UNDERSTANDING THE ECONOMICS OF CRIMINAL ACTIVITY IN KAZAKHSTAN

BY

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Abstract

This paper investigates the effects of various macroeconomic and demographic factors on criminal activity in Kazakhstan. In my analysis I focus on average gravity and grave crimes in addition to total crimes over the 2008-2016 period. Employing a fixed effects model I show that share of women and age group of 15-19 years age positively correlated, and shares of age group 0-14 and 50-64 years are negatively correlated both with total and average grave crimes. In addition, share of age group of 65+ years has a significant positive effect only for average grave crimes. On the other hand, unemployment rate is very highly and negatively correlated with both total and average crime rates. GDP per capita is estimated to be the only important determinant which negatively affects grave crimes. Furthermore, a-weights by locality population are employed to obtain estimates generalized for Kazakhstan. The findings suggest that women share positively affects all types of crime, both inflation and GDP per capita are positively correlated with total crime rate, and net migration has a positive effect on grave crimes. At the same time GDP per capita has a negative correlation with grave crimes. Additionally, unemployment rate has negative impacts for total and average gravity crimes but a positive impact for grave crimes. Moreover, age groups 0-14 and 50-64 years indicate negative influences on total and average gravity crimes, age groups 15-19 and 65+ have negative impacts on grave crimes while share of age group 35-49 positively correlates with it. Controlled year dummies are economically and statistically significant both for locality and country level estimates which provides evidence for a structural effect behind the recent increase in the crime rates.

Contents

1 Introduction

The attempt to model criminal activity in an economics context is first tackled by Becker (1968), in which he formulates supply and demand functions of crime utilizing the price theory and subsequently derives a model of deterrence considering arrest probability and size of punishment. However, in his model sanctions are assumed to be the same for any crime type, such as burglary and murder, leading to distorted incentives. This issue, referred as fundamental theoretical problem of "marginal deterrence", is later addressed by Stigler (1973). Levitt (2017) concludes that the Economics literature on causes and consequences of crime is good at explaining the relationship between individuals' decisions to engage in criminal activity and costs of punishment. According to Merlo (2004), the literature also provides useful insights to analyze alternative crime control policies.

The upward trend in criminal and violent acts leads to growing concern across many countries. The most reliable indicator to compare crime rates around the world is the homicide rate as definitions of other types of crime might differ significantly according to various jurisdictions of countries. Figures A1-A3 in the Appendix provide the trends in homicide rate in Americas, Asia, and Europe, respectively. In general the homicide rate in Central Asia is lower than in Americas and Europe; however, it is the highest in Asia. It is seen from Figure A2 in the Appendix that the homicide rate in Central Asia had decreased dramatically in between 2010 and 2014. Surprisingly, the opposite trend was observed in Kazakhstan (see Figure 1). The same pattern holds for total crime rates as well (while Russia, Belarus, Ukraine, and Uzbekistan have downward trends, Kazakhstan has an upward trend, source: the Secretariat of the Coordinating Council of Prosecutors General of the CIS).

According to the World Economic Forum's ranking, Kazakhstan is in the 63^{rd} place among 137 countries in the level of organized crimes in 2017. Moreover, Kazakhstan had the highest prison population rate in Asia in 2007 (see Table A1 in the Appendix). Despite the fact that prison population in China is larger than in Kazakhstan, its prison population rate is almost half as low as that of Kazakhstan (Institute of Criminal Policy). According to the Secretariat of the Coordinating Council of Prosecutors General of the CIS, Kazakhstan ranked 3^{rd} in terms of overall crime rate among the CIS countries in 2013.

