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DEVELOPMENT AND CRIME PATTERNS IN UKRAINE: CRIMINOMETRIC STUDY

Introduction. In Ukrainian modern criminology the influence of social and economic factors on crime is traditionally assumed an acxiom and has been recognized both among policymakers and in academic circles. On the background of numerous theoretical studies the lack of research giving the empirical evidence of the nexus, as well as the tightness of connections between the development indicators and certain crime is observed. The qualitative analysis prevails to the detriment of complex data analyzing. The negative impact of crime on societal development is also undoubted among the scholars. But the absence of elaborated methodology of crime estimation leads to the inconclusive empirical evidence and to the weak criminological policy.

Literature Review and Unsolved Questions. The previous studies of the nexus between crime and development were primarily focused on understanding the social nature of crime. At the beginning of XX century scientists predicted that crime would lose its causal base after improvement of public relations. They also considered that social, economic, political and cultural development would lead to a significant reduction of crime. But now optimistic forecasts about its reduction are not justified either in developed or in developing countries.

Contemporary scholars – Clifford (1963), Clinard and Abbott (1973), Shelley (1981), Soares (2004), Van Dijck (2007), Aebi and Linde (2014), Karstedt (2015) and others – proposed both theoretical and empirical theses based on criminometric methods describing and predicting the patterns of crime and deviance under development [1].

The academic interest in study of the functional dependence of crime intensity on socio-economic processes has led to the emergence of contradictory concepts that are based on different hypotheses. The flaws in the methodology of extrapolating of sociological and economic sciences achievements, exploring the models of interaction within the framework of social mobility status and roles, as well as the development of resources and financial capital, and wealth redistribution into the criminological matter

resulted in some phases to quite opposite conclusions about the nature of crime. The main demerit of each theory and study is the lack of universality. It means that each theory is valid for certain offenses in certain time and conditions due to the nonlinear development of countries. Therefore the context – economic, social and cultural parameters of development and crime – should be taken into account in order to not only giving the description but also an explanation. Taking into consideration the results and conclusions of previous studies this research will examine the Ukrainian context of crime and development.

The aim of the article is to test the following hypotheses: reported crime rate has/has not direct and indirect correlations with development indexes; development can/cannot be used as explanatory factor in description of crime etiology; criminological (criminometric) monitoring of threats and risks of development should/should be assumed as a basis of criminological forecast in order to work out the look-forward strategy of crime prevention and ensure the criminological security.

Methodology. In order to test the hypothesis of the study and prove or disprove the main questions raised, primarily the criminometric methodology will be employed. Criminometrics is an example of interdisciplinary scientific synthesis and represents a quantitative (mathematical) analysis of criminological data. This methodology originates from econometrics and exploits the statistical methods adapted to criminological issues. It has both scientific privileges and challengers [1].

Criminometrics in Ukraine has not been formed as a separate line of scientific and practical activities. But the achievements and success of this methodology in national and cross-national studies allow applying it to Ukrainian criminological realities and enabling to shift from description to explanation and prediction of crime and development reverse interaction.

The present study combines cross-sectional and longitudinal approaches and uses annual time series data from 1991 to 2011 in Ukraine. We are going to find out the correlation and regression between the number of detected crimes (dependent variables) and the indicators of development (independent or explanatory variables).

Crime data comprise the rate per 100000 population of Total Crime, Homicide, Theft, Theft of Motor Vehicle, Robbery, Fraud, Embezzlement, Economic crime and Drug offences (see appendix).

There are some sources of data on crime rates in Ukraine and all the information available is based on official records. We use primarily the United Nations Survey of Crime Trends and Operations of Criminal Justice Systems (UNCS) in order to have standardized definitions of different crimes according to UN requirements. Some missing data on crime rate has been calculated from official crime statistical reports of Ministry of Internal Affairs of Ukraine and number of population according to the information of State Statistics Service of Ukraine. Economic crime is defined in accordance with official crime statistical reports of Ministry of Internal Affairs of Ukraine.

Development has been usually associated with progressive changes. Despite this statement comprehensive analysis of development has to take into account the gaps and dislocations of positive transformations and include regressive indicators as well. That is why the following predictors that reflect development (or underdevelopment) are applied: the Human Development Index, GDP per capita (PPP), Urban Population, GINI Index, Unemployment and Poverty (see appendix). Democracy score could be potentially one of the development indicators. However standardized surveys of democracy level performed for example by Freedom House or The Economist Intelligence Unit only since 2006 are not sufficient for our longitude study.

Modern statistical analysis package STATISTICA (version 13) that implemented the latest computer and mathematical data analysis will be employed as software for the research.

Exposition of the Main Substance. Development can be determined as irreversible, directed, regular change of qualitative and quantitative properties of objects and possesses. The simultaneous presence of all mentioned elements distinguishes development transformations among other changes. The reversibility of changes characterizes the operating processes (repetition of permanent system of functions). The lack of patterns is inherent to random processes of unprompted type. Under the absence of direction, changes are not able to be accumulated, so the process loses intrinsic feature of a single, internally coherent line.

There are no universal criteria or system for the precise division of countries and states into groups or types in terms of development. Different operating systems use different classifications. As for Ukraine it is defined as a post socialistic developing country (average development) by the IMF and the UN and a country with income (GDP per capita) below average by the World Bank.

