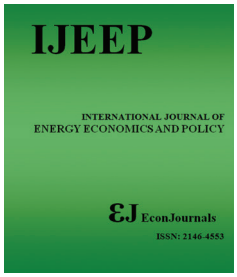

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Oil Hikes, Drugs and Bribes: Do Oil Prices Matter for Crime Rate in Russia?

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ABSTRACT

In this article we test the hypothesis about the impact of oil prices shocks on the unemployment and crime rate on the example of oil-exporting country. According to the hypothesis, there exist a dependence of the labor market on oil revenue. A negative oil price shock should lead to a decrease in the employment rate, which in turn should lead to a rise in illegal forms of behavior. Illegal behavior is measured as an average of registered crimes (bribery and drug dealing). Based on data for 1990-2017 we study a case of Russia, using vector error correction model for detecting short- and long-term effects. Results show that oil prices and unemployment affect crime rate in the long-run in a case of oil-exporting country. Yet, in the short-run both negative oil shocks and a rise in unemployment rate lead to a statistically significant increase in bribery and drug dealing. A 1% decrease in oil price will lead to a 1.14% rise in bribery and drug dealing and a 1% increase in the unemployment rate leads to a 2.72% increase in drug dealing and bribery.

Keywords: Oil Prices, Unemployment, Crime Rate, Bribery, Vector Error Correction Approach
JEL Classifications: Q41, E24, F43, K42

1. INTRODUCTION

Conventional economic wisdom states that the most important factors, as well as sources, for economic growth include consumption, exports, government spending and investment. Growing propensity to consume, leading to reduced budget constraint of households and empowered by households' lending activities helps to boost economic growth in the short run, if accepting the money non-neutrality hypothesis. Growing money demand bring to life an increased level of consumption, which in turn leads to increased output and employment rate. This, in turn, leads to short-lived, yet desirable growth in GDP.

In case of oil-exporting countries, economic growth and employment rate significantly depend on world oil prices dynamics. Oil prices, determining export revenues, which in most cases account for a large share of government spending, play a major role in determining the pace of the national economic growth. On the one hand, oil revenues being a major source for government spending, affect labor market in part of economically active population, employed in the budget sector. Falling oil revenues lead to a decline in the wages growth rates, as well as worsening expectations of economic agents, concerning spending and savings decisions. Another results of a negative shock in oil prices for oil-exporting country may be labor optimization schemes, leading to a growth in an unemployment rate in the budget sector in parallel with growing labor efficiency. On the other hand, a negative shock in oil prices, leading to decline in oil revenues may lead to a decrease in efficiency of budget spending multiplier, like in Samuelson model, which, in turn leads to lesser efficiency of budget funds allocation and reallocation between economic agents. The vicious circle may be strengthened by a decrease in efficiency of consumption multiplier: Lower wages in the budget sector leading to a surge in consumption. An initial negative shock may then lead to a decline in spending and real wages of labor force, employed in the commercial sectors of the national economy.

Yet, it's quite logically to assume that in the case of oil-exporting country, if oil revenues play a major role in government spending (like in cases of Saudi Arabia, Russia, Venezuela etc.), negative oil shocks may lead to an even greater negative impact on economic growth than in oil-importing countries or states, restraining the budget from resource curse. In other words, we hypothesize that a negative oil shock should lead to a rise in unemployment rate ceteris paribus. Many studies investigated this nexus and reported a statistically significant relationship between these macroeconomic variables see, e.g., Ahmad (2013), Alkhateeb et al. (2017), Burakov and Kurnysheva (2017). The detailed literature review is presented in the next section.

If oil prices are essential in case of oil-exporting countries for employment dynamics, then it's also logical to assume that unemployment should bring to life some negative externalities of economic and social nature. One of the most important negative externalities of unemployment is expected to be illegal behavior, that is crime.

A nexus between deterioration of the labor market and crime rate was theoretically described and assessed by the Nobel Prize Winner Becker (1968). In his infamous paper, an economic model of crime was developed, explaining that a willingness of economic agent to engage in crime activities will hold and even grow as long as the expected utility of committing crime would be greater than the expected utility of engaging in other activities. Hence, occurring exogenous and endogenous frictions on the labor market make crime activities more attractive. Economic theory of crime, then, states that there should exist a nexus between unemployment rate and crime rate in the national economy. During expansion phase of the business cycle, crime rate should decline and vice versa. That is why, when dealing with economic aspects of illegal behavior in most cases, researchers choose unemployment rate as a proxy for studying the nexus between labor market and property crimes. Yet, illegal forms of behavior include not only property (robbery, fraud, larceny), but also violent types of crime (murder, assault etc.)

For explaining relationship between different types of illegal behavior and unemployment rate, Cantor and Land (1985) developed a theoretical framework in an attempt to describe and explain the links between the variables. According to their point of view, there exist two important channels, though which one could explain engagement of an economic agent in crime activities: Opportunity and motivation. The motivation hypothesis, similar to Becker (1968) economic approach, states that a decrease in economic prospects should increase incentives to engage in crime, that is unemployed are more likely to become criminals than employed ones. The opportunity hypothesis suggests that a decline in economic activity should decrease availability of criminal targets, taking into account that unemployed are more likely to stay at home, decreasing their vulnerability to property crime. Motivation hypothesis tends to explain property crimes better, while opportunity hypothesis is relevant for both property and violent crimes.

According to the above described theoretical framework of relationships between oil prices and employment, as well as unemployment and crime rate, we hypothesize that there should exist a nexus between shocks in oil prices and crime rates. The effect of the relationship or the magnitude of the negative social externality of growing unemployment in the form of illegal behavior should be even more strongly expressed in case of oil exporting countries, dependent on oil revenues for government spending.