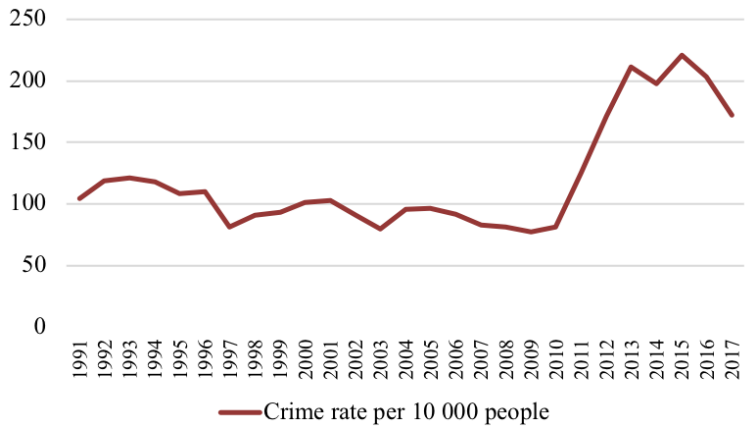

Figure 1: **Crime Rate Trends in Kazakhstan**

Figure 1 presents the trend in crime rate in Kazakhstan since its independence. While the crime rate decreased from 120 in 1992 to approximately 70 in 1997, there had been no considerable changes afterwards up until 2009. The crime rate increased from 77 in 2009 to 211 in 2013. In accordance with the Concept of the Republic's Legal Policy for 2010-2020, the Generals Prosecutors Office has introduced informational platforms for electronic registration of applications and reports of crimes. In addition, all internal affairs agencies have been connected to a unique electronic system since 2011. An example is "Biznes Tiregi" for entrepreneurs. According to the Committee of Legal Statistics and Special Accounts, 335 entrepreneurs reported illegal inspections during the first months of the project in 2010 and 70% of them were verified. According to the statistics crime rate in Astana remained at the same level in the first 13 years since it became a capital city while its population tripled. After the implementation of the above mentioned informational platform, reported crimes in Astana increased from 3 000 - 4 000 up to 15 000 per year.

The property crimes account for 63.6% of the total number of committed crimes, and every second committed crime is a theft in Kazakhstan. While 34.4% of the crimes were committed by people aged 21-29 years old, 27% committed by people aged 30-39 years old, and 5.2% committed by juveniles in 2016 (the Committee of Legal Statistics and Special Accounts, Qamqor). Theft can be perceived as a risky economic activity which helps individuals obtain basic necessities. Large amount of property crimes can be explained by low marginal costs since they are usually committed in crowded places whereby probability of getting

arrested is low (Glaeser and Sacerdote, 1999). House robberies might be widespread because many new buildings having standardized locks appeared in the recent years in Kazakhstan, and it is easier to break into these apartments.

This paper analyzes the relationship between criminal activity, and the macroeconomic and demographic changes in Kazakhstan. The considerable fluctuations in the crime rate coincide with the crisis and devaluation periods as seen in Figure 1. The economy of Kazakhstan heavily depends on oil and gas sector, and the low oil prices in 2014 led to a temporary decline in economic growth of the country (see Figure A4 in the Appendix). The highest rates of inflation were observed during the crisis period in 2008-2010. Economic downturns in 2009 and 2015 also coincided with sizeable internal migration into metropolitan cities (the Committee on Statistics).

There are many factors specified as the determinants of crime in the Economics literature such as population density, share of women, share of urban population, share of diverse age groups, share of net internal migration, unemployment rate (see Figure A5 in the Appendix), inflation rate (see Figure A6 in Appendix), Gini coefficient, GDP per capita, spending on law enforcement, labor force participation rate, and ratio of consumption income to subsistence level. A polychoric principal component analysis is utilized to reduce the dimensionality of the problem since some of these variables are highly correlated. Afterwards, a fixed effects model is employed to uncover the effect of macroeconomic and demographic variables on criminal activity.

The examination of the crime rates in different regions of Kazakhstan is warranted for several reasons. First of all, the economic and social environments of two main cities (Astana and Almaty) are very different from other regions (see Figures A8-A10 in the Appendix). Second, identifying macroeconomic and demographic determinants of criminal activity can help to implement new, or adjust existing policies. Finally, this is the first empirical research on economics of criminal activity in Kazakhstan.

The paper proceeds as follows. Section 2 is provides a literature review on economics of crime. Section 3 presents the data and methodology. Section 4 provides the execution of the polychoric principal component analysis. Section 5 presents the empirical results, which is followed by the conclusion in Section 6.

2 Literature Review

This section provides a detailed literature review on the determinants of criminal activity. The economics of crime traces its roots back to Becker's seminal research in 1968 which was the first attempt to model illegal activities in the domain of the price theory. Becker derives a criminal equilibrium, which is reached whenever benefits exceed costs.

Allison (1972) analyzes the economic determinants of crime rate using specifications based on commission of causes and prevention of violence, such as unemployment rate, proportion of males in the population, education level, spending on culture, and share of age group 15-24 years, etc. The effects of unemployment rate, share of men, and share of age group 15-24 years conform with the postulation that they are positively correlated with crime rates.

