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**RESEARCH ARTICLE**
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# Analysis of the Receipts of the National Fund of Kazakhstan

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## Abstract

The article discusses the key factors determining the National Fund of Kazakhstan (NFK) accumulation from January 2005 to February 2017. As the main factors in this model, world oil prices, the share of deductions of oil companies' income to the fund, domestic oil production, the tenge exchange rate against the U.S. dollar and interest income on the fund's investments were considered. In order to explain these factors impact on the oil fund receipts, a relevant functional model was developed. The stationarity of the data series was checked using the Augmented Dickey Fuller unit root test. Verification of the model was conducted using different econometric methods, as the primary model used the least squares method (LSM). Using the generalized method of moments (GMM) helped overcome the problem of autocorrelation and heteroscedasticity and validate the model specification. The autoregressive conditional heteroscedasticity (ARCH) method and the Generalized Linear Model (GLM) were also used to test the basic models. The built econometric models confirmed that NFK's receipts positively depend on the tax rate on oil producing firms, world oil prices, and domestic oil production and negatively on the exchange rate of tenge. However, the increase in interest rates on the U.S. Treasury bonds did not increase the fund's income. This can mean either the ineffectiveness of its investments or the periodic withdrawal of the investment income. In general, the study should help understand the factors determining NFK's revenue and increasing its amount in the future.

***Keywords:*** Oil Fund, Stabilization Rule, Savings Rule, Panel Data Analysis, Oil Production, Kazakhstan

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# 1. INTRODUCTION

The creation of the NFK in 2001 was significant for Kazakhstan, as it allowed to solve the problem of the Dutch disease associated with the influx of petrodollars due to the intensive development of hydrocarbon resources, and also created a safety cushion for the country's economy, as well as accumulate resources for future generations.

If in 2000, all the oil inflows went to the budget, then in 2001, only 29.1 percent of oil revenues went to the needs of the Republican budget, and 70.9 percent went to the country's oil fund (World Bank, 2005). This immediately solved the problem of the Dutch disease associated with a large influx of foreign currency from the sale of hydrocarbons to the domestic market. The creation of the NFK also raised credit ratings and reduced the cost of foreign borrowing for the government and firms. For example, Standard@Poor's raised the credit rating of Kazakhstan in foreign currency from B + in December 1999 to BB- in July 2000 and to BB in May 2001. Similarly, other rating agencies have increased the country's credit ratings (Trading Economics, 2018).

Unfortunately, today 51% of all budget expenditures are financed by the NFK. This was a consequence of the global financial crisis of 2008-2009 when money from it began to flow into the state budget in ever-increasing volumes. Therefore, especially at present, revenue receipts to the NFK play an essential role in ensuring the sustainability of the state budget. The state budget without these transfers would run a large deficit, leading to a sharp reduction in budget programs and hyperinflation in the country.

Due to the almost two-fold drop in world oil prices in 2014, oil tax revenues to the NFK decreased from $19-26 billion in 2011-2014 to $3.4-6.4 billion in 2015-2017 or fell 4-6 times. This led to a rapid depletion of the fund's assets. The government authorities, aware of the risk of rapid depletion of their assets in the face of low oil prices, on December 8, 2016, adopted a new concept for its accumulation and use. Its implementation was supposed to prevent a further reduction in the assets of the oil fund in the medium term, resume its accumulation in the long term and reduce the state budget's dependence on oil from 46 to 20 percent in 2017-2030 (President's Decree, 2016). However, this concept, despite its relevance, turned out to be ineffective because it did not provide a reliable way to achieve the desired results.

As a result of the fall of global oil prices from $64.3 per barrel at the end of 2019 to $42 per barrel in 2020 and cutting the oil production from 90 million tons to 86 million tons under the revised OPEC++ agreement, NFK assets, which amounted to around $62 billion, or 34% of GDP, in 2019, declined to $59 in 2020, or 38% of GDP. However, from the end of 2020 to August 2022, the assets of the NFK further decreased from $59 million to $54 million, or by 8.3%, even though oil price's increased to $107 per barrel, or 2.5 times. The decrease in NFK assets is not due to a decrease in its income, since, on the contrary, they have grown enormously, but to an increase in transfers to the state budget caused by an increase in spending to support the economy and the population in connection with the pandemic in 2020-2021, as well as an increase in social spending ahead of the presidential elections held in November 2022. If these trends continue, by 2025, the falling financial assets under NFK will be at par with the rising government debt at 30% of GDP, a vital benchmark of the fiscal rules. This can also affect the sovereign rating of our country and increase refinancing costs, as well as make market access more sensitive to fluctuations in investor sentiment due to external factors. Further depletion of NFK also puts at risk the capacity of the authorities of the country to keep macroeconomic and banking stable.

