constraints. S. Banerjee et al. It was concluded that inflation and GDP per capita affect the amount of private investment [9].

In C. Sharma's work it is assumed that higher international reserves aids macroeconomic stability, which means that, for example, for infrastructure projects, the risk of implementation declines [12].

Another critical conclusions were made by Khudko E.V. and Shcherbak A.O. in 2022 on how a positive impact on the volume of investment is provided by indicators of the volume international reserves [14].

The study of Kamasak, Rifat & Yurdakul, Hakan finds a weak association between the number of PPP projects and GDP growth. Authors state that it is related to the other macroeconomic factors that affect the growth of GDP as a proxy of overall economic development [15]. Thus, analyzing the impact of a single variable is considered as weakness of their paper and author recommends to consider other factors that might positively contributions to PPP project investments.

In conclusion, in literature a gap in existing research highlighted regarding the lack of consideration for industrial characteristics alongside macroeconomic indicators. There are various approaches for assessing factors influencing investment attraction in national economies, with a focus on popular indicators like economic openness, market capacity, and GDP per capita. While qualitative indicators are considered advantageous, their inclusion in regression analysis is deemed challenging due to difficulties in numerical representation. The article selects quantitative factors frequently mentioned in foreign literature, intending to analyze them in the context of Kazakhstan. So later in this research paper, analysis of these factors will be implemented on Kazakhstan's case.

Materials and methods

Methods and data sources

This research method chosen is going to be quantitative (statistical) and use secondary data. Due to regression being one of the most suitable types of analysis that can assess quantitatively the relationship between variables, in the course of the study, regression analysis will be used, hypotheses will be formulated and tested. In quantitative methodology, researchers describe existing theories, generate and test a hypotheses, and re-evaluate existing theories deductively based on their results of experiment [16]. Also regression helps to identify what factor significantly impact the attracted investment amount. It is a great tool for forecasting future investments. This can be valuable for policymakers, investors. Analysis is easy to understand and interpret the result to communicate with stakeholders [17]. Secondary data would include some open source data, for ex. data from web-site of Bureau of National Statistics of Republic of Kazakhstan, “Private Participation in Infrastructure” (PPI) and “World Development Indicators” (WDI) [18]. Also sources of information can be publications, press releases, such as Macroeconomic Reviews of Kazakhstan, which are submitted by Applied Economics Research Center (AERC) LLP, Public-Private Partnership Center, also by the Ministry of National Economy of Kazakhstan [19]. Selected period for all indicators are 2005–2023.

Analysis Techniques / Tools

Since the analysis in this study is quantitative analysis and regression analysis, MS Excel is used. The initial data consists of a table containing items, (see Figure 1). It contains from country's annual inflation rate (%), total government debt (% of GDP), population density (number of people per square kilometer), and real GDP. Per capita, (million USD), total investment in PPP projects, (million USD). It will be needed to interpret the results, high or low, moderate indicator R squared.

Results and Discussion

BUREAU OF NATIONAL STATISTICS provided inflation rate of 9.5% for 2023 year. Inflation (annual %): Notation is Inf.

Central Government Debt (% of GDP): Debt is a stock. It can be measured as of a given date, usually the last day of the fiscal year. Notation is TD. Total Debt is 162.7 US\$ as of January 1st 2024 [20].

Total Population as of January 1st 2024 is 20 033 546 people.

Population: Total population of the country. Density is measured by population diving by land area of the country.

Real GDP per capita: The gross domestic product divided by population [21]. Notation is percapRealGDP.

International Reserves (current US\$) are 35.1 billions [22]: Total reserves in months of imports of the country. Notation is ReserveInt.

Total amount of investment in PPP Projects. Notation is totalPPP.

Based on the above variables and available data, the below empirical model is tested statistically:

TotalPPP = f [Inf; TD; Density; percapRealGDP; ReserveInt]