Krohn (1976) studies the impacts of inequality and unemployment levels on crime rate in a cross-national framework. His study examines the hypothesis that nations having high unemployment and inequality rates also have high crime rates. He includes homicide, property, and total crime rates as functions of gross national product (GNP) per capita, unemployment rate, and Gini coefficient. The results show that neither unemployment rate nor economic inequality affects crime rate in the hypothesized direction. Both of them indeed have negative impacts for property and total crime rates, and positive effects on homicide rate. Furthermore, GNP per capita, which serves as a proxy for industrialization, is positively correlated with crime rate.

It is plausible to assume that crime commitment acts as a form of employment generating "income" (Raphael and Winter-Ebmer, 2001). However, criminal opportunity theorists claim that people who spend more time outside of the household are more likely to commit crimes. That is why an increase in unemployment rate does not necessarily lead to an increase in crime rate (Cantor and Land, 1985; Cohen and Felson, 1979; Jackson, 1984). A negative sign is more likely to appear in the context of violent and property crimes such as robbery, larceny, burglary, and homicide while a positive impact is observed only for property crimes (Cantor and Land, 1985).

Another contribution to the crime literature is by Entorf and Spengler (1998). They

find that deterrence has a negative impact on property crime rate. The demographic factors such as age and urbanization, and GDP per capita positively influence crime rates. Particularly, they find that share of age group 15-24 years is positively correlated with crime rate. The effect of population density is insignificant in their research. They further find that overall unemployment rate has insignificant and ambiguous effect on crime rate; nevertheless, youth unemployment positively affects crime rate.

Bechdolt (1975) investigates the relationship between macroeconomic indicators and crime rates in big cities such as Los Angeles and Chicago, and finds that large population and high employment densities positively affect crime rates.

Glaeser and Sacerdote (1999) investigate the problem in municipal cities of the United States and find that there are 79% more violent crimes in metropolitan areas compared to other cities. They support their findings with several strong arguments. Firstly, big cities provide more pecuniary benefits for crime commitment. For instance, there are more rich people in big cities whose house might be robbed. The authors utilize the victimization results from 1989 and show that there is a greater return to crime in metropolitan areas. Secondly, a larger population lowers the probability of getting arrested. Finally, there are more female-headed households in metropolitan areas, and it is easier to break into their houses. Due to the absence of data on female-headed households, I control for the share of women population in my empirical analysis.

Amaral and Bhalotra (2017) show that there exists a statistically significant positive correlation between women population and violent crimes.

Devine et. al. (1988) examine the effects of macroeconomic indicators and government social policy on criminal behavior. In particular, they use unemployment and inflation rates, and prison population as control variables. They run their models for different type of crimes such as burglary, violent crimes, homicide, etc., and find that an increase in unemployment rate has a positive effect on crime rate while the effect of prison population on crime is in the opposite direction. Since criminals in Kazakhstan do not necessarily go to prison in their own region, I can not include prison population in my analysis. Instead, I utilize spendings on law enforcement as a proxy for the prison population.

Many studies examine the impact of inflation on crime rates and as expected find

statistically significant positive influence of inflation on crime (for example Long and Witte, 1981).

Koenig (1991) provides empirical evidence for social control policies being more efficient for little and average grave crimes such as theft and robbery, but not for violent crimes.

Howsen and Jarrel (1987) discuss the determinants of crime in Kentucky and whether those determinants vary by types of crime. They control for various law enforcement variables such as number of police officers, apprehension rate, etc. as well as socioeconomic determinants such as unemployment, median household income, poverty, education, age categories, and urbanization. While law enforcement variables negatively affect all types of crime, poverty affects positively only property crime. Their findings suggest that a higher unemployment level leads to increases in both robberies and burglaries.

Many researchers include poverty line or an inequality level indicator (like Gini coefficient) in their empirical models (Fajnzylber et al., 2002). According to Pleskovic and Stiglitz (2010), the positive impact of inequality on crime rate leads to high social costs. In the United States estimates show that social monetary and non-monetary costs of crime account for approximately 3.8% of GDP.

Fajnzylber et. al. (2002) study the impact of inequality on homicide and robbery rates among various countries. They utilize Gini coefficient, GDP growth rate, young male population, number of police officers, etc. Their findings indicate a significant positive correlation between homicide rate and Gini coefficient while the effect of GDP growth rate on homicide rate is estimated to be negative.