In this regard, this article aims to find the key factors that impact the accumulation of the NFK, as well as the development of more effective methods and actions to improve its performance in the future.

This paper proceeds as follows. Section 2 provides a review of the literature. Section 3 discusses the research methodology. Section 4 discusses the data and econometric model build and validates them for adequacy and correctness. Section 5 sets out our findings and conclusions.

## 2. LITERATURE REVIEW

An optimal resource management system allows current spending to be increased sustainably, sustaining a higher public capital stock (IMF, 2012).

Alsweilem et al. (2015) conducted a comprehensive overview of the policies and institutional arrangements of leading SWF's in different countries such as Norway, Kuwait, Kazakhstan, Chile, and Abu Dhabi and identified the critical savings rules.

The analysis of Azhgaliyeva (2018) shows that an oil fund does not guarantee improvement in social welfare in oil-producing countries. The design of oil funds is crucial; appropriate rules can increase social welfare. In countries where the adjustment cost of government expenditure is high enough, expenditure-based rules with the fixed reference oil price or reference oil price following the moving average of oil prices are more suitable than revenue-based rules. In countries where oil production declines at a rate great enough, rules that yield the highest social welfare are the permanent oil income model (POIM) (at four and five percent) and the "Bird-in-hand" (BIH) rule (from six to ten percent). A budget deficit can be avoided if a fund follows a revenue-based rule because only a revenue-based rule is always affordable.

There are different rules which prevent governments from overspending resource revenues on current and non-productive expenditures (Campagne et al., 2020):

Non-resource primary balance rules or expenditure growth rules aim to limit expenditures' procyclicality by limiting government spending growth (in nominal or real terms or as a percent of non-resource GDP).

The Hartwick rule, which earmarks all revenues stemming from the exploitation of a depletable asset for the financing of capital expenditures only, which will generate returns in the future. This rule forbids the government to finance recurrent expenditures using a transient revenue stream.

Permanent income hypothesis rules mean that the resource-funded consumption level should not exceed the return on the NPV of future natural resource revenue. During the extraction phase, most revenues are saved to build up non-resource capital the return on these assets to compensate for the fall in revenue after extraction has ended.

An excellent example of effective management of oil revenues is the Norway fund. Its distinctive feature is that transfers into or out of the fund occur according to the non-oil budget deficit. The fund keeps the parliament fully informed of its activities. It also publishes complete audited statements while providing good returns (Bacon & Tordo, 2006).

Bergholt et al. (2017) study how the business cycle of an oil-exporting, small open economy is affected by international shocks. They developed a two-country New Keynesian model considers oil price shocks for Norway. Based on this model, they found that the oil price dynamic is an essential source of instability in an oil-producing country. The proper fiscal regime provides significant protection against external shocks.

In addition, various studies have been carried out about the National Fund of Kazakhstan, concerning its activities and financial sustainability.

Azhgaliyeva (2014), using data of Kazakhstan from January 1994 to July 2013, found positive but statistically not significant effect of produced oil on the real net revenue of the NFK's assets. Changes in oil taxation in 2009 significantly negatively impacted the actual net income of the oil fund.

Oshakbayev (2017) noted that the high dependence of the state budget on transfers from the oil fund indicates the vulnerability of budget revenues. In 2010, transfers accounted for 33 percent, and in 2017 - 46 percent of oil fund revenues.

ADB (2020) shows that the anti-crisis financing needs of the government in 2020 were $7 billion. This gap was financed by additional transfers from the NFK of $5 billion (18% of the accumulated assets of the NFK) and $2 billion through debt issuance. The rapid depletion of NFK jeopardizes the government's ability to maintain macroeconomic and banking stability. This situation is exacerbated by Kazakhstan's current financial volatility associated with dollarization, the lack of a developed non-mining economy, and significant exposure to terms-of-trade shocks.