	Inf (%)	TD (mln usd)	Density (people)	percapRealGDP (usd)	ReserveInt (bln usd)	totalPPP
2005	7,87	\$ 23 089,30	5,7	\$ 3 771,30	7,07	6 492 937,00 ¹
2006	8,4	\$ 32 723,73	5,8	\$ 5 291,60	19,13	6 492 937,00 ¹
2007	18,77	\$ 43 428,50	5,87	\$ 6 771,40	17,64	6 492 937,00 ¹
2008	9,48	\$ 74 014,10	5,94	\$ 8 458,00	19,88	6 492 937,00 ¹
2009	6,38	\$ 96 893,00	6,01	\$ 7 165,20	23,18	6 492 937,00 ¹
2010	7,97	\$ 107 933,40	6,1	\$ 9 070,50	28,26	6 492 937,00 ¹
2011	7,43	\$ 112 866,90	6,19	\$ 11 634,00	29,22	6 492 937,00 ¹
2012	6,06	\$ 118 222,80	6,27	\$ 12 386,70	28,3	6 492 937,00 ¹
2013	4,9	\$ 125 320,80	6,36	\$ 13 890,60	24,69	6 492 937,00 ¹
2014	7,54	\$ 136 918,20	6,45	\$ 12 807,30	29,25	6 492 937,00 ¹
2015	13,53	\$ 150 032,90	6,54	\$ 10 510,80	27,85	6 492 937,00 ¹
2016	8,29	\$ 157 114,50	6,63	\$ 7 714,80	29,6	6 492 937,00 ¹
2017	7,22	\$ 153 006,60	6,72	\$ 9 247,60	30,75	\$ 69 758 287,0
2018	5,43	\$ 163 528,50	6,8	\$ 9 812,60	30,98	265 504 230,00 ¹
2019	5,43	\$ 167 482,70	6,88	\$ 9 812,60	28,96	1 400 000,00 ¹
2020	6,37	\$ 160 331,30	6,96	\$ 9 121,60	35,64	96 524 905,50 ¹
2021	8,4	\$ 159 544,20	7	\$ 10 373,80	34,38	96 524 905,50 ¹
2022	20,3	\$ 163 980,10	7,11	\$ 11 492,00	35,08	109 053 312,00 ¹
2023	9,5	\$ 164 131,10	7,2	\$ 13 136,50	35,01	109 053 312,00 ¹

Figure 1 – Dependent and independent variables

Figure above shows independent variables (x): Inf, TD, Density, percapRealGDP, ReserveInt; and dependent variable (y): totalPPP.

Multiple R: Multiple R represents the correlation between the actual values of the dependent variable and the predicted values obtained from the regression model. It measures the strength and direction of the linear relationship between the independent variables and the dependent variable in a regression model.

In our case, this value is 0.66, which means a moderately positive relationship.

R-squared: R-squared is the square of multiple R and is commonly used to evaluate the explanatory power of a regression model. It shows what percentage of the variability in the dependent variable is explained by the independent variables in the model. Our value is 0.43, which means that the model moderately explains the variability in the dependent variable.

Table 1 – Regression Statistics

Regression statistics	
Multiple R	0,657917531
R-square	0,432855478
Nominal R-square	0,214722969
Standars error	59956769,7
Observations	19

F significance is a statistical test that is used to determine whether a regression model is statistically significant overall.

The statistical value I obtained is 0.15, which exceeds the critical threshold at a given significance level (usually 0.05), the regression model is considered statistically significant.

Analysis of variance					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significant F</i>
Regression	5	3,57E+16	7,13E+15	1,984369	0,148198527
Residual	13	4,67E+16	3,59E+15		
Total	18	8,24E+16			

Figure 2 – Analysis of variance

	Coefficients	Standard Error	t Stat	P-value
Intercept	-841 889 663,60	464 000 000,00	-1,81	0,09
Inf (%)	-2 055 885,97	3 718 468,00	-0,55	0,59
TD (mln usd)	-816,05	1 062,14	-0,77	0,46
Density (people)	155 071 303,00	89 078 432,00	1,74	0,11
percapRealGDP (usd)	-4 934,08	7 532,56	-0,66	0,52
ReserveInt (bln usd)	1 854 062,61	5 156 005,00	0,36	0,72

Figure 3 – Regression analysis

Withdrawal of balances

Residuals in regression analysis represent the difference between the actual values of the dependent variable and the predicted values obtained from the regression model. In effect, residuals represent model errors—what the model cannot explain or predict.

Each observation in the data has its own residual.

In our case, the model fits the data well because the residuals are random and do not have any systematic structure.

Key aspects of balances include:

Normality: The residuals should be normally distributed around zero. This is important for the correct use of statistical methods and obtaining reliable conclusions.

RESIDUAL OUTPUT			
<i>Observation</i>	<i>Predicted totalPPP</i>	<i>Residuals</i>	<i>Standard residuals</i>
1	1 495 247,37	4 997 689,63	0,10
2	22 909 295,59	-16 416 358,59	-0,32
3	-6 354 881,09	12 847 818,09	0,25
4	-5 528 800,92	12 021 737,91	0,24
5	5 526 302,12	966 634,88	0,02
6	7 222 079,08	-729 142,08	-0,01
7	7 394 077,58	-901 140,58	-0,02
8	12 826 044,58	-6 333 107,58	-0,12
9	9 261 438,45	-2 768 501,45	-0,05
10	22 125 876,40	-15 632 939,40	0,31
11	21 800 717,60	-15 307 780,60	0,30
12	57 791 338,53	-51 298 401,53	-1,01
13	71 869 017,71	-2 110 730,71	-0,04
14	77 007 042,71	188 497 187,30	3,70
15	82 440 716,54	-81 040 716,54	-1,59
16	114 544 374,20	-18 019 468,66	0,35
17	108 701 515,80	-12 176 610,31	0,24
18	93 454 955,81	1 558 356,19	0,31
19	121 247 838,00	-12 194 525,97	-0,24

Figure 4 – Residual

Constant variance: The residuals must have constant variance across all predictor values. If the variance of the residuals is not constant, this may indicate heteroscedasticity.