3 Data and Methodology

My empirical model is flexible in terms of including most of the determinants discussed in the economics of crime literature. I utilize the data from the Committee on Statistics, the informational analytical system of the Ministry of National Economy, Taldau, and the information service of the Committee of Legal Statistics and Special Accounts, Qamqor. My sample covers the time period 2008-2016 for the 14 regions and 2 municipal cities of Kazakhstan.

The Committee on Statistics cover total crime rate panel and regional level macroeconomic indicators such as GDP per capita (in thousands KZT), unemployment rate, inflation, ratio of consumption income to subsistence level (which is based on the cost of a minimum food basket and a fixed share - 40% - of spending on non-food items and services, source: the Ministry of Labour and Social Welfare), and spending on law enforcement (in millions KZT). The data on population density, age composition, urban share, net migration, and women share are taken from the annual demographic report of the Committee on Statistics. The regional level data on different types of crime is obtained from the Committee of Legal Statistics and Special Accounts, Qamqor. The informational analytical system of the Ministry of National Economy, Taldau, provides data for Gini coefficient and labor force participation rate. GDP per capita and spending on law enforcement are indexed using CPI by taking year 2010 as the base.

Crimes in Kazakhstan are officially divided into four categories: little grave, average grave, grave, and gravest crimes, based on the nature of crime and on the extent of the danger it might cause to the public.

Little grave crimes include intentional acts for which the maximum penalty is two years of imprisonment, also, careless acts for which the maximum penalty is five years of imprisonment. Examples of little grave crimes are thefts, robberies, and frauds. Average grave crimes include intentional acts for which the maximum penalty is five years of imprisonment, also, careless acts with maximum penalty more than five years of imprisonment. Examples are illegal acquisition, transfer, sale, storage, transportation, or carrying of weapons and incitement to suicide. Grave crimes are considered to be only intentional acts and include crimes such as illegal production, sale, or transfer of drugs and intentional infliction of serious harm to health. They lead for up to twelve years of imprisonment. Gravest crimes include only intentional acts which lead to twelve or more years of imprisonment. Examples are terrorist act and homicide (Criminal Code of the Republic of Kazakhstan, 1997). In other words, the main difference in crime types are penalties, that is the duration of imprisonment, they impose. I utilize average and grave crimes in addition to total number of crimes as the dependent variables in my analysis. Little grave and gravest crime rates are very low: nineteen little grave crimes and one gravest crime per 10 000 people on average per region.

Little grave crimes are usually subject to underreporting issues. According to the World Economic Forum's ranking, Kazakhstan is in the 87^{th} place on reliability of police services among 137 countries. The Minister of Internal Affairs, Kalmukhanbet Kasymov, claims that one of the reasons behind underreporting crimes could be inefficient work of law enforcement agencies. In many cases law enforcement officials do not register little grave crimes. The General's Prosecutor's Office in cooperation with the Ministry of Internal Affairs implemented policies targeted on combating underreporting of crimes in 2011. As a result the number of crimes reported involving law enforcement officials increased by 50% in 2012 (The Committee of Legal Statistics and Special Accounts).

The variables of interest contain almost all the macroeconomic and demographic indicators provided as the determinants of crime in the literature. The regression model I utilize is given by:

$$log(y_{it}) = x_{it}\beta_{it} + \alpha_i + \epsilon_{it},\ \epsilon_{it} \sim N(0, \sigma^2),$$

where y_{it} denotes the crime rates by type (average grave and grave crimes as well as total number of crimes), i represents 14 regions and 2 municipal cities, t is time, α_i denotes fixed effects, and ϵ_{it} is the error term with mean 0 and variance σ^2.

The regressors (x's) include:

1. Population density (per square km.)
2. Women share (percentage);
3. Urban share (percentage);
4. Share of age groups 0-14, 15-19, 20-34, 35-49, 50-64, and 65+;
5. Internal net migration share;
6. Total unemployment rate by age groups 15-19, 20-34, 35-49, 50-64, and 65+;
7. Gini coefficient;
8. Inflation rate;

9. Labour force participation rate (percentage);
10. Log of GDP per capita (in year 2010 thousands KZT);
11. Ratio of average income per capita to subsistence level;
12. Log of spending on law enforcement (in year 2010 mln.s KZT);
13. Year dummies;

Figure 2 provides average total crime rates by region over the time period 2008-2016. Astana and Almaty have the highest average crime rates, followed by Kostanay, Pavlodar, and Aktobe regions. The lowest average crime rates are observed in Mangistau and South-Kazakhstan regions.