A combined indicator of Human Development Index (HDI) is becoming more and more popular. It has been elaborated by UN and assesses long-term progress in three basic dimensions of human development: a long and healthy life, access to knowledge and a decent standard of living. Between 1990 and 2013, Ukraine's HDI value increased from 0.705 to 0.734, an increase of 4.1 percent or an average annual increase of about 0.18 percent. At the same time Ukraine's 2013 HDI of 0.734 is below the average of 0.735 for countries in the high human development group and below the average of 0.738 for countries in Europe and Central Asia [2].

Arguing that economic and social indexes do not always reflect the real well-being of nations New Economics Foundation (NEF) proposed Happy Planet Index (HPI) in 2006. The HPI uses global data on experienced wellbeing, life expectancy, and Ecological Footprint to generate an index revealing which countries are most efficient at producing long, happy lives for their inhabitants, whilst maintaining the conditions for future generations to do the same. In 2006 Ukraine had 174 place with a score of 22,21, in 2009 – 95 place with 38,1 points and in 2012 obtained 100 rank (out of 151) with 37,6 HPI corresponding to the average index[3]. This index has not got a long term observations yet, so cannot be useful in our research.

Comparative data analysis of UN Crime Trend Survey enables to find out Ukraine's place on the world «criminal map». With the mean crime rate of approximately 1000 cases per 100000 population Ukraine is among countries with the crime rate below average.

Our study is not the first scientific attempt to find out the interdependence of crime and society development. Before testing the hypotheses in the context of Ukraine we summarized the previous outputs of analyzing the similar national and cross-national indicators that were chosen for the present research. It should be noted that many other variables were presented in criminological research, for example ecology, demography, culture, morality, deterrence etc. Despite their significance in studying crime, they are not helpful in this research, since they don't directly indicate development or underdevelopment.

The sign «+» in the Table 1 means positive correlation (if one variable increases other also increases and if one variable decreases other also decreases), sign «-» means negative correlation (if one variable increases other decreases and vice versa), «0» – the absence or weak correlation and «?» – dependence is unclear or has not been studied.

Table 1

Summury from previous criminometrics studies on crime and development

Indicator of development / underdevelopment	Certain variable analyzed in previous researches	Impact on crime in general	Impact on property crime	Impact on violent crime	Impact on economic crime	Reverse impact (crime on development)
Economic	GDP per capita	«+», «-»	«+», «-», «0»	«+», «-», «0»	«-»	«-»
	Poverty level	«+»	«+»	«0»	«?»	«+»
Social	Unemployment	«+», «-»	«+», «-», «0»	«+», «0»	«?»	«+»
	Inequality / GINI index	«+»	«+», «-», «0»	«+», «-», «0»	«0»	«+»
Urbanization	The share of urban population	«+»	«?»	«?»	«+»	«-»

According to the summary the estimations on the association between economic development, social transition, urbanization and rising or decreasing crime rate are found in some points to be quite the opposite.

Ukrainian context of social transformation is unique. The perspective of the research reviles the distinct shifts: in modern history Ukraine has passed the development stages from socialist type of operation to capitalist state, from planned economy to free market economy, from communist rule to democracy. Abrupt and sudden ecomonical reforms without adequate institutional bases and the organization of life-support systems formed new available targets for criminally

motivated individuals. The loss of the traditional customs should have necessarily affected the general mood of the population and selection of the adaptive behavior to the changes. As deviant behavior also occurs to be an adaptation option, socio-economic changes inevitably have had an impact on the current rate and features of criminal activity. This statement applies both to the changes in crime patterns and structural transformation that mirrors the historical volatility of crime.

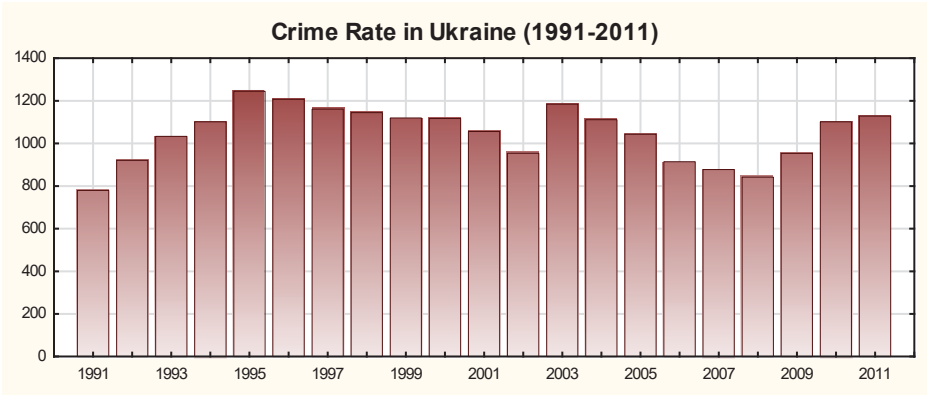
Some formal indicators reflect the ongoing development of the Ukrainian state and society, but in addition expose gaps in market and democratic transformations. Modernization models and strategies, successfully tested in other countries, do not always produce a necessary and anticipated effect in Ukraine.

One of the significant triggers for the general disruption and criminalization of society in Ukraine is the transitiveness of social processes. We are still searching for an optimal balance of democratic government, legal system, market institutions, civil society building, joint ideology and national idea.

