The Impact of Oil Factor on Azerbaijan Economy

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ABSTRACT

The paper examines the role of oil in the world economy and its impact on Azerbaijan economy. The reciprocal relations between factors in research were carried out by differential model of time series and times series have been checked whether they are unit root (Augmented Dickey-Fuller (ADF), Phillips-Perron (PP) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) as a methodology of the research. The research focused on the econometric analysis through traditional methods and statistics like EVIEWS 9, GRETL, PASW Statistics. The results confirm that the formation of demand and supply didn’t happen in the world market during 15-20 years. The relationships between oil prices and demand and supply prove the novelty of the research. The impact of oil price fluctuations on “economic concept” was high in 2007-2009 and 2014-2016. The practical importance of the article is the employment of the income ‒ generated from “the contract of the century” ‒ for the human development.

Keywords: Economic Development, Oil Prices, Econometric Analysis, Functional Dependence, Macroeconomic Indicators

JEL Classifications: E31, F31, Q41

1. INTRODUCTION

World Oil market is still in the centre of attentions in the modern world (Bataa et al., 2016; Liu et al., 2015). Thus, it is the energy driven factor of world economics, stock market, oil exporting and importing countries’ economics, exchange rate and etc. (Baffes, 2007; Jadidzadeh and Serletis, 2017). Modern oil market is featured in developing dynamics and it is related to the increase of consumption and world production. During 2005-2015, oil consumption and production increased 12.1% and 11.9% respectively. Besides, there is unstability in the world oil market. This case was observed seriously in 2008 and 2014-2016.

Average oil price was 43.55 dollar/barrel in 2016. This is the lower indicator than in 2016. However, it was 38.1 dollar/barrel in 2004. Having low prices was related to geopolitical issues. War and conflicts in the Near East, economic sanctions to Russia and etc. For the purpose of making the balance in the world oil market, oil exporters embarked on negotiations to impose a quota on oil production in February 2016 and in December, they concluded the agreement with “freezing”. During that period, oil price had been 50 dollars. Oil price had been 53-57 dollar/barrel at the beginning of December. Oil market affects on the world economy and other energy driven factors. Although it is expected to be reduced in the near future, oil governs the world economics and policy now.

2. LITERATURE REVIEW

Ghalyinini (2011) researched the fluctuation of oil prices and concluded that price shocks affected macroeconomic indicators through different channels. Geopolitical doubts and certain market dissessions paved the way to mercenares and speculative resources to turn out in the world oil market. In turn, it caused the increase of prices for a short period again
Besides, it has been concluded that oil price interconnects with the legislation of local authorities (Siddiqui. 2005). The increase of oil prices causes the inflation to go up and to reduce the profit generated from products and services and weakens economic development. Every government faces this problem when they want to increase oil prices (Nooreen et al., 2007).

Oil prices have a huge influence on the world economy but it is hard to determine because they are different for each country (Arezki and Blanchard, 2015, Barsky and Kilian, 2004). Michael and Menzie (2004) has concluded that impact of energy resources on economy is completely different from other resources. He claimed that inflation is directly influenced by oil prices. Besides, Turkish scholars Hakan and Taşçı (2002), Aydoğuş (1993), Olgun (1982) researched the influence of oil prices on Turkey, inflation and economic development. They concluded that salary and other factors such as profit, interest rate and rent must be regulated on the basis of oil prices and level of current prices.