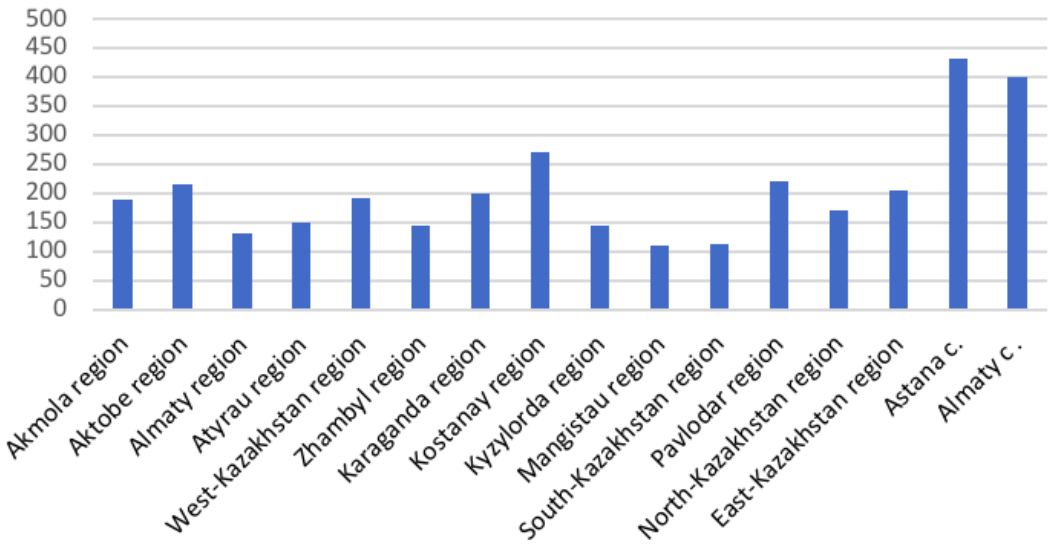

Figure 2: **Average Regional Crime Rates, 2008-2016**

Figure 3 provides regional crime rate trends in between 2008 and 2016. It can be seen that crime rates have upward trends in all the regions over the time. The highest level of criminal activity for all 14 regions was observed in 2013, and for Astana and Almaty in 2015.

Tables 1 and 2 provide descriptive statistics for the variables of interest. It is seen that minimum amount of total crimes committed by region by year per 10 000 people is 37 and maximum is 509. Average grave crime exhibit a minimum of 20 and a maximum of 345 crimes, and grave crimes show a minimum of 6 and a maximum of 74 crimes. There are so-