Hence, we assume that a negative oil shock in oil exporting country should lead to deterioration on the labor market, thus rising a crime rate. Unfortunately, this issue doesn't have a solid theoretical and empirical background, while most of studies and empirical investigations come from the US and the UK and are dedicated to research of local resource booms (oil, gas, coal) on the regional level and their impact on crime rates see e.g., Andrews and Deza (2018), Stretesky et al. (2018). Research, dedicated to investigation of the "oil prices-crime rate" nexus on the macro-level is scarce, as well as studies, investigating oil-exporting countries.

Moreover, most of the studies, dedicated to this issue, use violent and property forms of crimes as a proxy for crime rate. Neither bribery nor drug dealing are used in such studies. In contrast to existing research, we use bribery and drug dealing indices as a proxy for crime rate, when testing motivation hypothesis for rent-seeking economies.

The remainder of the paper is organized as follows: Section 2 provides an overview of relevant literature; section 3 describes econometric modeling techniques and data used; section 4 presents an analysis of empirical results; section 5 presents the conclusion of the study.

2. LITERATURE REVIEW

To test the stated hypothesis, we refer to the relevant literature on the issue. For convenience purpose, the literature review is divided into three groups. First group present main results of different investigations on oil prices-employment nexus both in developed and developing countries, as well as countries, exporting and importing oil.

Concerning oil prices-employment nexus, a lot of studies are devoted to analysis of domestic market competition producers of oil and the influence of positive and negative oil price shocks on the competitive position of individual firms (e.g., Gupta, 2016). Some papers are devoted to the study of the relationship of oil prices and relevant macroeconomic variables: Employment, migration, stock returns, costs and budget restrictions of households, economic growth, dynamics of export and import flows, international movement of capital, impact of oil prices on monetary policy, etc. A nice literature review on this issue is presented in the paper by Ozturk (2010).

In our case, the closest for the subject, are the studies devoted to the relationship between oil prices and the labor market, including employment/unemployment issue. A brief overview of the literature on this nexus is presented in Table 1.

Table 1: Literature review

Author	Sample	Methodology	Results of the study
Oil Prices-Employment Nexus			
Keane and Prasad (1996)	USA, oil prices - employment – real wages	Panel data analysis, OLS	Oil price increase leads to negative response in employment in short-run, in the long-run – positive. Oil price changes cause changes in employment and relative wages across industries
Hooker (1996)	USA, 1948-1994 with structural breaks, oil prices – unemployment – economic growth	Granger causality test	Oil price changes cause economic growth and changes in unemployment
Hoag and Wheeler (1996)	Impact of oil prices on employment on industrial level, USA (Ohio), micro-level analysis	VAR analysis	Oil price shocks significantly impact employment in mining industry.
Carruth et al. (1998)	USA, post-war period; Real oil prices-real interest rates - unemployment	-	Oil price shocks and shocks in real interest rates affect unemployment rate in the short-run.
Gil-Alana (2003)	Australia, oil prices - unemployment, 1954-1995	Cointegration approach	Oil prices and unemployment are cointegrated, the first causing the last.
Altay et al. (2006)	Turkey, Oil prices – Employment Nexus	VEC approach	Oil prices, income and employment are related in the long-run. Oil prices and income cause changes in employment in the short-run.
Ewing and Thompson (2007)	USA, oil prices – unemployment	Cyclical estimates, filtering analysis, correlation analysis	Oil price changes significantly affect unemployment, inflation, output and stock market index.
Dogrul and Soytas (2010)	Turkey, 2005-2009, interest rate, oil price and unemployment nexus	Toda-Yamamoto causality test	Oil prices significantly cause unemployment
Ahmad (2013)	Pakistan, 1991-2010, interest rate, oil price and unemployment nexus	Toda-Yamamoto causality test	Oil prices significantly cause unemployment (precautionary demand)
Tarek et al. (2017)	Saudi Arabia, 1980-2015, oil price-employment level	ARDL approach	Oil price positively influence employment. Effects of positive and negative oil shocks on employment are asymmetric.
Burakov and Kurnysheva (2017)	Russia, 1990-2016, oil prices – unemployment – real wages	VEC approach	There exist a long-term relationship between world oil prices, levels of employment and real wages both in long- and short-run.
(Un) employment-Crime rate nexus			
Carmichael and Ward (2001)	Male unemployment – crime rate nexus, Britain, 1989-1996	Causality analysis	Male unemployment is the most influencing factor to the crime rate in Britain. Most of the crimes in Britain are positively related to male un-employment regardless of age structure.
Messner et al. (2001)	Unemployment-crime rate nexus, USA.	Time-series analysis	Unemployment rate is negatively related to crime in the United States and the coefficients are statistically significant at 1% and 5% levels.
Narayan and Smyth (2004)	Crime rate - male youth unemployment - real income, Australia, 1964-2001	Granger causality test	Result show that unemployment rate is not an important determinant of crime in Australia because the Granger causality test tends to show neutrality causal effect results.
Lee and Holoviak (2006)	Unemployment-crime rate variables nexus, Australia, Japan, South Korea	Johansen's maximum likelihood cointegration tests	The results of the study provide strong support for a long-run equilibrium relationship between unemployment and several crime series.

(Contd...)