No autocorrelation: The residuals should not be correlated with each other. If the residuals are correlated, this may indicate a violation of the assumption of independence of observations.

Lack of systematic patterns: The residuals should not show any systematic patterns such as trends or cycles. The presence of such patterns may indicate an incorrect model specification.

Conclusion

Implications in relation to literature review, my results support and justify theories mentioned in literature. The results of this study will help both state and private investors to make a decision. It can be found useful for the government, investors, project managers.

This method is suitable for encouraging state investments in various budget constraints (constant level of public debt of a public funds). Pooling resources and financing with investors are required.

The dynamics of the money supply is important for investors when deciding whether or not to participate in a PPP project, because it is often necessary to obtain external sources of financing to meet PPP agreement obligations.

Based on the findings of this study, it is very difficult to make initial recommendations and suggestions because investors should focus on industry performance rather than population density when making investment decisions in PPP projects in developing countries. Sectoral indicators also make it possible to talk about the possibility of implementing intensive projects.

It is very difficult to give any preliminary recommendations and proposals based on the results of this study, because considering developing countries, when investor decides whether to invest in PPP projects in, it is needed to focus not so much on, for ex., density of country's population as on industry and its indicators. Industrial indicators also allow us to talk about the feasibility of implementing intensive projects.

Given the subject of the study, the study could be limited if there were little information in the public domain, or inaccurate and unreliable information about the country's macro-indicators. It is also worth considering industrial indicators, as they also differ.

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^{1*}**Бекбаева А.Е.,**

магистрант, ORCID ID: 0009-0002-8213-5859, e-mail: a.bekbaeva2001@gmail.com

²**Кесер Е.,**

экономика магистрі, ORCID ID: 0000-0003-0360-7492, e-mail: emrekeser1987@gmail.com

¹Қазақстан-Британ техникалық университеті, 050000, Алматы қ., Қазақстан

²Ыстық университеті, Стамбул қ., Түркия

МЖӘ ЖОБАЛАРЫНА ЖАЛПЫ ЖЫЛДЫҚ ИНВЕСТИЦИЯ КӨЛЕМІНДЕГІ МАКРОЭКОНОМИКАЛЫҚ ФАКТОРЛАРДЫҢ ӘСЕРІ

Аңдатпа

Мақалада МЖӘ жобаларының инвестициялық тартымдылығына макроэкономикалық факторлардың әсері талданады. Бұл мақаланың мақсаты – тартылған инвестиция көлеміне сыртқы макроэкономикалық факторлардың әсер ету дәрежесін анықтау үшін осы зерттеуді жүргізу. Жұмыстың әдістемесі сандық, регрессиялық талдау. Талдау нәтижелері тәуелді және тәуелсіз айнымалылар арасында орташа күшті

байланыс бар екенін көрсетеді. Қорытындылай келе, бұл зерттеу мемлекетке де, жеке инвесторларға да, жоба менеджерлеріне де көмектеседі, өйткені тартылған инвестициялардың өсуі өңірдің бәсекеге қабілеттілігін арттыруға, әлеуметтік-экономикалық өсудің жоғары және тұрақты қарқынын қамтамасыз етуге әкеледі.

Тірек сөздер: жобаларды басқару, МЖӘ макроэкономикалық факторлар, регрессиялық талдау, инвестициялар, ұлттық экономика.

^{1*}**Бекбаева А.Е.,**

магистрант, ORCID ID: 0009-0002-8213-5859, e-mail: a.bekbaeva2001@gmail.com

²**Кесер Е.,**

магистр экономика, ORCID ID: 0000-0003-0360-7492, e-mail: emrekeser1987@gmail.com

¹Казахстанско-Британский технический университет, 050000, г. Алматы, Казахстан

²Ишик университет, г. Стамбул, Турция

ВЛИЯНИЕ МАКРОЭКОНОМИЧЕСКИХ ФАКТОРОВ НА ОБЩИЙ ГОДОВОЙ ОБЪЕМ ИНВЕСТИЦИЙ В ПРОЕКТЫ ГЧП

Аннотация

В статье анализируется влияние макроэкономических факторов на инвестиционную привлекательность проектов ГЧП. Целью статьи является проведение данного исследования для выявления степени влияния внешних макроэкономических факторов на объем привлеченных инвестиций. Методология работы – количественный, регрессионный анализ. Результаты анализа показывают, что существует умеренно сильная связь между зависимыми и независимыми переменными. В заключение данное исследование поможет как государству, так и частным инвесторам, а также руководителям проектов, поскольку рост привлеченных инвестиций приводит к повышению конкурентоспособности региона, обеспечению высоких и устойчивых темпов социально-экономического роста.

Ключевые слова: управление проектами, ГЧП проекты, макроэкономические факторы, регрессионный анализ, инвестиции, национальная экономика.