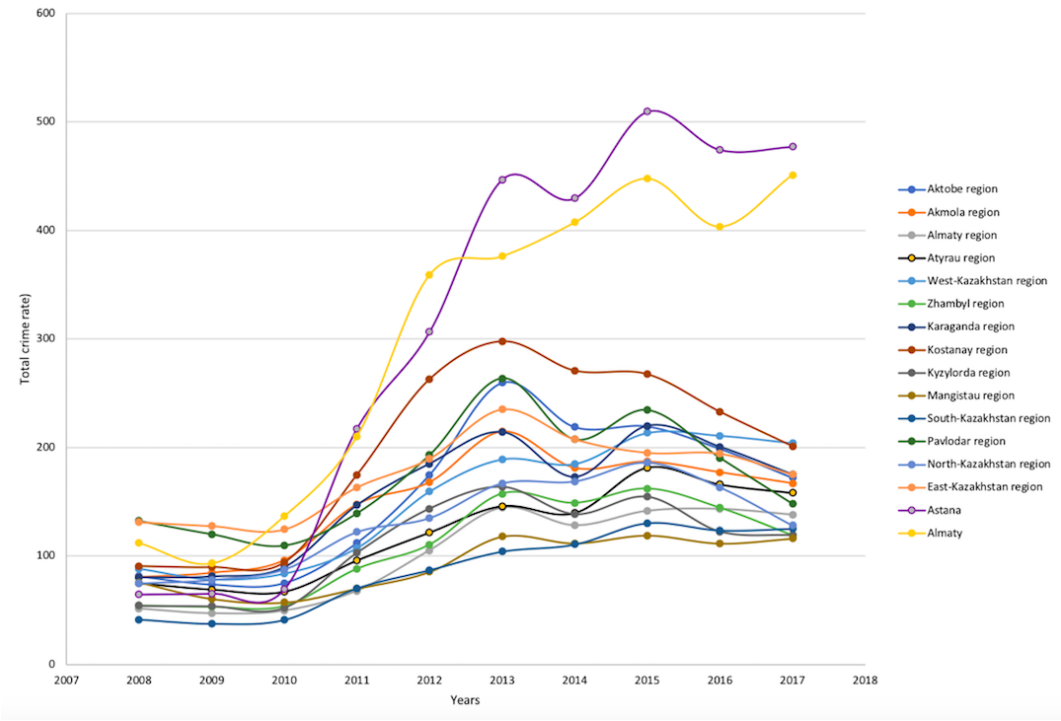

Figure 3: **Regional Crime Rate Trends**

me places with extremely low density (2.3) and other places with very high density (2 498). The largest share of age group is 20-34 years old and the smallest one is 15-19 years old. We can see that inflation has a significant gap between minimum, 3.4%, and maximum, 18.8%, along with spending on law enforcement which indicates 391.5 mln.s KZT at the minimum and 26 048 mln.s KZT at the maximum.

4 Polychoric Principal Component Analysis

My regression model, laid out in previous section, includes 13 determinants of crime presented in the Economics literature. However some of these variables might be highly intercorrelated leading to an over-controlling problem. That is why before proceeding to estimation I execute a polychoric principal component analysis (PPCA) to reduce the dimensionality of the problem by eliminating highly intercorrelated variables (year dummies and share of age groups are excluded from the PPCA). Tables A2-A7 in the Appendix provide the steps of my PPCA estimation.

Table 1: Summary statistics

Variable	Obs	Mean	Std.Dev.	Min	Max
Total crime rate	144	153.8	93.42	37.63	509.3
Average grave crime	144	111.6	73.06	20.29	345.8
Grave crime	144	18.86	12.66	6.261	74.52
Population density	144	205.4	568.1	2.341	2498
Women share	144	51.78	1.092	50.01	54.50
Urban share	144	55.86	20.88	23.07	100
Share of Age group 0-14	144	24.57	4.950	18.03	35.26
Share of Age group 15-19	144	8.060	1.572	4.602	11.17
Share of Age group 20-34	144	26.11	2.961	21.52	36.12
Share of Age group 35-49	144	20.27	1.326	16.89	25.52
Share of Age group 50-64	144	13.95	2.897	8.922	20.67
Share of Age group 65+	144	7.048	2.365	3.292	12.28
Net internal migration	144	0.0713	1.278	-1.831	8.818
Unemployment	144	5.533	0.668	4.600	7.700
Gini	144	0.249	0.0319	0.159	0.355
Inflation	144	7.829	2.575	3.400	18.80
LFPR	144	71.74	3.503	64.60	79.70
GDP per capita (thousands KZT)	144	1789	1307	356.7	6513
Ratio cons.income to sub.level	144	1.961	0.377	0.975	2.865
Spending on law enforc (mln.s KZT)	144	7405	6691	391.5	26048

Table A3 in the Appendix provides the eigenvalues which show the explanatory importance of each factor. Figure 4 provides the relevant scree plot. A factor contains little variance if it indicates a low eigenvalue. The aim is to determine which variables explain factors with low eigenvalues then drop them. Using the "scree" method, one can conclude that 4 factors might be dropped. In order to identify which variables are highly correlated, I refer to the polychoric correlation matrix provided in Table A2 in the Appendix.

Table 2: Summary statistics: aweight

Variable	Obs	Mean	Std.Dev.	Min	Max
Total crime rate	144	152.3	96.49	37.63	509.3
Average grave crime	144	110.1	75.08	20.29	345.8
Grave crime	144	21.03	14.04	6.261	74.52
Population density	144	246.3	643.4	2.341	2498
Women share	144	51.77	1.190	50.01	54.50
Urban share	144	54.81	22.68	23.07	100
Share of Age group 0-14	144	25.22	5.418	18.03	35.26
Share of Age group 15-19	144	8.117	1.597	4.602	11.17
Share of Age group 20-34 (reference group)	144	26.08	2.825	21.52	36.12
Share of Age group 35-49	144	19.99	1.444	16.89	25.52
Share of Age group 50-64	144	13.66	2.803	8.922	20.67
Share of Age group 65+	144	6.933	2.299	3.292	12.28
Net internal migration	144	0.000728	1.159	-1.831	8.818
Unemployment	144	5.533	0.651	4.600	7.700
Gini	144	0.248	0.0315	0.159	0.355
Inflation	144	7.839	2.557	3.400	18.80
LFPR	144	71.12	3.581	64.60	79.70
GDP per capita (thousands KZT)	144	1532	1197	356.7	6513
Ratio cons.income to sub.level	144	1.956	0.403	0.975	2.865
Spending on law enforc (mln.s KZT)	144	6771	6911	391.5	26048