Table 1: (Continued)

Author	Sample	Methodology	Results of the study
Tang and Lean (2007)	Inflation-unemployment rate-crime rate nexus, USA, 1960-2006	Bounds testing approach, Modified Wald test	Inflation and unemployment rates are two important determinants of crime in the United States. Yet, in the short-run unemploy-ment rate is negatively related to crime rate. But the relationship shifts to positive in the long run.
Tang (2009)	Relation between inflation, unemployment and crime rates, Malaysia, 1970-2006	VEC approach	Inflation and unemployment are positively related to crime rate in the long-run. Unemployment is significant for crime rate in the short run. Causality direction is running from inflation and unemployment to crime rate.
Papps and Winkelmann (2009)	Unemployment - crime rates nexus, New Zealand, 1984-1996	Random and fixed effects modeling	Regression results provide evidence for significant effects of unemployment on crime, both for total crime and for some subcategories of crime.
Saridakis and Spengler (2012)	Crime-deterrence-unemployment nexus, Greece, 1991-1998	Panel analysis, dynamic modelling, GMM	The results show that property crimes are significantly deterred by higher clear-up rates and that unemployment increases crime. For violent crimes, the effect of the clear-up rate and unemployment are found to be generally insignificant.
Han et al. (2013)	Crime detection rate/prison population-unemployment rate-real earnings nexus, England and Wales, 1992-2008	Fixed effect dynamic GMM estimation methodology	Higher detection rate and prison population leads to lower property and violent crimes. However, socio-economic variables with the exception of real earnings play a limited role in explaining different crime types.
Speziale (2014)	Unemployment-crime rate nexus, Italy (regional level, 103 provinces), 2000-2005	Dynamic specification approach	Results are in line with the predictions of the economic model of crime. The unemployment rates have a positive correlation with all crime rates.
Blomquist and Westerlund (2014)	Unemployment-crime rate nexus, Sweden (regional level, 21 counties), 1975-2010	Cointegration analysis	The results do not support cointegration between unemployment and crime rate, and suggest that previous findings of a significant unemployment - crime relationship might be spurious.
Janko and Popli (2015)	Unemployment rate-crime rate nexus, Canada (national and regional levels), 1979-2006	Error correction approach, panel analysis	Authors find no evidence of long-run relationship between crime and unemployment, both when look at disaggregation by type of crime and disaggregation by region.
Oil-Crime rate nexus			
Luthra et al. (2007)	Oil/gas industry development-crime rate nexus, US regional level, Louisiana	Pooled time-series analysis	The results suggest that changes in oil activity and high levels of labor market involvement in the offshore oil industry are neither strongly nor consistently associated with community disruption in the form of crime
O'Connor (2017)	Oil boom-crime rate nexus, US regional level, North Dakota	Regression analysis, t-tests	Few significant relationships were found that could link the oil boom to increases in crime and disorder

(Contd...)

Table 1: (Continued)

Author	Sample	Methodology	Results of the study
James and Smith (2017)	Tight oil/shale gas production – crime rate (excluding drug dealing), US counties (215), 2000-2011	Difference-in-difference approach, conditional relationship analysis	Results bring evidence that regional shale booms elevate crime rates in different counties across the US. Authors find statistically significant increase in all types of crimes (assault, rape, murder, larceny, robbery and auto theft).
Andrews and Deza (2018)	Value of local oil reserves – crime (murder, robbery, larceny) nexus, US regional level, Texas	Regression analysis, OLS, two-stage least squares	Results show that a 1% increase in the value of oil reserves increases murder by 0.16%, robbery by 0.55% and larceny by 0.18%. Using the estimated elasticities, an average increase in the value of oil reserves (26% increase in the value of reserves) results in a 4.15% increase in murder rates, 8% increase in robbery and 4.7% increase in larceny.
Stretesky et al. (2018)	Spudded oil and gas wells – violent and property crime rates nexus, the UK regional level (69 local authorities), 2004-2015	Fixed effects regression analysis	Results show that wells are positively correlated with violent crime rates. Each additional well is associated with a 1.5% increase in violent crime. When the analysis is limited to those local authorities that have constructed the most wells, the correlation between wells and crime increases as the boomtown literature might suggest. In particular, each additional well is associated with a 4.9% increase in violent crime and a 4.9% increase in property crime.

As can be seen from the overview given in Table 1, most of research, devoted to oil prices-employment nexus confirms the statistical significance of oil price shocks on various macroeconomic variables, especially on employment, economic growth and wage levels. In some cases, an important role is played by the status of the national economy. If the country is a net importer of oil, the reaction to the rise in oil prices is more likely to be negative. If the country is an oil exporter, the additional income leads to economic growth, growth of wages and the multiplying effect in other sectors of the economy.

The second group of the literature sources is devoted to investigation of unemployment-crime rate nexus. As can be seen from literature review in Table 1, results of different studies are ambiguous. In some cases, authors find strong statistical evidence of importance of unemployment in explaining dynamics of crime rate. Different econometric models, different time spans, different states sampled bring ambiguous results. This ambiguity may be brought to life by several reasons. Firstly, investigations of the nexus use different proxies and indices for capturing crime behavior. Some studies include only violent crimes; others are devoted to investigation of property crimes (economic model or motivation hypothesis of crime). Secondly, some studies are devoted to the search of causal relationship between the variables, while others test the cointegration issue and try to find short- and long-term effects. Yet, overall results for Italy, Greece, Malaysia and New Zealand show that the motivation hypothesis (rising unemployment during recessions increasing property crime rate) holds true (Saridakis and Spengler, 2012; Speziale, 2014; Papps and Winkelmann, 2009; Tang, 2009). The opportunity hypothesis is confirmed in the short-run for the US (Messner, 2001; Tang and Lean, 2007). Results, obtained by Han et al. (2013), Blomquist and Westerlund (2014), as well as by Janko and Popli (2015), showing no relationship between the variables in the UK, Sweden and Canada may be attributed to higher institutional quality, national traditions and other social institutions, like law enforcement, civil rights protection quality, social payments or higher costs of engagement in crime activities.