| Study | Period and Country/Region | Methodology | Results of the study |
|-------|---------------------------|-------------|----------------------|
| Guglielmo et al. (2015) | China, 1997M1-2014M2 | VAR–GARCH–in–mean model, VAR DCC–GARCH–in–mean model | Exchange rates in the stock market depend on the world oil price positively |
| Siok et al. (2015) | China, 1980-2010 | ARDL Model | World oil prices influence on the main determinants of inflation in less dependent sectors of oil – on real exchange rates direct, on production expenditures of exporters indirect. It is recommended to reduce the effects of these shocks through exchange policy |
| Fatih and Fethi (2016) | Turkey, 2004-2014 | VAR model | Oil prices directly influence on exchange rates |
| Seyhun and Demezca (2015) | Turkey, 2001M2-2011M7 | Kejriwal – Perron (2009) test results, cointegration | Oil prices directly influence on exchange rates |
| Lanouar, et al. (2018) | USA,1947Q2-2016Q4 | AR (p)–GARCH | Oil prices impact little on economic development. The impact is non–linear and not constant |
| Sakib (2014) | Bangladesh | Real business cycle (RBC) model, dynamic stochastic general equilibrium (DSGE) analysis. Impulse Response Functions (IRFs) | Oil prices are not the main factors of business cycle of economics |
| Nooreen et al. (1998) | Pakistan, 1998M3-2005M12 | GARCH, Granger causality test | There is no strong relations between oil prices and stock market. The reason for this is the utilisation of gas beside oil |
| Umut et al. (2013) | Turkey, 1991M1-2010M2 | Fully modified OLS (FMO–OLS), dynamic OLS (DOLS) cointegration | There is a long–term and direct relationship among exchange rates and oil prices as well as exchange rates of securities (stock market) |
| Osigwe and Arawomo (2015) | Nigeria | The Granger causality test within an ECM framework was used to estimate the inter–linkage among the variables | There is no relations between kerosene prices and consumption and economic development. There is a positive relation between energy consumption and economic development |
| Foudeh (2017) | Kingdoms of Saudi Arabia, 1995Q4-2015Q4 | ARDL model | Oil prices impact on GDP positively. Trade balance, budget, internal economics, gold–currency reserves, foreign investment are directly related to oil prices. It directly impacts on the main determinant of economics – government expenditures |
| Theodosios and Dagoumas (2017) | Russian, 1995-2014 | Two vector autoregressions (VARs) and VECM | Macroeconomic indicators such as – industry production index, unemployment, GDP, government expenditures depend on oil factors like oil price and oil production but there is no evidence for Dutch disease |
| Elsiddig et al. (2016) | Sudan, 2000Q1-2011Q2. | ARDL, VAR model, Granger causality test | There is an adverse relation between oil prices and macroeconomic indicators of developed countries. However, it affects underdeveloped countries like Sudan directly. The reduction of oil prices makes the oil prices down, cut down current prices and government budget. But the increase of oil price doesn’t impact on budget resurgence (Granger causality). Oil prices affect the budget asymmetrically |
| Study                        | Period and Country/Region            | Methodology                                      | Results of the study                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-----------------------------|--------------------------------------|--------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Aynur (2016)                | OESD, 1995-2013                       | Panel VECM, Granger causality tests, cointegration| There is cointegration among economic development, energy consumption, employment and capital. There is relations between economic development and energy consumption in a short period (VECM). However, there is no relations between economic development and energy consumption in a long term                                                                                                                                                                                                                                                                                                                                 |
| Nasser et al. (2016)        | Oman 1980-2012                        | Simple macroeconomic model, Regression analysis  | Oil sector influences on GDP and all sectors of economy positively. The strongest impact happens in gas sector but the weakest in agrarian sector. Economics is far away comprehensive development                                                                                                                                                                                                                                                                                                                   |
| Yusoff and Bekhet (2016)    | Malaysian 1990-2013                   | Furthermore, on the basis of the standardised CGE model developed by Lofgren et al. (2002), an energy subsidies CGE (ESCGE) model was established. Model of the general balance (MGB) constant elasticity of substitution (CES)                                                                 | Fuel and tax subsidies have a strong influence on energy consumption structure. Reduction in fuel and tax subsidies will reduce energy consumption and will stimulate alternative energy sources. This will cause the reduction of budget shortcoming and will increase GDP                                                                                                                                                                                                                       |