According to the Chairman of the NBK, Galymzhan Pirmatov, in 2022, the NFK assets grew to $55.8bn due to a rebound in the oil price and correspondingly high revenues, and its annualized yield since inception is 3.08% (Prime Minister, 2022).

Thus, a review of various literary sources shows that to ensure the successful operation of an oil fund, clear and straightforward financial rules governing its formation and use, as well as strict fiscal discipline, are necessary. At the same time, the best oil funds should be chosen as a benchmark to improve the activities of the NFK.

## 3. METHODOLOGY

### 3.1. Evaluation of the oil fund's stabilization policy (stabilization rule)

Suppose the government wishes to provide future generations with a permanent source of income financed by the revenues generated by its depleting natural assets. In that case, building up an investment fund during the years of resource extraction before it is depleted is necessary. The total receipts $(R)$ of the oil fund will be equal to the product of the total revenues from the oil produced $(X)$ by the share of deductions $(\varphi)$ in the stabilization fund in a particular year ($k$):

$$R_k = \varphi \cdot X_k, \tag{1}$$

In turn, total oil tax revenues $(X)$ can be found as the product of a country's crude oil production $(q)$, world oil prices $(p)$, and the tenge to U.S. dollar exchange rate $(w)$:

$$X_k = q_k \cdot p_k \cdot w_k \tag{2}$$

In this case, the size of the stabilization fund $(S_t)$ in the current year $(t)$ will be equal:

$$S_t = \Sigma(R_k) = \Sigma\, (\varphi \cdot q_k \cdot p_k \cdot w_k), \tag{3}$$

where $k$ takes values from $0$ to $t$ years.

The budget constraint of the stabilization fund is that its maximum size can’t exceed 10 billion USD (President’s Decree, 2016):

$$S_t \leq 10 \tag{4}$$

### 3.2. Evaluation of the oil fund's accumulation policy (savings rule)

If the stabilization portfolio at the end of the year exceeds U.S. $10 billion, the excess amount will be transferred to the savings portfolio so the size of the savings fund $(Z_t)$ is calculated using the formula (President’s Decree, 2016):

$$Z_t = Z_{t-1} + (S_{t-1} - 10) \tag{5}$$

Or, using Equation 3, we can write:

$$Z_t = Z_{t-1} + [\Sigma\, (\varphi \cdot X_k) - 10], \tag{6}$$

where *k* takes values from *0* to *t-1* years.

The budgetary limit of the savings fund provides that its minimum balance should not be less than 30% of the projected value of GDP *(Y)* at the end of the current year *(t):*

$$Z_t \geq 0.3 \cdot Y_t \quad (7)$$

Over time the size of the savings fund *(Z)* will change according to the rule:

$$Z_t = (1+i_t)\,[Z_{t-1} + \Sigma\,(\varphi \cdot X_k) - 10] - T_t, \quad (8)$$

where *i* is the return generated on the savings fund and *T* is the transfer obtained from the oil to the state budget.

The total amount of oil fund (*A)* will be the sum of stabilization and savings funds:

$$A_t = (1+i_t)\,A_{t-1} + \varphi \cdot X_t - T_t, \quad (9)$$

where $A_{t-1}$ is the sum of savings fund and the excess amount of the stabilization fund transferred to the savings portfolio in the previous period.

The total oil fund receipts *(X')*, which include oil tax revenues and the investment return, depending on several macroeconomic factors, such as internal production of crude oil *(q)*, world oil prices *(p)*, the share of income deductions from oil companies to the oil fund (*φ)*, as well as interest rate of tenge to USD *(w)*, and rates on U.S. Treasury bonds *(i)*.

$$X' = f\,(q, p, \varphi, w, i) \quad (10)$$

Oil fund receipts from oil companies increase with the production of crude oil *(q)* and an increase in world oil prices *(p)*. Depreciation of the tenge to the U.S. dollar *(w)* will lead to a reduction in foreign exchange earnings of the oil fund in the short term since each tenge can change to a smaller amount of dollars. On the contrary, strengthening the tenge against the U.S. dollar increases the foreign exchange earnings of the oil fund since each tenge can be exchanged for a more significant amount of dollars. An increase in the rate on U.S. Treasury bonds *(i)*, in which the oil fund typically holds its assets, should cause an increase in its income.