The ideological legacy of the Soviet era, multiplied by the dysfunction of public institutions provoked variety of destructive phenomena and processes: a high concentration of shadow economy based on illegal or semi-legal privatization process; widespread corruption, which replaces the formal relationship; substantial material differentiation; lack of the middle class that is undoubtedly the backbone of any society; underdeveloped social capital; invalid social elevators; consumer orientated psychology and ets.

On the background of society transformation crime evolves. Institutional dysfunction under weak social control enhances the functionality of criminal behavior.

During the independence period the peak of criminal activity occurred in the middle of 1990th. Two more waves were observed in 2003 and 2011.



But it should be emphasized that during two last decades serious changes occurred not only in dynamic of crime but also in the structure of criminal activity. The transition to a post-industrial society has led to a significant burst of pecuniary inequality and property crimes. Besides traditional mercenary

motivation, status (prestige) motives for criminal behavior have become more pronounced. Violent crime – that is usually associated with low level of education and culture and also with the weakness of social ties and irrational leisure – had a pick in 1990th and decreased in 2000th.

Explicitly noticeable shifts have been observed in so-called non-core or conventional forms of criminal activity, such as drug crime, economic crime and organized crime. Crime related to drugs has shown the most rapid growth allowing taking the second position after property crimes according to the share in the structure of crime in Ukraine. The evolution of economic criminal behavior in Ukraine can be also indicated: from an embezzlement or misappropriation of public property by separate individuals in Soviet times within administrative command economy to developed forms of corporate fraud in transition to market economy. In Soviet times, so called "blat" (beneficial connections) was the most functional. Access to public office positions and the distribution of wealth determined the criminal economic opportunities. Today, along with the white-collar criminals the marginalized persons, so-called new marginals have being increasingly involved in illegal economic activity. Those are persons who in spite of the high level of education, have been left without successful career, and hence social welfare. A weak relationship between the labor and the salary amount seems to be quite criminogenic. Organized crime has also evolved from primitive assaults (banditry) to advanced forms of transnational crime due to inclusion to transnational criminal markets of human trafficking, migrant smuggling, drugs transportation and etc. The Informational Society Age has provided crime with innovativeness. Communication devises and new technologies have become the engines of not only general development, but also crime modernization, that is reflected in the trends of crime virtualization and penetration into cyber space.

As has been previously noted, the links between crime and development seem to be obvious at the first glance. Present criminometric study is aimed to give the adequate empirical evidence or disprove this statement regarding to Ukraine's reality.

Table 2 presents the descriptive statistics of crime and development of 1991-2011 (module Basic Statistics and Tables/Descriptive Statistics). The crime statistics shows that theft dominates and has a larger range of variation than other property crimes or violent crimes and drug offences in Ukraine.

First of all the possible statistical correlation dependence between variables will be analyzed. Table 3 performs data of Pearson pair correlation coefficients (module Basic Statistics and Tables/Correlation Matrices) between studied variables.

According to criminometric methodology in most cases dependence between variables exists when each value of one variable corresponds not to any particular, but to the set of possible values of another variable (or the certain relative distribution of another variable). Such dependency is called statistical or probabilistic. A perfect positive correlation is represented by the value +1.00, while a 0.00 indicates no correlation and a -1.00 indicates a perfect negative correlation.

Table 2

Statistics

	Mean	Minimum	Maximum	Std.Dev.
Crime Rate	1048,095	780,000	1246,000	127,847
Homicide Rate	7,168	4,320	9,580	1,645
Theft Rate	404,995	238,800	610,700	106,694
Theft, Motor Vehicle	12,713	9,290	18,000	2,890
Robbery Rate	60,569	42,020	99,820	16,904
Fraud	32,435	11,460	54,560	12,800
Embezzlement Rate	25,400	14,940	75,090	20,479
Economic Crime	94,391	65,390	130,710	19,015
Drug Offences Rate	86,910	2,000	139,000	50,189
HDI	0,751	0,721	0,799	0,022
GDP per capita (PPP)	5540,553	3404,629	8417,004	1777,341
Urban Population	67,501	66,800	68,880	0,664
GINI Index	29,176	24,550	39,290	3,934
Unemployment, total	8,395	5,600	11,600	1,790
Poverty	1,711	0,000	8,260	2,647

Table 3

Pairwise correlations

Variable	*Marked correlations are significant at p < ,10000 **Marked correlations are significant at p < ,05000 ***Marked correlations are significant at p < ,01000					
	HDI	GDP per capita (PPP)	Urban Population	GINI Index	Unemployment, total	Poverty
Crime Rate	-,2433 p=,288	-,6099*** p=,003	-,1990 p=,387	,4609* p=,097	,3263 p=,149	,5208* p=,056
Homicide Rate	,0688 p=,767	-,9026*** p=,000	-,6987*** p=,000	,7321*** p=,003	,4950** p=,023	,7397*** p=,002
Theft Rate	,3404 p=,181	,0151 p=,954	,1693 p=,516	-,2158 p=,479	,1932 p=,457	-,1244 p=,686
Theft, Motor Vehicle	,6885** p=,019	-,9351*** p=,000	-,8972*** p=,000	,6413** p=,046	,7207** p=,012	,9357*** p=,000
Robbery Rate	,0785 p=,735	,4468** p=,042	,3080 p=,174	-,0143 p=,961	-,4919** p=,024	-,4953* p=,072
Fraud	-,3573 p=,112	,5195** p=,016	,8666*** p=,000	-,7538*** p=,002	,0887 p=,702	-,5353** p=,049
Embezzlement Rate	-,3614 p=,107	-,5174** p=,016	-,3430 p=,128	,8566*** p=,000	-,1894 p=,411	,6340** p=,015
Economic Crime	-,5300** p=,020	-,5833*** p=,009	-,1736 p=,477	,7062** p=,010	,2239 p=,357	,6351** p=,026
Drug Offences Rate	-,0212 p=,927	,6204*** p=,003	,7332*** p=,000	-,7698*** p=,001	,1096 p=,636	-,6961*** p=,006