| Aziz and Dahalan (2015)     | ASEAN–5 Malaysia Indonesia and Singapore Thailand and Philippines, 1991-2012 | Panel regressions analysis                      | Oil price fluctuations impact on RSCA negatively in all technological processes                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Bass (2019)                 | Russian, 2010-2017                    | VECM, Granger causality tests, cointegration     | The influence of world oil price fluctuations on inflation and exchange rate in Russia has been examined. World oil price, inflation and exchange rate is in the cointegration. Oil price and exchange rate are one of the factors that cause inflation                                                                                                                                                                                                                                                                                                                                 |
| Mourad and Ben-Salha (2019) | WORLD, 1990M1-2017M11                 | Linear and Nonlinear ARDL modeling              | Cause effect reactions between macroeconomic indicators and oil price has been changed. Different reasons of oil price increase affect differently to economics                                                                                                                                                                                                                                                                                                                                                   |
| Kilian (2009)               | USA 1973M1-2007M12                    | The structural VAR model                        | The increase of oil price for oil exporting countries doesn’t influence on their economic development. However, the dependence of G−7 countries on oil reduce their GDP a bit                                                                                                                                                                                                                                                                                                                                 |
| Ghalayini (2011)            | OPEC, G–7, Russian, India and China, 2000Q1-2010Q1 | Granger Causality tests                         | The correlation between oil price and produced products is only statically compliance. There is no systematics case                                                                                                                                                                                                                                                                                                                                                                                                 |
| Hamilton (1983)             | USA 1947-1981                         | Granger Causality tests                         | Oil price shocks directly affect to production and its price and effectivity in a long term                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Bruno and Sachs (1982)      | United Kingdom 1950-1979              | Macroeconomics analysis                         | If Salary, rent, profit are stable, the oil price increase cause inflation not much. However, oil price becomes string if it changes according to oil price and even causes hyperinflation                                                                                                                                                                                                                                                                                                                                 |
| Hakan and Taşçı (2002)      | Turkey 1990                          | Input–output analysis                            | Oil price shocks directly affect African oil exporting countries economy via currency–credit system, unemployment, exchange rate and etc., It stimulates business. There is a correlation between GDP and oil price                                                                                                                                                                                                                                                                                                                                 |
| Mathew and Ngalawa (2017)   | 1980M1-2015M4                         | PSVAR                                            | Oil shocks impact is asymmetric                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Hamilton (2005)             | USA 1949Q2-1980Q4                     | OLS regression                                  | After second world war, 9/10 downsizing had been prior to oil prices in the USA                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Kilian (2009)               | USA 1947-2005                         | The fitted value of the linear ordinary least squares (OLS) regressions | European countries and Japan have been affected more than the USA by oil shocks since they are dependent on oil prices. Generally, it wasn’t strong impact                                                                                                                                                                                                                                                                                                                                 |
| Michael and Menzie (2004)   | USA, United Kingdom, France, Germany and Japan, 1980-2005 | ARDL, Fillips curve                             | This paper reviews some of the literature on the macroeconomic effects of oil price shocks with a particular focus on possible nonlinearities in the relation and recent new results obtained by Kilian and Vigfusson (2009)                                                                                                                                                                                                                                                                 |
| Hamilton (2010)             | USA 1949Q2-2001Q3                     | OLS to estimate the forecasting regression, impulse–response functions. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
3. MATERIALS AND METHODS