Thus, the following factors can be used as the main factors explaining the size of the oil fund since they correspond to theoretical expectations and statistical information is available for them (Table 1).

**TABLE 1.** The Methods of Variables calculating for the First Model

| Sign | Name | Calculation method |
|---|---|---|
| *X'* | Receipts of the oil fund | In dollar terms, bln. USA dollars |
| *p* | World oil prices | U.S. dollars per barrel of oil, Brent |
| *φ* | Share of income deductions from oil companies to the fund | A share of total oil tax revenues (X) is saved every year into the oil fund, % |
| *q* | Oil production | Crude oil production (crude oil, NGPL, and other liquids) in Kazakhstan, million barrels per Day. EIA (2020) |
| *w* | Exchange rate | Exchange rate of tenge to U.S. dollar, on average for the period (NBK, 2020) |
| *i* | Interest return on the savings fund of the NFK | As a proxy variable used Yield rates on 6-month Treasury Bill of the USA. Federal Reserve Bank of St. Louis (2017) |
| *Note:* compiled by the author | | |

We examine the impact of the dependence of the income of the oil fund (*X'*) on various internal and external factors using the following time regression model:

$$X'_t = \propto + \beta_1 q_t + \beta_2 p_t + \beta_3 \varphi_t + \beta_4 w_t + \beta_5 i_t + \varepsilon_t \quad (11)$$

where *X'* denotes the income of the oil fund at time *t*. The variable *q* represents oil production in Kazakhstan, million barrels per day; *p* is world oil prices, U.S. dollars per barrel; *φ* denotes the share of income transfers from oil companies to the oil fund, %; *w* represents the exchange rate of tenge to U.S. dollar. Finally, *i* is interest return on savings fund (interest rates on U.S. 10-year Treasury bonds are used as proxy variables) and $\varepsilon_t$ is error term.

## 3.3. Data

The data are monthly series covering the period from January 2005 to February 2017, because, from March 2017, the government has stopped publishing monthly reports on the activities of the NFK. The oil production and world oil prices are sourced from the U.S. Energy Information Administration (EIA, 2020), data on oil firms are taken from the Committee on Statistics of the Ministry of National Economy of Kazakhstan (2018), data on exchange rates are taken from the database of the NBK (2018), data on the 10-Year Treasury Constant Maturity Rate are received from the Federal Reserve of Saint Louis Economic Data database (Federal Reserve, 2017). All data are sufficiently stationary. Methods of calculating different variables are defined in Table 2.

**TABLE 2.** Methods of variables calculating

| Name | | Calculation methods |
|---|---|---|
| Oil fund receipts | *X'* | Trillion USD |
| Oil production in Kazakhstan | *q* | Million barrels per day |
| World oil prices | *p* | Dollar per barrel (Brent) |
| The share of revenues deductions from oil firms to the oil fund | *φ* | % |
| The exchange rate of the tenge to the U.S. dollar | *w* | Exchange rate at the end of the period |
| Interest rates on 10-year U.S. Treasuries | *i* | % |
| *Note:* compiled by the author | | |

The results of the Augmented Dickey Fuller unit root test on the stationarity of data series is presented in Table 3.

**TABLE 3.** Unit Root Test Results

| Variable | Test for unit roots in | Adjusted t-statistics | p-value |
|---|---|---|---|
| *X* | level | -5.119840 | 1% |
| | 1st difference | -14.31953 | 1% |
| *p* | level | -2.343812 | 20% |
| | 1st difference | -8.740823 | 1% |
| *φ* | level | -1.955295 | 35% |
| | 1st difference | -4.657797 | 1% |
| *q* | level | -1.256518 | 65% |
| | 1st difference | -13.30425 | 1% |
| *w* | level | -0.206182 | 95% |
| | 1st difference | -7.047610 | 1% |
| *i* | level | -1.596169 | 50% |
| | 1st difference | -9.564622 | 1% |
| *Note:* compiled by the author | | | |

It examines the null hypothesis of unit root (non-stationary) in level and in 1st difference. A description of data for the considered variables is given in Table 4. It means that in order to eliminate the random walk of individual variables, it is better to use them in the form of a difference of the 1st order.