Quite strong correlations between certain types of crimes and certain indexes of development, both positive and negative, are evident from the table. Based on the obtained data the connection between crime and economic indicators is the most significant. The indicator of unemployment has the least statistical association with crime.

Thus, despite the fact that the impact of unemployment on criminal decision seems to be reasonable, there are no evident correlations, except the correlation with motor vehicle theft; consequently there is no casual effect from unemployment on crime at a macrolevel. In order to test the hypothesis about the impact of unemployment on crime at a microlevel it is necessary to take into account the behavior of a person before the unemployed position as he/she could commit crimes being officially employed. In addition, the researcher should test the control group – the unemployed who didn't commit crimes, and the unemployed who had no income from legal occupancy but were involved in the underground economy, for example.

Unlike some mercenary motivated crime theft rate, robbery rate and tested development indicators are linearly independent or exhibit a rather weak dependence. One of the plausible explanations for this output is essential resizing of harm amount required to qualify these actions as crime that mechanically influenced the change of statistical indicators of crimes, and thus the reliability of calculations.

Tested data have shown that the economic indicators such as GDP per capita and poverty have a significant correlation with crime in Ukraine. The overall crime rate decreases with an increase in GDP and increases with poverty growth. Homicides, theft of motor vehicles, embezzlement and economic crime have analogous patterns. Fraud and drug-related crimes reveal inverse pattern in the context of economic indicators. The rate of these crime increases with GDP growth.

Two opposite but possible effects of economic development indicators should be taken into account: on the one hand, a part of the perpetrators are able to take part in legal activity and leave the criminal environment with the improvement of the economic situation in the country, but, on the other hand, more wealth appears that one can steal or embezzle.

It should be also noted that ordinary violent and mercenary crime are the core of total criminal activity and have been little exposed with the historical variability in content and character of act but their dynamics is changing. Economic crime is rather associated with the development in terms of quality changes.

With regard to social development indicators, inequality measured by Ginny index and associated with social strain is positively correlated with homicide, theft of motor vehicles, embezzlement and economic crime.

Urbanization rate is not correlated with total crime rate, but has a negative correlation with the level of homicides and thefts of motor vehicles and positive one with embezzlement and drug offences.

Thus the identified correlations indicate close links between variables, but they cannot be assumed as causality indicators.

The determination of the dependence between variables appeals to the construction of multiple regression models (see Table 4). It is noteworthy that pair regression on observed indicators shows quite significant coefficients. But pair regression is able to give reliable results in modeling, if the influence of other factors affecting the object of research might be neglected. Meanwhile crime is a systemic activity influenced by a set of factors. It is practically difficult to perform an exhaustive list of crime factors, therefore it is almost impossible to ignore.

The way out is to reveal the influence of one or more factors, introducing them into the multiple regression model.

Criminometric multiple regression model is the equation of the type

$$y = a + b_1 x_1 + \ldots + b_p x_p + \varepsilon$$

where y – the value of the dependent variable, α – constant, $x_1, \ldots, x_p$ - independent variables, $b_1 b_p$ – regression coefficients, ε - unobservable value.

In reliable model the predictors (independent variables) should not be intercorrelated and much less have the exact functional relationship. Some tested independent variables have high pair correlation coefficients; in particular GDP shows a high positive correlation with urbanization and negative with poverty rate. Under such conditions the actual multicollinearity of factors exists. The dependence between the predictors leads to the fact that the system of equations may be ill-conditioned, and may cause the instability and unreliability of regression coefficients. As a result, the variation in the original data ceases to be independent, and the evaluation of the effect of each factor separately becomes impossible.

Certain predictors will be selected to decrease multicollinearity and make the results of multiple regression more objective and reliable. Correlation coefficients between predicted series y (crime) and each of the independent variables x (predictors) are to be quite high. That is why the development indicators with the correlation coefficient of at least 0,5 value[1] were sorted out from correlation matrix for the criminometric model for each crime type.

As all the correlation coefficients are rather low in case of theft and robbery (less than 0.5), calculations of the regression for these crime types makes no sense.

The test of regression equation significance is based on analysis of variance. The method of least squares was employed for the estimation of the regression parameters. R2 value is an indicator of the fitting degree of the model to the data. The value of R2 is the fraction of variance of the variable y, explained by variables x. Unexplained (residual) fraction of the dispersion is the result of parameters influence not reflected in the model, or the complex nonlinear relationship exists between variables.