In the research, world GDP, world industry production, daily oil production and including oil price have been generated by internet resources. Azerbaijan macroeconomic indicators have been taken from Azerbaijan State Statistics Committee.

For econometric analysis, we have used simple and complex regressions:
\[ \hat{y} = a + bx \] (1)

Simple regression function includes:
\[ 0.7 < |r_{xy}| \leq 1, n \geq 6 \] (2)
\[ \hat{y} = a + b_1 x_1 + b_2 x_2 + \ldots + b_m x_m \] (3)

Complex regression function includes:
\[ 0.3 < R_{x_i}^2 < 1; R_{x_i}^2 < \min \left( R_{x_i}, \left| R_{x_i} \right| \right), \] (4)
\[ \forall k \neq l, \forall k, l = 1, m, n \geq 6m \]

Simple linear regression function is used in terms of the simplicity of economic significance of the model.

So, the more the regression function is complex, the more complex is the parameter.

In case of the lack of information, having more regression parameters is statistically important or causes the low quality of the model by criteria. We have established models by using special econometric computer programs.

The smallest square method has been used for the calculation of linear regression function parameters. It is required to choose regression parameters carefully:

\[ S(a, b_1, b_2, \ldots, b_m) = \sum_{t} (y_t - \hat{y}_t)^2 \]
\[ = \sum_{t} \left( y_t - a - b_1 x_{t1} \right) - b_2 x_{t2} - \ldots - b_m x_{tm} \right)^2 \rightarrow \min \] (5)

The following parameters are required for the quality of regression model:
1. General importance is verified: \( F \geq F_{a; m, n-k} \)
2. The importance of regression function parameters is verified: \(|r| \geq 1-a; n-k-1\)
3. The verification of the smallest square method.

However, since time series are mostly non-stationary, the employment of the ordinary least squares (OLS) method might cause false dependency among variables. The probability is high among our time series, that’s why we can only mention three of them:
1. Let’s insert the lag order inputs (indicators) on the right side of \( y_t = a + bx_t \). equation.
\[ y_t = a + bx_{t-1} + \gamma y_{t-1} + \delta x_{t-1} + u_{t-1} \] (6)

Here, \( u_{t-1} \) is stationary series while \( x_{t-1} \) is an exogenous indicator.

We can establish this equation in 2 forms:
\[ a. \quad y_t = a + bx_{t-1} + \gamma y_{t-1} + \delta x_{t-1} + u_{t-1} \] (7)
\[ b. \quad y_t = a + bx_{t-1} + (\beta + \delta) x_{t-1} - \delta x_t + u_t \] (8)

In both cases, integrated \( y_{t-1} \) stands here. \( \beta \) zero – on the right side of the equation is the coefficient of \( \Delta x \), stationary variable. \( y_{t-1}, x_{t-1}, \Delta(1), u_{t-1} \) is stationary series. Sims et al. (1990) indicated in his article that the employment of the ordinary least squares method is important for the coefficient of the equation. \( \beta \) is normal unless it is asymptotic. The usual t– statistics possesses asymptotic normal distribution N(0,1) in order to check \( H_0: \beta = 0 \) hypotheses. Analogically, \( \delta \) on the right side of the equation is the coefficient of \( \Delta x \), stationary variable \( y_{t-1}, x_{t-1}, \Delta(1), u_{t-1} \) is stationary series. That’s why \( \delta \) is normal unless it is asymptotic. The usual t– statistics possesses asymptotic normal distribution N(0,1) in order to check \( H_0: \beta = 0 \) hypotheses.

2. Prior to model assessment, lets differentiate series, in other word, lets analyse the model in series difference.
\[ \Delta y_t = a + \beta \Delta x_t + u_t \] (9)

In that case, we can see that in equation \( u_{t-1} \) is stationary series. In this model, the assessment of the ordinary least squares for either \( a \) or \( \beta \) is normal unless it is asymptotic. If \( u_{t-1} \) white noise,
then both $t$– statistics possess asymptotic normal distribution $N(0,1)$.

3. Using autocorrelation regression model for assessment.

$$y_t = \alpha + \beta x_t + \epsilon_t = \rho x_{t-1} + \epsilon_t, \quad t \sim i.i.d. N(0, \sigma^2)$$

(10)

In case of false regression $\hat{\rho} \to 1$ (on probability). That’s why, in case $T$ is higher, this method equals to primary differentiation method of series. We will employ the second method – primary differentiation method of series.

4. EMPIRICAL RESULTS AND DISCUSSION

First of all, the stationary of time series has been checked and tested though commonly–accepted three tests (ADF – Augmented Dickey–Fuller, PP – Phillips–Perron and KPSS – Kwiatkowski–Phillips–Schmidt–Shin). Tests have been done through EVIEWS 9 econometric program (Table 1).