**TABLE 4.** Description of the variables used

| Par. | X’ | q | p | φ | w | i |
|---|---|---|---|---|---|---|
| Mean | 7486.925 | 1568.609 | 80.39671 | 12.06201 | 167.7055 | 3.099452 |
| Median | 5121.649 | 1596.500 | 74.73500 | 10.10305 | 148.0000 | 2.865000 |
| Maximum | 37830.89 | 1867.000 | 140.4400 | 46.78907 | 362.0000 | 5.110000 |
| Minimum | 14.97711 | 1226.345 | 34.73000 | 0.124474 | 117.0000 | 1.500000 |
| Std. Dev. | 7404.178 | 151.0982 | 26.02363 | 9.063532 | 64.02868 | 1.060755 |
| Skewness | 1.510903 | -0.174601 | 0.165044 | 0.922383 | 1.997487 | 0.293942 |
| Kurtosis | 5.215285 | 2.304764 | 1.738271 | 3.667816 | 5.691266 | 1.788075 |
| Jarque-Bera | 85.40266 | 3.682209 | 10.34725 | 23.41561 | 141.1500 | 11.03742 |
| Probability | 0.000000 | 0.158642 | 0.005664 | 0.000008 | 0.000000 | 0.004011 |
| Sum | 1093091. | 229016.9 | 11737.92 | 1761.054 | 24485.00 | 452.5200 |
| Sum Sq. Dev. | 7.95E+09 | 3310446. | 98198.27 | 11911.40 | 594452.3 | 163.1542 |
| Observations | 146 | 146 | 146 | 146 | 146 | 146 |

*Note:* compiled by the author

The analysis of the correlation matrix (Table 5) shows that there is a positive relationship between the receipts of the oil fund *(X’)* and oil production in Kazakhstan *(q)*, as well as world oil prices *(p)*, and the share of revenues deductions from oil companies to the oil fund *(φ)*.

**TABLE 5.** Matrix of correlations between model variables

| Par. | X’ | q | p | φ | w | i |
|---|---|---|---|---|---|---|
| *X’* | 1.000000 | 0.347361 | 0.415711 | 0.733889 | -0.101714 | -0.387576 |
| *q* | 0.347361 | 1.000000 | 0.087586 | 0.334249 | 0.561880 | -0.730325 |
| *p* | 0.415711 | 0.087586 | 1.000000 | 0.320992 | -0.434584 | -0.135271 |
| *φ* | 0.733889 | 0.334249 | 0.320992 | 1.000000 | -0.070021 | -0.399073 |
| *w* | -0.101714 | 0.561880 | -0.434584 | -0.070021 | 1.000000 | -0.565845 |
| *i* | -0.387576 | -0.730325 | -0.135271 | -0.399073 | -0.565845 | 1.000000 |

*Note:* compiled by the author
The statistical significance is defined as *** p< 0.01, ** p < 0.05, * p <0.1.

In turn, there is a negative correlation between the NFK’s revenues *(X’)* and the exchange rate of tenge to U.S. dollar *(w)*, as well as interest rates on 10-year U.S. Treasuries *(i)*. Almost all relationships were in line with expectations, with the exception of the relationship between oil fund receipts *(X ')* and interest rates on 10-year U.S. Treasury bonds *(i)*.

Analysis for multicollinearity shows that there is a high correlation (74 percent) between the share of revenues transferred by oil companies to the oil fund and the growth in the NFK’s revenues, as well as between interest rates on 10-years U.S. Treasury bonds and oil production in Kazakhstan (73 percent). The average correlation between interest rates on 10-years U.S. Treasuries and exchange rate of tenge to U.S. dollar is 57 percent, and between exchange rate of tenge to U.S. dollar and oil production in Kazakhstan is 56 percent. Despite this, there is no reason to talk about multicollinearity, since all variables are independent.

## 4. FINDINGS AND DISCUSSION

On the basis of monthly data from January 2005 to February 2017 (a total of 144 observations), a basic model of the impact of various factors on the receipts in the oil fund was constructed (see Table 6, Model 0).