[1] It is considered that the correlation coefficients that are greater than 0.7 in absolute value indicate the strong nexus (the coefficients of determination > 50% that is one feature defines the other by more than half). The correlation coefficients, which in absolute value are less than 0.7 but more than 0.5, indicate the nexus of medium strength (the coefficients of determination are less than 50% but more than 25%).

Table 4

Regression summary (* marked as significant)

N=21	Regression Summary for Dependent Variable: Crime Rate R= ,61009677 R?= ,37221807 Adjusted R?= ,30246452 F(2,18)=5,3362 p					
	b*	Std.Err. of b*	b	Std.Err. of b	t(18)	p-value
Intercept			1284,109	125,0187	10,27133	0,000000
GDP per capita (PPP)	-0,597010*	0,258463	-0,043	0,0186	-2,30985	0,032964
Poverty	0,018714	0,258463	1,121	15,4834	0,07240	0,943079

N=21	Regression Summary for Dependent Variable: Homicide Rate R= ,91494666 R?= ,83712739 Adjusted R?= ,79640923 F(4,16)=20,559 p					
	b*	Std.Err. of b*	b	Std.Err. of b	t(16)	p-value
Intercept			-25,9672	31,59614	-0,82185	0,423242
GDP per capita (PPP)	-1,05747*	0,202930	-0,0010	0,00019	-5,21103	0,000086
Poverty	-0,11656	0,151517	-0,0898	0,11678	-0,76925	0,452950
Urban Population	0,21576	0,188620	0,5345	0,46728	1,14390	0,269493
GINI Index	0,17388	0,143107	0,0902	0,07421	1,21504	0,241979

N=21	Regression Summary for Dependent Variable: Theft, Motor Vehicle Rate R= ,76513414 R?= ,58543026 Adjusted R?= ,40775751 F(6,14)=3,2950 p					
	b*	Std.Err. of b*	b	Std.Err. of b	t(14)	p-value
Intercept			-51,2926	101,5434	-0,50513	0,621326
HDI	0,472612	0,239766	43,8294	22,2355	1,97114	0,068807
GDP per capita (PPP)	-0,473615	0,607635	-0,0005	0,0007	-0,77944	0,448697
Urban Population	0,123943	0,453683	0,3815	1,3965	0,27319	0,788693
GINI Index	0,310291	0,382539	0,1999	0,2465	0,81113	0,430863
Unemployment, total	0,311982	0,369075	0,3562	0,4214	0,84531	0,412153
Poverty	-0,295146	0,266865	-0,2826	0,2556	-1,10598	0,287381

N=21	Regression Summary for Dependent Variable: Fraud Rate R= ,94886021 R?= ,90033570 Adjusted R?= ,87541963 F(4,16)=36,135 p					
	b*	Std.Err. of b*	b	Std.Err. of b	t(16)	p-value
Intercept			-1589,89	192,3484	-8,26569	0,000000
GDP per capita (PPP)	-0,714501*	0,158742	-0,01	0,0011	-4,50103	0,000363
Urban Population	1,285866*	0,147548	24,79	2,8447	8,71490	0,000000
GINI Index	-0,183399	0,111945	-0,74	0,4518	-1,63829	0,120873
Poverty	-0,094825	0,118524	-0,57	0,7109	-0,80005	0,435400

End of Table 4

N=21	Regression Summary for Dependent Variable: Embezzlement Rate R= ,71165106 R?= ,50644723 Adjusted R?= ,41934968 F(3,17)=5,8147 p					
	b*	Std.Err. of b*	b	Std.Err. of b	t(17)	p-value
Intercept			-77,6782	49,47096	-1,57018	0,134799
GDP per capita (PPP)	-0,123891	0,246332	-0,0014	0,00284	-0,50294	0,621458
GINI Index	0,583337*	0,228055	3,7663	1,47243	2,55788	0,020377
Poverty	0,066947	0,253622	0,6424	2,43378	0,26396	0,794981

N=21	Regression Summary for Dependent Variable: Economic Crime Rate R= ,77266973 R?= ,59701851 Adjusted R?= ,49627314 F(4,16)=5,9260 p					
	b*	Std.Err. of b*	b	Std.Err. of b	t(16)	p-value
Intercept			438,868	106,1916	4,13279	0,000781
GDP per capita (PPP)	-0,503566*	0,231103	-0,005	0,0023	-2,17897	0,044627
GINI Index	0,214876	0,213432	1,222	1,2138	1,00677	0,329031
Poverty	-0,107271	0,239904	-0,907	2,0278	-0,44714	0,660766
HDI	-0,569515*	0,161659	-466,188	132,3291	-3,52295	0,002823

N=21	Regression Summary for Dependent Variable: **Drug Offences Rate** R= ,77669141 R?= ,60324954 Adjusted R?= ,50406193 F(4,16)=6,0819 p					
	b*	Std.Err. of b*	b	Std.Err. of b	t(16)	p-value
Intercept			-2831,29	1504,754	-1,88156	0,078218
GDP per capita (PPP)	-0,133445	0,316724	-0,00	0,009	-0,42133	0,679119
GINI Index	-0,218913	0,223355	-3,46	3,534	-0,98011	0,341619
Poverty	-0,190258	0,236481	-4,47	5,561	-0,80454	0,432879
Urban Population	0,597299	0,294389	45,15	22,254	2,02894	0,059443

According to the estimations total crime rate has the closest negative connection to the change of GDP. All other indicators examined in a model are not significant. But the analysis of variance shows that only 37% of the changes in total crime rate can be explained by the change of indicators of development. It does not give grounds to use the development indicators as explanatory factors of total crime rate.