Population density is highly correlated with women share (0.5), urban share (0.7), net migration (0.6), and log of spending on law enforcement (0.6). Log of spending on law enforcement indicates high correlations with urban share (0.8), net migration (0.6), and log of GDP per capita (0.9). Ratio of consumption income to subsistence level is highly correlated with women share (0.6), urban share (0.6), and Gini coefficient (0.6). Therefore, I exclude population density, log of spending on law enforcement, and ratio of consumption

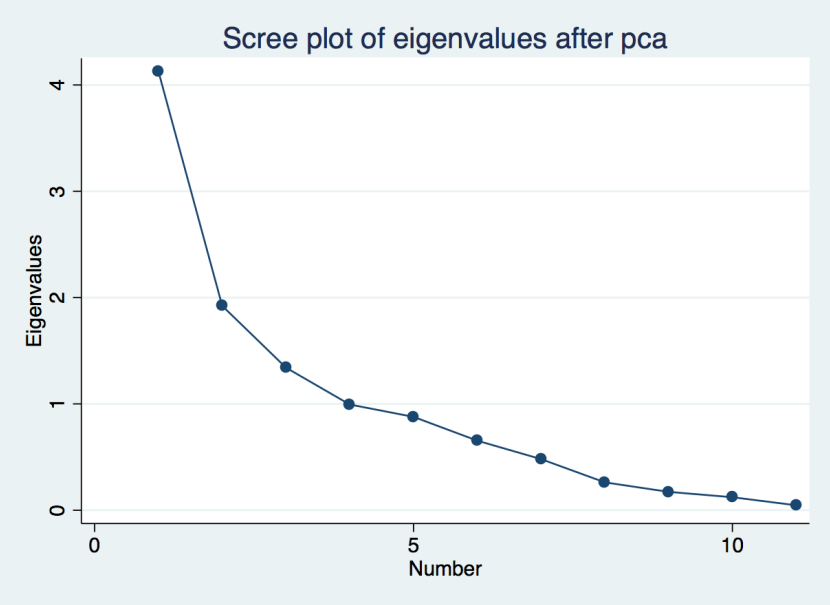

Figure 4: **Screeplot for Eigenvalues**

income to subsistence level. Looking at the correlation matrix remaining suspects are women share and urban share. In order to exclude one of them I refer to Table A4 in Appendix and see that women share has high coefficients for the first two factors while urban share indicates importance only for the first one. Therefore I exclude urban share from my analysis.

After exclusion of four highly intercorrelated variables, namely population density, urban share, ratio of consumption income to subsistence level, and log of spending on law enforcement, I run another PPCA. Tables A5-A7 in Appendix provide the details for the remaining model with 7 variables whereby all components explain a reasonable portion of the variation. Figure 5 provides the relevant scree plot.

5 Estimation Results

After conducting the PPCA, I first estimate my fixed effects model on the remaining variables. The results are provided in Table 3. According to my estimation, women share positively affects total crime rates. This is in line with Glaeser and Sacerdote (1999) who show that number of female-headed households is the most important explanation behind urban crimes. Gender inequality in Kazakhstan is high, and this is an important factor