**TABLE 6.** The impact of different factors on the oil fund's receipts (X')

| Par. | Model 0 | Model 1 | | Model 2 | | Model 3 |
|---|---|---|---|---|---|---|
| | LS | LS | GMM | LS | GMM | ARCH |
| *φ* | 9.06*** | 336.67*** | 292.10*** | 368.80*** | 384.95*** | 244.04*** |
| *w* | -1.51 | -25.13* | -23.79** | | | |
| *i* | -1.27 | -1215.62 | -1528.01** | | | |
| *p* | 1.94* | 44.44 | 46.81* | 72.57*** | 85.97*** | 123.00*** |
| *q* | 1.56 | 10.00* | 5.76* | 9.38** | 6.71** | 8.55*** |
| *C* | -0.82 | -7870.23 | -398.02 | -17535.2*** | -15043.2*** | -18807*** |
| *AR(1)* | | 0.41*** | 0.36*** | 0.41*** | 0.35*** | 0.39*** |
| Obs. | 144 | 144 | 144 | 144 | 144 | 144 |
| Adjusted R-squared | 0.595 | 0.626 | 0.619 | 0.623 | 0.618 | 0.610 |
| S.E. of regression | 4794.54 | 4526.49 | 4568.38 | 4543.67 | 4573.26 | 4686.14 |
| F-statistic | 41.16 | 41.20 | | 60.58 | | |
| Akaike info criterion | 19.83 | 19.72 | | 19.71 | | 19.11 |
| Schwarz criterion | 19.95 | 19.86 | | 19.82 | | 19.33 |
| Durbin-Watson stat | 1.38 | 2.05 | 1.88 | 2.06 | 1.93 | 1.74 |
| J-statistic | | | 8.76 | | 6.60 | |

*Note*: compiled by the author
The statistical significance is defined as *** p< 0.01, ** p < 0.05, * p <0.1.

Our research has shown that the proposed model correctly describes the receipts of the oil fund to the state budget. The methods of econometric modelling carried out the verification. The least squares method (LS) was used as the primary method. However, autocorrelation and heteroscedasticity of the residuals could lead to ineffective estimates of the regression coefficients. The problem of solid autocorrelation was eliminated using the AR(1) first-order autoregressive model. We also used the Generalized Method of Moments (GMM) to overcome the problem of autocorrelation and heteroscedasticity and check the correctness of the model specification. It also provides for calculating variables using 1st order differences, which follows from the requirements of the data stationarity test. The ARCH method was used to validate the models, as the data fluctuated slightly around the mean, showing periodic spikes in values. The Generalized Linear Model (GLM) was used to help eliminate the autocorrelation and heteroscedasticity problem.

As a result of our research, we made the following contributions: First, a model of oil fund receipts was developed using five explanatory variables. Second, the model was tested on a sample spanning January 2005 to February 2017. Testing showed high results for the proposed model. It explains the behaviour of the oil fund by about 60-63 percent.

The least squares method (LS) was used as the calculation method. All coefficients for explanatory variables show theoretically expected signs and are significant. The only exception is the 10-year U.S. Treasury bond interest rate, which shows the wrong sign but is of low value (t statistics is 1.26).

In this model, the significant factors are the share of transfers of oil companies to the oil fund and world oil prices. Other factors, such as the exchange rate of the tenge against the U.S. dollar, and the volume of oil production in Kazakhstan, showed weak statistical significance. The autocorrelation of residuals leads to the fact that the estimates of the regression coefficients, while remaining linear and unbiased, cease to be effective. In addition, there was a problem of residues heteroscedasticity, which led to a decrease in the effectiveness of the regression coefficients. For this reason, t and F-statistics, which determine the significance of the regression coefficients and the model's coefficient of determination, may be distorted.

The problem of strong autocorrelation was eliminated by using the AR(1) first order autoregressive model, which has the form: $y_t = \alpha y_{t-1} + \varepsilon_t$, where $\alpha$ – numerical coefficient satisfying the condition $/\alpha/ < 1$; $\varepsilon_t$ – a sequence of random variables forming white noise. As a result, the adjusted R-squared explaining the strength of the model increased from 59.5 to 62.6, the F-statistic – from 41.16 to 41.2, and the sum of the standard errors of regression decreased from 4794.5 to 4526.5 (Model 1, LS). We also used the Generalized Method of Moments (GMM) to overcome autocorrelation and heteroscedasticity in terms of errors and check the model specification's correctness (Model 1, GMM). This method allows for improving ordinary squares in the presence of both heteroscedasticity and autocorrelation (HAC) of the anonymous form (Newey and West, 1987; Arellano and Bond, 1991). All selected variables were found to be statistically significant. At the same time, using GMM method did not lead to a noticeable change in the regression coefficients for the variables.