Reliability of multiple regression models for the other studied crimes is sufficiently high. For each reduction per 1 of GDP, there is an increase in homicide rate by 1.1, an increase in fraud rate by 0.7 and an increase in economic crime rate by 0.5. For each increase of urbanization per 1, fraud rate increases by 1.3. For each increase of GINI index per 1, embezzlement rate increases by 0.6. For each reduction of HGI per 1, economic crime increases by 0.6.

Expanding economic motivation is a generating process for crime patterns. The differential rates of increase in crime seem to corroborate more with the economic motivation explanation. It is notable that we used only the official data on income per capita for the study. Meanwhile there are a lot of facts of evident opportunities for obtaining illegal revenue – including revenue from the so-called non-criminal sectors of shadow economy.

A series of high-profile cases in Ukraine over the last decade have provided a comprehensive insight into the potential damage caused by economic and financial crime, which includes damaged credibility for businesses and institutions, bankruptcy and loss of jobs. "In the developed world, the impact of such crimes may be easier to contain, given the size of their economies and their ability to install appropriate regulatory mechanisms. In the developing world, however, the long-term impact on and costs for sustainable development are significantly higher as a result of weak regulatory frameworks and limited government capacity" [4].

In case of theft of motor vehicle and drug offences multiple regression model is reliable but has found no dependence on parameters of development despite of relatively high correlation coefficients.

The impact of socio-economic parameters of development on crime has time delay. Criminometric model of Distributed Lags Analysis (module Time Series/Forecasting within Advanced linear/Nonlinear Models) is based on the data on one object of a series of consecutive points (periods) of time.

Time (dynamic) series is a set of values of an indicator for several consecutive times, or periods of time. But in the contrast to the spatial patterns the observation in time series, as a rule, cannot be considered as independent. Each level of the time series is influenced by many factors that can be divided into three groups: factors of series trend; factors of the cyclical fluctuations of the series; random factors. The dependence of series levels on time is able take many forms because of various combinations in the studied phenomenon or the factors [5].

Dependent variable y (crime) and an independent or explanatory variable x (development) are both measured repeatedly over time. The simplest way to describe the relationship between the two would be in a simple linear relationship: yt = s bi*xt-i. In this equation, the value of the dependent variable at time t is expressed as a linear function of x measured at times t, t-1, t-2, etc. Thus, the dependent variable is a linear function of x, and x is lagged by 1, 2, etc. time periods. The Beta weights (bi) can be considered slope parameters in this equation. If the weights for the lagged time periods are statistically significant, we can conclude that the y variable is predicted (or explained) with the respective lag [6, p. 510-511].

Distributed Lags Analysis has shown that the elasticity of ordinary mercenary and violent criminal activities is the most significant in first lag, and the elasticity of embezzlement and economic crime – in first and second lags.

Ordinary mercenary crimes as well as economic crime have a high degree of inertia. But the delay in more than one lag for economic criminal activity can be explained by the higher latency and the lack of control that triggers the following crimes.

The lag variables have positive value that reveal the likelihood of criminal recidivism and potential stability of crime in these periods. The impact of development indicators for the next periods was not significant.

Crime is prone to autocorrelation that contributes to the mechanism of crime expanded reproduction. It means that if there is a trend in the time series, the value

of each subsequent series level depends on the previous series. Quantitatively, the autocorrelation series levels can be measured by the linear correlation coefficient between the levels of the original time series, and this series of levels shifted with several steps in time. In our calculations, the autocorrelation and partial autocorrelation functions in first lag are close to 1, indicating a significant autocorrelation and strong linear trend in the time series of crime.

The conclusion. Despite the popularity of sustainable development concept and the aspiration for it in modern communities many criminogenic threats and risk of social changes are being neglected; development is not sufficiently appreciated as a context for crime. Meanwhile crime patterns and development transformations have an interaction and a mutual influence that should not be ignored by preventive and punitive policies. Disorganization and crime are the side effects of developmental transformations and can in some ways serve as a barometer of change.

Development is not the direct cause of crime, but a catalyst, which together with other factors has an impact. The proposed research criminometric model of crime in the context of development has not been designed to describe and explain individual criminal behavior (the micro level) as it doesn't take into account opportunities and abilities of a particular person to commit a crime, the impact of environment and the incentives and the deterrent potential of local social control. Nevertheless, criminometric macro analysis of the nexus between crime and development is theoretically and practically significant. It intends to contribute to a better understanding of the interactions between crime, economic performance and social dislocations. That is accidental, situational, exceptional issue from the general rule at the micro level could be viewed as an undulating system of patterns at a macro level. It enables to reveal the etiology of crime and to predict the evolution of crime more accurately, especially in transitive type of social development in Ukraine.