| Abbreviations | World gross domestic product, dollar | World industrial production, dollar | World production, barrel | World consumption, barrel | Oil prices | Azerbaijan gross domestic product, manat | Azerbaijan investment on fixed capital, manat | Azerbaijan oil production, ton | Azerbaijan external a trade turnover, dollar | Azerbaijan import, dollar | Azerbaijan export, dollar |
|---------------|-------------------------------------|-----------------------------------|--------------------------|---------------------------|------------|------------------------------------------|-----------------------------------------------|----------------------------|-----------------------------------------------|----------------------------|----------------------------|
| WGDPC         | PB                                  | WIP                               | WPP                      | WCP                       | PB         | AZGDPC                                   | AZIFC                                      | AZOP                        | AZETT                                   | AZIM                       | AZEX                       |
|               | $-$4.10**                           | $-$3.71**                         | $-$3.76**                | $-$3.95***                | $-$5.33*** | $-$3.32**                                | $-$3.71**                                | $-$3.82**                   | $-$3.82**                               | $-$4.61**                  | $-$6.48**                  |
|               | $-$4.10***                          | $-$3.67**                         | $-$3.73**                | $-$4.00***                | $-$5.58**   | $-$5.15**                                | $-$3.71**                                | $-$3.82**                   | $-$3.82**                               | $-$3.59**                  | $-$4.88**                  |
|               |                                    | $-$4.50**                          | $-$3.59*                 | $-$3.67*                  | $-$5.49**   | $-$4.24**                                | $-$3.67*                                | $-$3.83**                   | $-$3.83**                               | $-$5.39**                  | $-$5.68**                  |
|               |                                    | $-$1.26**                          | $-$1.26**                | $-$1.00**                 | $-$1.10**   | $-$1.00**                                | $-$1.00**                                | $-$1.10**                   | $-$1.10**                               | $-$1.10**                  | $-$1.10**                  |
|               |                                    | $-$1.00**                          | $-$1.00**                | $-$1.00**                 | $-$1.00**   | $-$1.00**                                | $-$1.00**                                | $-$1.00**                   | $-$1.00**                               | $-$1.00**                  | $-$1.00**                  |
|               |                                    | $-$1.00**                          | $-$1.00**                | $-$1.00**                 | $-$1.00**   | $-$1.00**                                | $-$1.00**                                | $-$1.00**                   | $-$1.00**                               | $-$1.00**                  | $-$1.00**                  |
|               |                                    | $-$1.00**                          | $-$1.00**                | $-$1.00**                 | $-$1.00**   | $-$1.00**                                | $-$1.00**                                | $-$1.00**                   | $-$1.00**                               | $-$1.00**                  | $-$1.00**                  |

ADF reveals that world GDP, world industry production, oil prices, world oil production (supply) and world oil consumption (demand) are in the 1st difference and stationary in three cases (constant; constant and trend; none). Only world GDP in the 1st difference is not stationary in one case (none). This result is suitable for the method. The results of PP is similar to ADF test, but is unclear a bit. Thus, world GDP and oil process are stationary (none) both in 1st difference and in simple case. KPSS test is also unclear. The above–mentioned facts might be referred to time series tests of Azerbaijan macroeconomic indicators.

The coefficients of only two of the models (models 1 and 2) that reflect the impact of World GDP, world industry production, daily oil production (supply) and oil consumption (demand) on oil price are statistically significant (Table 2). In other words, world GDP and world industry production influence on world oil prices. It can be inferred that model 3 and 4 has no any impact of world daily oil production (supply) and oil consumption (demand) on world oil prices. Thus, the coefficients are not statistically significance. According to the Breusch–Godfrey Serial Correlation LM Test, autocorrelation in models doesn’t exist. Autocorrelation exists only in model 3. So, we can infer that although world industry production plays a certain role in world oil price fluctuation and world GDP, daily oil production (supply) and oil consumption (demand) don’t impact on world oil price. As mentioned in the beginning of the research, non–economic factors play a role in oil price fluctuations (up and down).

The models (model 5-8) reflecting the dependency of investment on fixed assets on oil price and oil production in Azerbaijan happens the adverse process (Table 3). So, model 5 and 7 either constant or oil price coefficient is statically significance. Generally, model is significant and adequate. However, model 6 and 8 (models that reflect the dependency of oil price on Azerbaijan GDP and investment on fixed capital) are not statistically significance (reflecting oil production coefficient in Azerbaijan) and generally, models are not adequate. It gives an evidence once more that Azerbaijan’s GDP and investment on fixed capital depends entirely on the oil price and does not depend on the volume of oil production in Azerbaijan (mainly in the short–term). According to the Breusch–Godfrey Serial Correlation LM Test, autocorrelation has been active in model 5.