Such variables as the share of revenues from oil companies to the oil fund (φ) and oil prices (p) were statistically significant. However, variables such as world and the interest return on the savings fund (i), the exchange rate of the tenge to the U.S. dollar (w), and oil production in Kazakhstan (q), showed low statistical significance. In the second model (Model 2, LS), we excluded such variables as a return of the savings fund (i) and the exchange rate of tenge to U.S. dollar (w), which had a strong autocorrelation of residuals. As a result, the statistical parameters of the model improved markedly. This is evidenced by a significant increase in the F-statistic to 60.58. The coefficient of determination of the model remained at the same level. The GMM method (Model 2, GMM) did not change the model. The statistics of the model remain the same, as well as the magnitude of the coefficients.

In order to check the correctness of the constructed models, the ARCH method (Model 3, ARCH) was also used since, in our case, the indicators slightly fluctuate around the average while showing periodic "bursts" of values. Using the ARCH method resulted in a high significance of all explanatory variables. However, the rise in standard errors over Model 1 and Model 2 suggests that the overall explanatory power of the model has remained the same.

Thus, summarizing the story, it should be noted that all the variable Equations 10 show the right and significant signs, except the return on saving funds. When using Model 1 (LS), which includes all the variables under consideration, an increase in the share of transfers of oil companies to the oil fund by 1% led to an increase in the revenues of the oil fund by $337 million. An increase in world oil prices by 1% led to an increase in revenues by $44.5 million, as well as an increase in oil production by 1% led to an increase in revenues by $10 million. On the other hand, the devaluation of the tenge against the U.S. dollar by 1% led to a decrease in receipts to the NFK by $25 million, and an increase in the interest rate on 10-year U.S. bonds by 1% led to a decrease in receipts to NFK by U.S. $1.215 million.

However, even though all relevant factors of the expected revenues of the oil fund were included in the model, it explains its receipts only by 63 percent. This means that some factors still need to be considered by ordinary methods.

First, the low explanatory power of the oil receipts model can be caused by model specification's errors when not all relevant factors are included. However, we tried to take into account all the relevant factors. Therefore, this hypothesis is not convincing.

Secondly, the oil receipts model's low explanatory power may also be associated with ineffective management. However, the National Bank of Kazakhstan (NBK) has invited reputable and experienced foreign management companies to manage the assets of the oil fund. Therefore, in current conditions, this hypothesis is not relevant.

Third, the model's low explanatory power may result from low transparency when not all of the receipts of the oil fund are fully reflected in its financial statements. Moreover, the observed negative relationship between the receipts of the oil fund and the interest rate on long-term U.S. Treasury bonds, in which the fund's assets are usually placed, cannot be explained unless it is assumed that the excess income is diverted from the fund's accounts to some secret government accounts. This is quite possible, since the history of the creation of the NFK begins with the transfer of money from such foreign secret accounts to the domestic account of the government in 2001.

Furthermore, according to the results of the research conducted by Aiman Tursynkan of the NFK, 8 trillion tenge "evaporated" in 2016. As the economist explained, the size of the expenditure part of the Republican budget was then less than 9 trillion tenge, which means that almost one annual Republican budget disappeared from the NFK (Glushkova, 2022). The NBK explained that this was caused by the exchange rate revaluation of the fund's assets in 2015 due to the transition to a floating exchange rate of the national currency since the main currency for investing the assets of the NFK is the dollar while reporting on the assets of the NFK is made in the national currency. However, this explanation is not convincing, as Kazakhstan has officially floated the tenge since 1999 (Beinoeva, 2021).

A slight decrease in NFK assets from 2020 to 2022 is of concern, despite a significant increase in world oil prices by 2.6 times. This means that the state continues to view the NFK not as a fund for future generations, as it was originally intended, but as a reserve wallet from which money can be drawn to address urgent current issues.