Every society has its unique path of modernization on the basis of historical, economic, political, cultural, ethnic and informational context of development. Obviously there couldn't be the universal formulas or models of interaction between development and crime. In Ukraine the transition from a socialist to a capitalist type of society was accompanied by a considerable surge of crime (underreportiong in the Soviet time and the collapse of law enforcement in the early years of independence have also contributed to the crime pattern changes, but were not the major). This observation corresponds to the economic theory and lifestyle theory of crime. Meanwhile the overview would not be complete without pointing the high concentration of social disorganization, including the growth of poverty and social stratification. This turning point in Ukrainian society has been marked by rapid transformations and high elasticity of crime, but should be recognized as temporary condition that is not able to explain the interaction of the modern period.

Transitive period of Ukraine's independence is characterized by controversial trends of development. In present study the attempt to reflect the impact of not only positive changes that are usually associated with the development,

but also the negative aspects of poor performance of development on crime was made. The results confirmed the hypothesis on correlations between selected social and economic indicators and crime indexes.

GDP per capita is proved to be the most significant predictor with inverse relationship for homicide, fraud and economic crime.

The impact of socio-economic parameters of development on crime has time delay. Furthermore crime is prone to autocorrelation that contributes to the mechanism of crime expanded reproduction. The elasticity of ordinary mercenary and violent criminal activities is the most significant in first lag, and the elasticity of embezzlement and economic crime – in first and second lags. Lag variables has positive value that reveal the likelihood of criminal recidivism and potential stability of crime in this periods. The impact of development indicators for the next periods was not significant.

However, it should be admitted that obtained results can't be applied in construction of general deterministic effects theory. The causal impact of development is not systematic and cannot be used as explanatory factor in description of crime etiology. In addition, a weak point of criminometric analysis in the context of development and crime is the multicollinearity of variables. Socio-economic indicators are often commonly interdependent.

But crime rate even better describes the state of society than many other indices. The monitoring of crime patterns in the context of development impact is able to perform the right balance of crime prevention strategies. It could help to find out which economic and social (consequently not punitive) measures are capable to reduce the attractiveness of criminal activity and also to institutionalize the general social prevention instead of increasing the expenditures on law enforcement and criminal justice.

Nowadays when development and crime control in a particular country can no longer rely only on local political, economic and social management under the causes of global trends, asymmetry of countries and regions should be taken into account in order to minimize the perpetrators achievements from the privileges of development on the one hand and neutralize criminogenic provocativeness of underdevelopment on the other.

The empirical analysis in this paper could be extended in a number of directions. The proposed criminometric model has been primarily focused on the research of the impact of development indicators on crime that does not remove the need for further study of the reverse effect and determination of the real harm from crime at the macro level. The observation of high crime rate in developed countries is the evidence of criminalization, but may have low potential threats to sustainable development. Obviously, the state with developed economies experiences the problem of crime easier then underdeveloped one. Crime is more noticeable in weak states and communities. In addition, there is a necessity for the introduction and consideration of another parameter – the speed and pace of criminalization in comparison with development changes. The present study has performed a general overview of the interaction. The certain types of crime require more in-depth detailed

analysis considering different nature and motivations of various crimes. Some criminal activities has eliminated during society transformation; the ordinary property and violent crime are the core of crime pattern and do not usually have significant changes; the conventional crime (such as economic, political crime) has evolved due to the controversial developmental processes; cybercrime and hi-tech crime are innovative and have emerged recently due to scientific and technical progress.

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Appendix

CRIME DATA (UKRAINE) / DEPENDENT VARIABLES

Recorded Rate per 100 000 population	Crime Rate	Homicide Rate	Theft Rate	Theft, Motor Vehicle Rate	Robbery Rate	Fraud Rate	Embezzlement Rate	Economic Crime Rate	Drug Ofences Rate
1991	780	5,09	-	-	42,02	12,83	18,05	65,39*	21,96
1992	921	6,46	-	-	58,24	11,46	16,46	69,37*	28,19
1993	1034	7,08	-	-	63,91	14,16	16,97	79,53*	48,44
1994	1102	8,13	-	-	62,70	22,22	18,24	90,55*	54,72
1995	1246	8,55	404,70	-	59,02	18,81	73,50	118,61*	2,00
1996	1208	9,58	388,24	-	54,02	21,36	73,89	119,99*	3,06
1997	1162	8,35	350,71	-	48,72	35,61	75,09	123,75*	8,30
1998	1145	8,34	367,29	-	44,72	30,82	20,04	130,71*	79,12
1999	1120	8,52	351,53	-	42,65	32,22	21,32	106,41*	85,34
2000	1118	8,93	357,57	-	43,29	29,56	21,38	105,27*	92,03
2001	1057**	9,48*	501,84*	17,43*	48,20*	34,24*	14,94*	86,60*	99,18*
2002	955**	8,98*	409,74*	18,0*	44,05*	31,77*	16,71*	67,42*	121,56*

(End of Table)

2003	1185**	7,57	554,1	14,67	76,32	33,78*	15,40*	91,06*	120,5
2004	1112**	7,32	492,6	12,34	85,96	32,34*	15,72*	93,78*	139,0
2005	1044**	6,42	396,0	13,15	99,82	49,44*	15,92*	96,39*	138,5
2006	915**	6,25	282,0	11,82	88,88	34,78*	15,86*	91,69*	138,7
2007	878**	5,66	245,8	11,65	69,16	33,24*	15,57*	92,56*	137,9
2008	843**	5,25	238,8	9,99	79,48	44,28*	15,60*	84,0*	138,4
2009	954**	4,74	380,1	11,20	59,65	50,72*	17,11*	80,34*	126,4*
2010	1102**	4,32	553,2	9,29	50,60	54,56*	18,07*	-	124,7*
2011	1129*	5,51*	610,7	10,3*	50,53*	52,93*	17,55*	-	117,1*

Sources: United Nations Office on Drugs and Crime. Original data: https://data.unodc.org/

*Data on crime rate calculated from official crime statistical reports of Ministry of Internal Affairs of Ukraine and number of population according to the information of State Statistics Service of Ukraine

**State Statistics Service of Ukraine. Original data: http://www.ukrstat.gov.ua/druk/katalog/poslugi/zlo_2010.zip

Missing data were replaced by mean substitution method during the calculations.