Table 1: The unit root test results (1st difference)

| Variables | ADF | PP | KPSS | Constant | ADF | PP | KPSS | Constant and trend |
|-----------|-----|----|------|----------|-----|----|------|-------------------|
| PB        | -4.10*** | -4.10*** | 0.23 | -4.33** | -4.50** | 0.16** | -4.16*** | -4.16*** |
| WGDPC     | -3.71** | -3.67** | 0.13 | -3.32** | -3.59* | 0.12* | -3.12*** | -3.12*** |
| WIP       | -3.76** | -3.73** | 0.15 | -3.71** | -3.67* | 0.12* | -3.12*** | -3.12*** |
| WPP       | -3.95*** | -4.00*** | 0.12 | -3.82** | -3.83** | 0.11 | -3.25** | -3.25** |
| WCP       | -5.33*** | -5.58** | 0.09 | -5.15*** | -5.49*** | 0.09 | -3.05*** | -3.05*** |
| PB        | -3.52*** | -3.48** | 0.17 | -3.64* | -4.24*** | 0.17 | -3.59*** | -3.59*** |
| AZGDPC    | -3.33** | -3.26** | 0.12 | -3.22 | -3.09 | 0.11 | -2.08** | -1.97*** |
| AZIFC     | -3.61** | -3.59** | 0.11 | -3.53** | -3.51* | 0.10 | -2.63** | -2.63** |
| AZOP      | -1.77 | -1.76 | 0.25 | -2.08 | -2.06 | 0.09 | -1.77* | -1.77* |
| AZETT     | -6.47** | -6.78*** | 0.19 | -6.51*** | -7.29*** | 0.23*** | -6.59*** | -6.85*** |
| AZEX      | -6.69*** | -7.02*** | 0.16 | -6.71*** | -7.70*** | 0.09 | -6.88*** | -7.23*** |
| AZIM      | -4.48** | -4.48** | 0.16 | -4.67*** | -4.69* | 0.11 | -3.83*** | -3.86*** |

ADF denotes the Augmented Dickey–Fuller single root system respectively. The maximum lag order is 3. The optimum lag order is selected based on the Schwarz criterion automatically; ***, ** and * indicate rejection of the null hypotheses at the 1%, 5% and 10% significance levels respectively. The critical values are taken from MacKinnon (Mackinnon, 1996). PP Phillips–Perron is single root system. The optimum lag order in PP test is selected based on the Newey–West criterion automatically; ***, ** and * indicate rejection of the null hypotheses at the 1%, 5% and 10% significance levels respectively. The critical values are taken from MacKinnon (Mackinnon, 1996). KPSS denotes Kwiatkowski–Phillips–Schmidt–Shin (Kwiatkowski et al., 1992) single root system. The optimum lag order in KPSS test is selected based on the Newey–West criterion automatically; ***, ** and * indicate rejection of the null hypotheses at the 1%, 5% and 10% significance levels respectively. The critical values are taken from Kwiatkowski–Phillips–Schmidt–Shin [90]. Assessment period: 1999-2017*
The macroeconomic indicators of the Azerbaijani manat and the models (models 9, 11 and 13) expressed in figures from the models reflecting the influence of oil prices on macroeconomic indicators in Azerbaijan (model 9-14) are statistically significant and the models are adequate. However, these indicators are expressed in models that are dependent on oil prices (models 9, 11 and 13) but macroeconomic indicators are statistically significant, and the constants are negligible. Thus, the results of these models (model 9-14) once again prove that the relationship between oil prices and many macroeconomic indicators is different in oil exporting and oil importing countries.

5. CONCLUSION

The reasoning of models either economic or mathematical point of view can closely be related to the relative proximity of the economic growth rate with oil production and price rate. Unlike world economic situation, as noted above, there is no absolute dependency close to between world oil production and consumption as well as the relative dependency among world oil production, consumption and world GDP and in general, dependency between oil price and these factors (world oil production, consumption and world GDP), especially in the last decade. That’s why our Azerbaijan also witnesses the reverse processes. Although economic growth and demand act as an important factor in the world oil price, it can be inferred that the economic growth observed in Azerbaijan, one of the world’s smallest exporter of oil production in the world, is largely dependent on oil production and oil prices.

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