Another problem is the cessation of publication of monthly reports on the activities of the NFK from March 2017 to the present, which makes it impossible to conduct a deep analysis of the formation and use of the fund.

## 5. CONCLUSIONS

The creation of the NFK in 2001 was a critical decision for our country. It helped solve the problem of overheating the economy due to the influx of petrodollars due to the intensive development of hydrocarbon resources. Also, it created a safety cushion for the country's economy and accumulated resources for future generations.

Based on official government documents, the oil fund's accumulation policy (savings rule) model was developed, which has the following form: $X' = f(q, p, \varphi, w, i)$. The total oil fund receipts *(X')*, which include oil tax revenues and the investment return, depends on a number of macroeconomic factors, such as internal production of crude oil *(q)*, world oil prices *(p)*, the share of income deductions from oil companies to the oil fund *(φ)*, as well as interest rate of tenge to USD *(w)*, and rates on U.S. Treasury bonds *(i)*.

A regression model was also built, which has the following form:

$$X'_t = \propto + \beta_1 q_t + \beta_2 p_t + \beta_3 \varphi_t + \beta_4 w_t + \beta_5 i_t + \varepsilon_t, \qquad (11)$$

where *X*' denotes the income of the oil fund at time *t*. The variable *q* represents oil production in Kazakhstan, million barrels per day; *p* is world oil prices, U.S. dollars per barrel; *φ* denotes the share of income transfers from oil companies to the oil fund, %; *w* represents the exchange rate of tenge to U.S. dollar. Finally, *i* is interest return on savings fund (interest rates on U.S. 10-years Treasury bonds are used as proxy variables) and $\varepsilon_t$ is error term.

As a result of our research, we made the following contributions. A model of oil fund receipts was developed using five explanatory variables. The model was tested on a sample spanning January 2005 to February 2017. Testing showed high results of the proposed model. It explains the behaviour of the oil fund by about 60-63 percent.

The most significant factors in the model of receipts of the NFK are the share of income deductions from oil companies to the oil fund (φ), world oil prices (p) and oil production in Kazakhstan (q). Their growth of these indicators by 1 percent led to a growth in receipts of the oil fund by $336 million, $44.5 million and $10 million, respectively. Thus, almost all hypotheses regarding NFK's income were confirmed, namely, a positive relationship between the share of transfers of oil companies to the oil fund, world oil prices, oil production and oil fund income, as well as the negative impact of tenge devaluation on NFK's income.

Only the hypothesis of the positive impact of the interest rate on 10-year U.S. bonds on NFK's income was not confirmed. Our hypothesis is that the income received for the savings fund can be unofficially withdrawn from the fund's accounts. However, this assumption requires verification, which is difficult in the current conditions due to the incomplete transparency of its activities, since detailed information on the objects, sizes, terms and conditions for placing the fund's savings has not yet been published.

Thus, filling the NFK from the side of income positively depends on the height of the tax rate from oil enterprises, on the value of world oil prices, the volume of domestic oil production and the strengthening of the tenge. At the same time, the increase in interest rates on U.S.Treasury bonds did not lead to an increase in the fund's income, which means either the ineffectiveness of the fund's investments, which is very doubtful, or the periodic withdrawal of the fund's investment income as soon as it is received.

Future research will be possible if the National Bank resumes the publication of monthly NFK's reporting, which it stopped starting in March 2017. In addition, the reporting should be supplemented with new indicators relating to using all income from the placement of the fund's assets, including investment income. Then it will be possible to check why the hypothesis of the positive impact of the interest rate on 10-year U.S. bonds on NFK's is not met. As recommendations for the government to increase revenues to the National Fund, we propose the following measures. The most effective tools are an increase in the share of income deductions from oil companies to the fund, as well as an increase in oil production. In addition, it is necessary to ensure the stability of the tenge exchange rate, since the 1% devaluation of the tenge against the U.S. dollar led to a decrease of its receipts by $25 million. With regard to investment income from NFK's assets placed abroad, the lack of a positive relationship between the increase in the interest rate on U.S. bonds and its receipts is a mystery and requires a fiscal review of the legality of the use of the NFK's assets.

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