EXPLANATORY VARIABLES

	HDI	GDP per capita (PPP)	Urban Population	GINI Index	Unemployment, total	Poverty
1991	0,799	6403,33	66.80	-	6,7	-
1992	0,773	5897,088	66.84	29,71	7,5	1,58
1993	0,76	5175,633	66.87	-	8,7	-
1994	0,744	4093,79	66.91	-	7	-
1995	0,747	3698,43	66.95	39,29	5,6	5,38
1996	0,731	3419,564	66.99	35,16	7,6	5,37
1997	0,721	3404,629	67.03	-	8,9	-
1998	0,744	3406,498	67.07	-	11,3	-
1999	0,742	3484,411	67.11	28,96	11,6	8,26
2000	0,755	3812,138	67.15	-	11,6	-
2001	0,766	4300,749	67.18	-	10,9	-
2002	0,777	4639,719	67.28	29,05	9,6	1,67
2003	0,766	5219,247	67.43	28,66	9,1	0,63
2004	0,774	6057,436	67.60	28,93	8,6	0,56
2005	0,788	6468,382	67.79	29,02	7,2	0,26
2006	0,725	7202,337	67.97	29,79	6,8	0,13
2007	0,732	8025,899	68.15	28,57	6,4	0,04
2008	0,736	8417,004	68.33	26,64	6,4	0,01
2009	0,728	7257,897	68.50	25,32	8,8	0,07
2010	0,733	7685,57	68.69	24,82	8,1	0
2011	0,737	8281,867	68.88	24,55	7,9	0

Missing data were replaced by mean substitution method during the calculations.

VARIABLES DEFINITIONS

Variable	Definition	Data Source
HDI (Human Development Index)	The HDI is a summary measure for assessing long-term progress in three basic dimensions of human development: a long and healthy life, access to knowledge and a decent standard of living.	Human Development Report // http://hdr.undp.org/sites/all/themes/hdr_theme/country-notes/UKR.pdf
GDP per capita (PPP)	Gross domestic product based on purchasing-power-parity (PPP) per capita GDP (Current international dollar). Expressed in GDP in PPP dollars per person. Data are derived by dividing GDP in PPP dollars by total population.	The World Bank http://data.worldbank.org/data-catalog/world-development-indicators
Urban Population	Urban population (% of total) Urban population refers to people living in urban areas as defined by national statistical offices. It is calculated using World Bank population estimates and urban ratios from the United Nations World Urbanization Prospects.	The World Bank http://data.worldbank.org/data-catalog/world-development-indicators
GINI Index	World Bank estimate. Gini index measures the extent to which the distribution of income (or, in some cases, consumption expenditure) among individuals or households within an economy deviates from a perfectly equal distribution. Gini index of 0 represents perfect equality, while an index of 100 implies perfect inequality.	The World Bank http://data.worldbank.org/data-catalog/world-development-indicators
Unemployment, total	Unemployment, total (% of total labor force) (modeled ILO estimate)	The World Bank http://data.worldbank.org/data-catalog/world-development-indicators
Poverty	Poverty headcount ratio at $1.90 a day (2011 PPP) (% of population)	The World Bank http://data.worldbank.org/data-catalog/world-development-indicators

Summary

Melnychuk T. V. **Development and Crime Patterns in Ukraine: Criminometric Study.** – Article.

The article highlights the results of the study of regression and correlation interrelations between the indicators of development (Human Development Index, GDP per capita, GINI index, etc.) and the ratio of crime intensity and the intensity of certain types of crimes on the basis of criminometric methods.

Key words: crime, development, criminometrics, quantitative analysis, quantitative methods.

Анотація

Мельничук Т. В. **Розвиток та закономірності злочинності в Україні.** – Стаття.

У статті відображені результати дослідження кореляційних та регресійних взаємозв'язків між індикаторами розвитку (індекс людського розвитку, ВВП на душу населення, Джіні індекс та ін.) та коефіцієнтом інтенсивності злочинності, а також окремих видів злочинів на основі застосування кримінометричних методів.

Ключові слова: злочинність, розвиток, кримінометрика, кількісний аналіз, кількісні методи.

Аннотация

Мельничук Т. В. **Развитие и закономерности преступности в Украине.** – Статья.

В статье отражены результаты исследования корреляционных и регрессионных взаимосвязей между индикаторами развития (индекс человеческого развития, ВВП на душу населения, Джинни индекс и др.) и коэффициентом интенсивности преступности, а также отдельных видов преступлений на основе применения криминометрических методов.

Ключевые слова: преступность, развитие, криминометрика, количественный анализ, количественные методы.