The third group of the literature sources is devoted to investigation of oil prices-crime rate nexus. The studies on this nexus are rather scarce. Most of literature on this issue is devoted to empirical research of oil price shock effects on crime rate on the regional or even town level. Earlier results show that the link is absent (e.g., Luthra et al., 2007; O'Connor, 2017), yet current investigations on examples of the US and the UK bring evidence of oil price shocks being significant for rising crime rates in the sampled regions. (James and Smith, 2017; Andrews and Deza, 2018; Stretesky et al., 2018) Ambiguity of results may be related, in our opinion, to differences in used econometric techniques, as well as to shifts in costs of engagement in crime activities over time. For example, growing digitalization and automatization of economies, rising economic and financial inequality may be sufficient factors, explaining the spur of the nexus.

Yet, empirical studies, devoted to the investigation of the relationship between oil prices' shocks and crime rate (measured

as bribery and drug dealing) at the macro-level in oil-exporting countries are absent.

3. MATERIALS AND METHODS

3.1. Research Methods

To test the hypothesis about relationship between shocks in oil prices, unemployment and crime rate in Russia, we use econometric techniques to analyze time series. The algorithm of the ongoing study is determined by several key stages. First and foremost, one should test sampled variables on stationarity or order of cointegration, since the time series must have the same order, as can be seen from equation (1). Secondly, it is necessary to determine presence/absence of correlation in long term between the variables in the equation. To check this assumption, we use a Johansen cointegration test. In a case of a long-term relationship on the one hand and condition of stationarity of sampled time series in the first order I (1) on the other, it is possible to use VEC model. In case of confirmation of presence of cointegration between the variables of the sample, residuals of the equilibrium regression can be used to estimate error correction model. Also based on VEC model it is possible to identify short-term relationships between sampled variables. For this purpose, we use the Wald test. The final stage of constructing a model is to conduct diagnostic tests to determine validity of the model. These include testing for heteroscedasticity and serial correlation, normality and stability of the model.

3.2. Unit Root Test

For the analysis of long-term relationships between the variables, Johansen and Juselieus (1990) admit that this form of testing is only possible after fulfilling the requirements of stationarity of the time series. In other words, if two series are co-integrated in order d (i.e., $I(d)$) then each series has to be differenced d times to restore stationarity. For $d = 0$, each series would be stationary in levels, while for $d = 1$, first differencing is needed to obtain stationarity. A series is said to be non-stationary if it has non-constant mean, variance, and auto-covariance over time (Johansen and Juselius, 1990). It is important to cover non-stationary variables into stationary process. Otherwise, they do not drift toward a long-term equilibrium. There are two approaches to test the stationarity: Augmented Dickey and Fuller (ADF) test (1979) and the Phillips-Perron (P-P) test (1988). Here, test is referred to as unit-root tests as they test for the presence of unit roots in the series. The use of these tests allows to eliminate serial correlation between the variables by adding the lagged changes in the residuals of regression. The equation for ADF test is presented below:

$$\Delta Y_t = \beta_1 + \beta_2 t + aY_{t-1} + \delta_3 \sum \Delta Y_{t-1} + \varepsilon_t \quad (1)$$

where ε_t is an error term, β_1 is a drift term and $\beta_2 t$ is the time trend and Δ is the differencing operator. In ADF test, it tests whether a = 0, therefore the null and alternative hypothesis of unit root tests can be written as follows:

H_0: a = 0 (Yt is non-stationary or there is a unit root).

H_1: a < 0 (Yt is stationary or there is no unit root).

The null hypothesis can be rejected if the calculated t-value (ADF statistics) lies to the left of the relevant critical value. The alternate hypothesis is that a < 0. This means that the variable to be estimated is stationary. Conversely, we cannot reject the null hypothesis if null hypothesis is that a = 0, and this means that the variables are non-stationary time series and have unit roots in level. However, normally after taking first differences, the variable will be stationary (Johansen and Juselius, 1990). On the other hand, the specification of P-P test is the same as ADF test, except that the P-P test uses nonparametric statistical method to take care of the serial correlation in the error terms without adding lagged differences (Gujarati, 2003). In this research, we use both ADF and P-P test to examine the stationarity of the sampled time series.

3.3. Johansen Co-Integration Test

To test for presence of cointegration we apply the Johansen test using non-stationary time series (values in levels). If between variables does exist a cointegration, the first-best solution would be using VECM model. An optimal number of lags according to Akaike information criterion for providing Johansen test is determined in VAR space. To conduct Johansen test, we estimate a VAR model of the following type:

$$y_t = A_1 y_{t-1} + \ldots + A_p y_{t-p} + Bx_t + \epsilon_t \quad (2)$$

In which each component of y_t is non-reposeful series and it is integrated of order 1. x_t is a fixed exogenous vector, indicating the constant term, trend term and other certain terms. ε_t is a disturbance vector of k dimension.

We can rewrite this model as:

$$\Delta y_t = \prod y_{t-1} + \sum_{i=1}^{p-1} V_i \Delta y_{t-1} + Bx_t + \epsilon_t \quad (3)$$

Where

$$\prod = \sum_{i=1}^{p} A_i - I, V_i = -\sum_{j=i+1}^{p} A_j \quad (4)$$

If the coefficient matrix Π has reduced rank $r < k$, then there exist $k \times r$ matrices α and β each with rank r such that $\prod = \alpha\beta$ and $\beta' y_t$ is I (0). r is the number of cointegrating relations (the cointegrating rank) and each column of β is the cointegrating vector. The elements of α are known as the adjustment parameters in the VEC model. Johansen's method is to estimate Π matrix from an unrestricted VAR and to test whether we can reject the restrictions implied by the reduced rank of $\prod$ (Johansen, 1998).

3.4. Vector Error Correction Model

Granger (1988) suggested the application of Vector Error Correction methodology (VECM) in case if the variables are cointegrated in order to find short-run causal relationships. VECM, therefore, enables to discriminate between long-run equilibrium and short-run dynamics. In this sense, we employ following VECMs to estimate causal linkages among the variables:

$$\Delta ln\, l = a_0 + \sum_{i=1}^{k} a_1 \Delta lnl_{t-i} + \sum_{i=1}^{n} a_2 \Delta lns_{t-i} + \sum_{i=1}^{m} a_3 \Delta lnr_{t-i} + \lambda ECT_{t-1} + v_1$$

$$\Delta ln\, m = \beta_0 + \sum_{i=1}^{k} \beta_1 \Delta lnm_{t-i} + \sum_{i=1}^{n} \beta_2 \Delta lnl_{t-i} - \sum_{i=1}^{m} \beta_3 \Delta lnr_{t-i} + \phi ECT_{t-1} + v_2$$

$$\Delta lnr = \eta_0 + \sum_{i=1}^{k} \eta_1 \Delta lnr_{t-i} + \sum_{i=1}^{n} \eta_2 \Delta lnl_{t-i} + \sum_{i=1}^{m} \eta_3 \Delta lnm_{t-i} + \chi ECT_{t-1} + v_3$$

Where l - international oil prices (Brent), s – unemployment rate in Russia, y – averaged index of crime rate in Russia, including bribery and drug dealing (Granger, 1988).

Providing regression analysis of the sampled variables by modeling VECM allows us to determine the existence of substantial and statistically significant dependence not only on the values of other variables in the sample, but also dependence on previous values of the variable.

However, VEC model must meet the requirements of serial correlation's absence, homoscedasticity of the residuals and to meet the requirement of stability and normality. Only in this case the results can be considered valid.

3.5. Materials and Data Processing

We test a hypothesis of relationship between oil prices shocks, unemployment rate and crime rate (bribery and drug dealing average) on example of Russian data for the period 1990-2017. The base period is 1 year. Unfortunately, use of monthly and quarterly values of variables for the analysis is hindered due to availability of only yearly data for crime rate statistics. Moreover, for Brent oil prices we use aggregate yearly values. Using VECM, we set ourselves a task to determine sensitivity of crime activity in Russia to shocks in international oil prices.

Data on unemployment rate and crime rate is obtained from Federal Service of State Statistics (www.gks.ru) and Ministry of Internal Affairs of the Russian Federation (https://en.mvd.ru) Data on world prices of oil is obtained from the statistical database of NASDAQ (www.nasdaq.com).

To conduct time-series analysis, all variables were transformed into logarithms. To identify and formally assess the relationship between variables, we use simple correlation analysis. To study sensitivity and causal linkages between the variables in the sample in short-and long-run, we turn to regression analysis, which involves the construction of VEC model of certain type based on stationary time series, testing the model for heteroscedasticity of the residuals, autocorrelation.

4. RESULTS AND DISCUSSION

The first step in testing the hypothesis is to test the variables for the presence of correlation. We use simple correlation analysis and imply Pearson statistical significance test. Results of correlation analysis ate presented in Table 2.

As can be seen from the results of the correlation analysis, the relationship between variables is statistically significant and the correlation coefficients are significant. For example, the correlation between oil prices and unemployment is negative in sign. Growth in oil prices leads to a decrease in unemployment rate in Russia and vice versa. At a confidence interval of 5%, the value of the correlation coefficient is 0.7935. The explanation to this observation, in our opinion, lies in the presence of indirect depending on the level of employment from oil prices. The price increase leads to an increase in government revenue and expenditure, growth of household incomes and thus consumption and, consequently, employment. In the period of crisis, the relationship is also opposite. The falling oil price reduces income, consumption, investment, and the need for workers, thus giving rise to unemployment.

Unemployment also correlates with the crime rate, being statistically significant. The correlation coefficient has a positive sign, meaning that a rise in unemployment rate increases crime activities, measured as drug dealing and bribery. And, logically, a rise in oil prices leads to a decline in drug dealing and bribery. Preliminary correlation results speak in support of motivation hypothesis.

However, unconditional acceptance of the results of correlation analysis is impossible due to possible existence of serial correlation, problem of multicollinearity. In this regard, it is necessary to turn to more qualitative techniques of analysis.

The second step in testing hypotheses is to test variables for the presence of unit root. For this purpose, we use standard tests - ADF and P-P test. Results of unit root testing are presented in Table 3.

Table 2: Results of correlation analysis

Variable	Unemployment rate	Crime rate	Oil prices (brent)
Unemployment rate	1	-	-
Crime rate	0,8543 (0.0019)	1	-
Oil prices (brent)	−0.7935 (0.0042)	−0.7831 (0.0144)	1

Table 3: Results of individual unit root test

Variables in	ADF		PP	
	Statistic	Prob.**	Statistic	Prob.**
Levels				
Intercept	8.464	0.691	7.352	0.4695
Intercept and trend	11.942	0.249	13.931	0.1143
First-difference				
Intercept	35.294	0.0000**	42.568	0.0000**
Intercept and trend	28.852	0.0010**	49.242	0.0000**

**Denotes statistical significance at the 5% level of significance

Table 4: Results of unrestricted VAR model diagnostic testing

Type of test	Results		
	Lags	LM-Statistic	P value
VAR residual serial correlation LM test	1	7.7834	0.5341
	2	5.9245	0.6483
Stability condition test	All roots lie within the circle. VAR satisfies stability condition		
Heteroscedasticity (White test)	0.4183*		
VAR residual cross correlation test	No autocorrelation in the residuals		

**Denotes acceptance of null hypothesis (H_0: There is no serial correlation). *Denotes acceptance of null hypothesis of homoscedasticity

Table 5: Results of Johansen co-integration test

Hypothesized no. of CE (s)	Eigenvalue	Trace Statistics	0.05 Critical Value	Prob.*
None*	0.9853	73.2048	29.7970	0.0153*
At most 1	0.3864	8.7053	15.4947	0.3895
At most 2	0.0536	1.2549	3.8414	0.1249

Trace statistics indicate 1 cointegrating equation at the 0.05 level. *denotes statistical significance at the 5% level of significance

As can be seen from the test results of the variables for the presence of unit root in their differentiation to the first order, we can reject the null hypothesis of unit root in each of the variables. Thus, the condition of stationarity at I (1) is performed, which gives us reason to test variables for cointegration. However, it is necessary to determine the optimal time lag.

Building a VAR model involves determining the optimal number of lags. In our case, the Akaike information criterion equals 1. Consequently, we built a model based using time lag of 1 year to determine the relationship in the short run. The results of the diagnostic testing of VAR model for heteroscedasticity of residuals, autocorrelation, serial cross-correlation, and stability are presented in Table 4. As can be seen from Table 4, the model is stable, heteroscedasticity and serial correlation of residuals in the model are absent.

The model is used to determine the level of sensitivity of control variables to shocks in oil prices in the short run and we use it to test for stable long-run relationship, applying Johansen cointegration test. Results of Johansen co-integration test are presented in Table 5.

Johansen test results show the presence of cointegration between a number of equations, which allows presuming the existence of a long-term relationship between them. Starting from the results of the cointegration test, we can proceed to the construction of VECM model to reveal presence or absence of long-term and short-term relations between variables.

The results of the model, showing the relationship between oil prices, crime rates and unemployment rate are presented in Table 6.

As can be seen from the Table 6, the value of error correction term C (1) is negative in sign and statistically significant. This

Table 6: Results of vector error correction model

Coefficient number	Coefficient meaning	Standard error	t-Statistic	Prob.
C(1)	−0.2891	347.143	3.0927	0.0104*
C(2)	−0.1523	0.380	5.2718	0.4509
C(3)	−0.0114	291.354	2.5473	0.0143
C(4)	0.0272	227.143	2.2839	0.0358
C(5)	926.1378	385.882	2.6185	0.0034

*Denotes statistical significance

suggests the existence of long-run relationship between the variables of the sample. In other words, we obtained evidence that world oil prices, unemployment rate and crime rate in Russia are cointegrated, so that they have similar trends of movement in the long term.

The C (1) shows speed of long run adjustment. In other words, this coefficient shows how fast the system of interrelated variables would be restored back to equilibrium in the long run or the disequilibrium would be corrected. Given statistical significance at 5% level (P < 5%) and negative meaning, the system of variables corrects its previous period disequilibrium at a speed of 28.91% in 1 year (given optimal lag meaning of 1 year for ECM). It implies that the model identifies the sizeable speed of adjustment by 28.91% of disequilibrium correction in 1 year for reaching long run equilibrium steady state position.

High speed of adjustment of relations between variables towards equilibrium is quite understandable. Considering the above mentioned fact about the dependence of the Russian economy on oil rents, as well as the fact that a significant proportion of economic active population employed in the public sector, it is not surprising that shocks in oil prices have an impact on the main source of salary costs - the budget. In the case of reduced income from oil exports unemployment rate begins to increase.

To identify short-term relationship between the variables we refer to the Wald test results. This test allows to determine the interrelationship between variables in the short term. In other words, under the null hypothesis of this test, the response of error correction term to explanatory variables equals zero, i.e., the sensitivity of resulting variable to changes (shocks) in explaining are not observed. Results of Wald Test for the model are presented in Table 7.

As can be seen from the results of the Wald test in the short term there is a relationship between changes in world oil prices and changes in the crime rate. Moreover, this relationship is opposite. Based on the results of the Wald test, we can detect statistically significant effects running from changes in oil prices to the rate of drug dealing and bribery with rate of adjustment towards equilibrium of 1.14% in t-1. In other words, a rise (decline) in oil prices leads to a fall (rise) in crime activities. For example, a 1% decrease in oil price will lead to a 1.14% rise in bribery and drug dealing.

The second result shows presence of causality running from unemployment rate to crime rate with the speed of adjustment towards equilibrium at 2.72%. So, the results of Wald test show

Table 7: Wald test results for short run relationship

Test statistic	Value	df	Probability	Test statistic	Value	df	Probability
t-statistic	1.4775	10	0.0012*	t-statistic	−1.1567	10	0.0143
F-statistic	1.5894	(1.10)	0.0012*	F-statistic	1.2371	(1.10)	0.0143
Chi-square	1.5894	1	0.0007*	Chi-square	1.2371	1	0.0079
Null hypothesis: C (3)=0 (world oil prices)				Null hypothesis: C (4)=0 (unemployment rate)			

*Denotes statistical significance and rejection of H_0: No short-run relationship

Table 8: Results of diagnostic testing

Test type	Value	Probability characteristic		P value
Heteroscedasticity test: Breusch-pagan-godfrey				
F-statistic	4.926431	Prob. F (6,17)		0.1864
Obs.*R-squared	11.17340	Prob. Chi-square (6)		0.2971
Scaled explained SS	3.845761	Prob. Chi-square (6)		0.8863
Heteroskedasticity test: ARCH				
F-statistic	0.95745	Prob. F (1,12)		0.6184
Obs*R-squared	0.78341	Prob. Chi-Square (1)		0.5731
Breusch-Godfrey serial correlation LM test:				
F-statistic	2.27086	Prob. F (2,8)		0.5012
Obs*R-squared	3.05843	Prob. Chi-Square (2)		0.2943
Autocorrelation/partial correlation				
Lag	AC	PAC	Q-Stat	Prob.
1	−0.012	−0.012	0.0016	0.854
2	−0.314	−0.314	2.7342	0.386

that unemployment rate in the short term has the potential to affect crime rate. Thus, a 1% increase in the unemployment rate leads to a 2.72% increase in crime activities, measured by drug dealing and bribery.

The revealed effects confirm the motivation hypothesis. On the one hand, a surge in oil prices leads to a decrease in oil revenue, which accounts for >40% of Russia's budget revenues. Falling oil revenue leads to a decrease in government spending, budget sector wages and growth in unemployment. Moreover, falling oil prices, leading to growth in unemployment rate, multiply the initial effect in the economy, leading to even more growing unemployment, which in turn accelerates engagement in crime activities. Thus, an initial shock (1% decrease in oil prices) is multiplied through unemployment channel up to 3.86%.

Overall, the obtained results are consistent with existing empirical and theoretical results of the previous studies, reporting that a rise in unemployment could lead to a rise in crime rate. The explanation of the obtained results falls in line with the motivation hypothesis. Lost jobs and declining wages increase the gap between consumption level and the budget constraint, leaving unemployed with the necessity to get addition income, which can be obtained through drug dealing. Another interesting puzzle is an increase in bribery during recessions. Again, the background is hidden in the necessity of state employees to restore the lost income (in form of bonuses, e.g.,) due to the cut in the wages by accelerating bribery schemes.

The final stage of the analysis of the model is to determine the extent of its validity. For this, it is necessary to conduct some diagnostic tests, including tests for heteroscedasticity of the residuals and serial correlation in the model. The results of these tests are presented in Table 8.

5. CONCLUSION

In case of oil-exporting countries, economic growth and employment rate significantly depend on world oil prices dynamics. Oil prices, determining export revenues, which in most cases account for a large share of government spending, play a major role in determining the pace of the national economic growth. it's quite logically to assume that in the case of oil-exporting country, if oil revenues play a major role in government spending (like in cases of Saudi Arabia, Russia, Venezuela etc.), negative oil shocks may lead to an even greater negative impact on economic growth than in oil-importing countries or states, restraining the budget from resource curse. In other words, we hypothesize that a negative oil shock should lead to a rise in unemployment rate ceteris paribus. Also we assume that a negative oil shock in oil exporting country should lead to deterioration on the labor market, thus rising a crime rate.

To test the hypothesis about relationship between shocks in oil prices, unemployment and crime rate in Russia, we use vector error correction approach. We test a hypothesis of relationship between oil prices shocks, unemployment rate and crime rate (bribery and drug dealing average) on example of Russian data for the period 1990-2017. The base period is 1 year.

Results of the study show that world oil prices, unemployment rate and crime rate in Russia are cointegrated, so that they have similar trends of movement in the long term. Given statistical significance at 5% level ($P < 5\%$) and negative meaning, the system of variables corrects its previous period disequilibrium at a speed of 28.91% in 1 year (given optimal lag meaning of 1 year for ECM). It implies that the model identifies the sizeable speed of adjustment by 28.91% of disequilibrium correction in 1 year for reaching long run equilibrium steady state position. Based on the results of the

Wald test, we can detect statistically significant short-run effects running from changes in oil prices to the rate of drug dealing and bribery with rate of adjustment towards equilibrium of 1.14% in t-1. In other words, a rise (decline) in oil prices leads to a fall (rise) in crime activities. For example, a 1% decrease in oil price will lead to a 1.14% rise in bribery and drug dealing. The second result shows presence of causality running from unemployment rate to crime rate with the speed of adjustment towards equilibrium at 2.72%. So, the results of Wald test show that unemployment rate in the short term has the potential to affect crime rate. Thus, a 1% increase in the unemployment rate leads to a 2.72% increase in crime activities, measured by drug dealing and bribery.

The revealed effects confirm the motivation hypothesis. On the one hand, a surge in oil prices leads to a decrease in oil revenue, which accounts for more than 40% of Russia's budget revenues. Falling oil revenue leads to a decrease in government spending, budget sector wages and growth in unemployment. Moreover, falling oil prices, leading to growth in unemployment rate, multiply the initial effect in the economy, leading to even more growing unemployment, which in turn accelerates engagement in crime activities. Thus, an initial shock (1% decrease in oil prices) is multiplied through unemployment channel up to 3.86%.

Overall, the obtained results are consistent with existing empirical and theoretical results of the previous studies, reporting that a rise in unemployment and a decrease in oil prices could lead to a rise in crime rate. The explanation of the obtained results falls in line with the motivation hypothesis.

REFERENCES

Ahmad, F. (2013), The effect of oil prices on unemployment: Evidence from Pakistan. Business and Economic Research Journal, 4(1), 43-57.

Alkhateeb, T.T.Y., Sultan, Z.A., Mahmood, H. (2017), Oil revenue, public spending, gross domestic product and employment in Saudi Arabia. International Journal of Energy Economics and Policy, 7(6), 27-31.

Altay, B., Topeu, M., Erdogan, E. (2013), Oil price, output and employment in Turkey: Evidence from vector error correction model. International Journal of Energy Economics and Policy, 3, 7-13.

Andrews, R., Deza, M. (2018), Local natural resources and crime: Evidence from oil price fluctuations in Texas. Journal of Economic Behavior and Organization, 151, 123-142.

Becker, G. (1968), Crime and punishment: An economic approach. Journal of Political Economy, 76, 1169-1271.

Blomquist, J., Westerlund, J. (2014), A non-stationary panel data investigation of the unemployment–crime relationship. Social Science Research, 44, 114-125.

Burakov, D., Kurnysheva, I.(2017), Do oil price shocks matter for competition: A vector error correction approach to russian labor market. International Journal of Energy Economics and Policy, 7(4), 68-75.

Cantor, D., Land, K. (1985), Unemployment and crime rates in the post-world war II United States: A theoretical and empirical analysis. American Sociological Review, 50(3), 317-332.

Carmichael, F., Ward, R. (2001), Male unemployment and crime in England and wales. Economics Letters, 73, 111-115.

Carruth, A., Hooker, M.A., Oswald, A. (1998), Unemployment equilibrium and input prices: Theory and evidence from the United States. Review of Economics and Statistics, 80, 621-628.

Dickey, D., Fuller, W. (1979), Distribution of the estimators for autoregressive time series with a unit root. Journal of American Statistical Association, 74, 427-431.

Dogrul, H.G., Soytas, U. (2010), Relationship between oil prices, interest rate and unemployment: Evidence from an emerging market. Energy Economics, 32(6), 1523-1528.

Ewing, B., Thompson, M. (2007), Dynamic cyclical co-movements of oil prices with industrial production, consumer prices, unemployment, and stock prices. Energy Policy, 35, 5535-5540.

Gil-Alana, L.A. (2003), Unemployment and real oil prices in Australia: A fractionally cointegrated approach. Applied Economics Letters, 10, 201-204.

Granger, C.W.J. (1988), Some recent development in a concept of causality. Journal of Econometrics, 39, 199-211.

Gujarati, D. (2003), Basic Econometrics. 4th ed. London: Mc Graw-Hill.

Gupta, K. (2016), Oil price shocks, competition, and oil and gas stock returns-global evidence. Energy Economics, 57, 140-153.

Han, L., Bandyopadhyay, S., Bhattacharya, S. (2013), Determinants of violent and property crimes in England and wales: A panel data analysis. Applied Economics, 45(34), 4820-4830.

Hoag, J., Wheeler, M. (1996), Oil price shocks and employment: The case of Ohio coal mining. Energy Economics, 18(3), 211-220.

Hooker, M.A. (1996), What happened to the oil price-macro economy relationship? Journal of Monetary Economics, 38, 195-213.

James, A., Smith, B. (2017), There will be blood: Crime rates in shale-rich U.S. counties. Journal of Environmental Economics and Management, 84, 125-152.

Janko, Z., Popli, G. (2015), Examining the link between crime and unemployment: A time-series analysis for Canada. Applied Economics, 47(37), 4007-4019.

Johansen, S. (1988), Statistical analysis of co-integration vectors. Journal of Economics Dynamic and Control, 12, 231-254.

Johansen, S., Juselius, K. (1990), Maximum likehood estimation and inference on co-integration with applications to the demand for money. Oxford Bulletin of Economics and Statistics, 52, 169-210.

Keane, M.P., Prasad, E.S. (1996), The employment and wage effects of oil price changes: A sectoral analysis. Review of Economics and Statistics, 78(3), 389-400.

Lee, D., Holoviak, S. (2006), Unemployment and crime: An empirical investigation. Applied Economics Letters, 13(12), 805-810.

Luthra, A.D., Bankson, W., Kalich, D., Forsyth, C. (2007), Economic fluctuation and crime: A time-series analysis of the effects of oil development in the coastal regions of Louisiana. Deviant Behavior, 28(2), 113-130.

Messner, S.F., Raffalovich, L.E., McMillan, R. (2001), Economic depreciation and changes in homicide rates for white and black youths, 1967-1998: A national time-series analysis. Criminology, 39, 591-614.

Narayan, P.K., Smyth, R. (2004), Crime rates, male youth unemployment and real income in Australia: Evidence from granger causality tests. Applied Economics, 36, 2079-2095.

O'Connor, C. (2017), Oil, crime, and disorder: A methodological examination of the oil boom's impact in North Dakota. Deviant Behavior, 38(4), 477-491.

Ozturk, I. (2010), Literature survey on energy-growth nexus. Energy Policy, 38, 340-349.

Papps, K., Winkelmann, R. (2000), Unemployment and crime: New evidence for an old question. New Zealand Economic Papers, 34(1), 53-71.

Phillips, P.C.B., Perron, P. (1988), Testing for unit root in time series regression. Biometrica, 5, 335-346.

Saridakis, G., Spengler, H. (2012), Crime, deterrence and unemployment in Greece: A panel data approach. The Social Science Journal, 49(2), 167-174.

Speziale, N. (2014), Does unemployment increase crime? Evidence from Italian province. Applied Economics Letters, 21(15), 1083-1089.
Stretesky, P.B., Long, M.A., McKie, R., Aryee, F.A. (2018), Does oil and gas development increase crime within UK local authorities? The Extractive Industries and Society, 5, 356-365.
Tang, C.F. (2009), The linkages among inflation, unemployment and crime rates in Malaysia. International Journal of Economics and Management, 3, 50-61.
Tang, C.F., Lean, H.H. (2007), Will inflation increase crime rate? New evidence from bounds and modified wald tests. Global Crime, 8, 311-323.
Tarek, T.Y.A., Haider, M., Zafar, A.S., Nawaz, A. (2017), Oil price and employment nexus in Saudi Arabia. International Journal of Energy Economics and Policy, 7(3), 277-281.