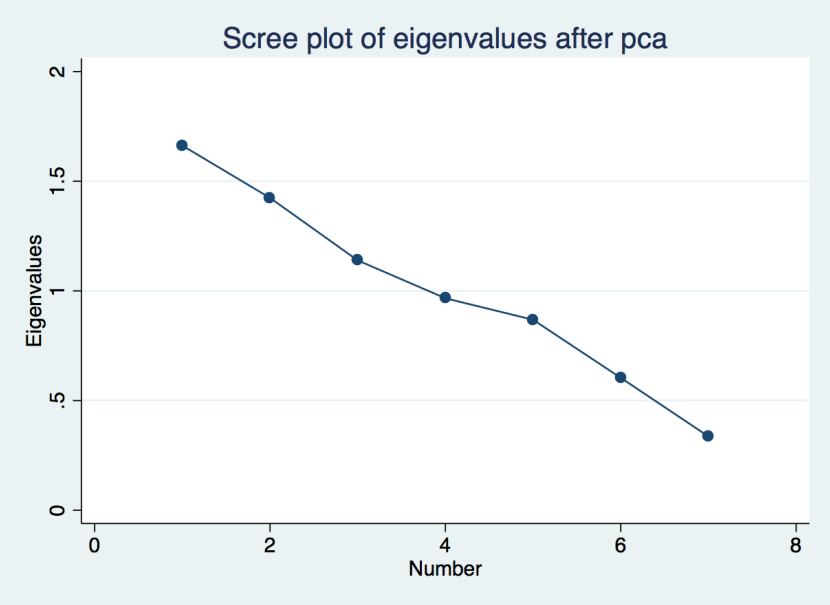

Figure 5: **Screeplot for Eigenvalues**

behind domestic violence. About a quarter of Kazakh women aged 18 and over experienced physical, psychological and sexual violence from their partners (Statistic Agency of Kazakhstan, Domestic violence report, 2016). On the other hand, Oaxaca et al. (2013) suggest that being a woman increases the chances to receive a shorter sentence. A similar conclusion is also documented by Mustard (2001). Becker's (1968) rule suggests that the decision to commit a crime is based on the costs and benefits. Women in this context have lower costs from committing a crime. There is no data available on crime commitment based on gender in Kazakhstan to check this hypothesis. However, this is a pressing topic for further research.

Results for unemployment indicate highly negative correlations with total and average gravity crimes whereas this effect disappears for grave crimes. This is in favor of the criminal opportunity hypothesis. The interaction terms between unemployment rate and age groups demonstrate that an increase in the shares of unemployed people aged 15-19 or 50-64 years old relative to reference group of 20-34 years old partly mitigates this negative correlation. However, it is exacerbated by the increase in the share of unemployed in the 65+ age group.

Looking at different age groups, an increase in number of children decreases total and average gravity crimes as expected since incidence of crime below age 14 is extremely low. There is evidence for juvenile crimes (aged 15-19) for both total and average gravity crimes

Table 3: Fixed effects model: estimation results

VARIABLES	(1) log(Total CR)	(2) log(Average grav CR)	(3) log(Grave CR)
women_share	0.317**	0.171	0.330
	(0.142)	(0.155)	(0.270)
Net_migr	-0.006	-0.015	0.021
	(0.017)	(0.018)	(0.032)
Unemployment	-3.489***	-4.986***	-2.681
	(1.097)	(1.194)	(2.081)
Unemp15_19	0.047***	0.070***	0.046
	(0.015)	(0.016)	(0.028)
Unemp35_49	0.048	0.063	0.011
	(0.039)	(0.043)	(0.074)
Unemp50_64	0.153***	0.207***	0.053
	(0.026)	(0.028)	(0.049)
Unemp65+	-0.069**	-0.075**	0.095
	(0.030)	(0.033)	(0.058)
Age0_14	-0.176**	-0.245***	-0.145
	(0.076)	(0.083)	(0.144)
Age15_19	0.110**	0.164***	0.138
	(0.046)	(0.050)	(0.088)
Age35_49	-0.221	-0.320	-0.184
	(0.241)	(0.262)	(0.457)
Age50_64	-0.775***	-1.028***	-0.123
	(0.130)	(0.142)	(0.247)
Age65+	0.273	0.312*	-0.360
	(0.166)	(0.181)	(0.315)
Gini	-1.372	-0.944	2.412
	(0.941)	(1.024)	(1.785)
Inflation	0.010	0.010	-0.005
	(0.015)	(0.016)	(0.028)
LFPR	-0.001	-0.004	0.001
	(0.007)	(0.008)	(0.014)
Log(GDP_per_cap)	0.143	0.054	-1.183***
	(0.151)	(0.164)	(0.286)
Year2008	-1.127***	-1.163***	0.258
	(0.262)	(0.285)	(0.496)
Year2009	-1.293***	-1.350***	0.303
	(0.259)	(0.282)	(0.491)
Year2010	-1.285***	-1.272***	0.241
	(0.210)	(0.228)	(0.397)
Year2011	-0.784***	-0.653***	0.584*
	(0.169)	(0.184)	(0.321)
Year2012	-0.415***	-0.222	0.428
	(0.142)	(0.154)	(0.269)
Year2013	-0.133	0.047	0.515**
	(0.118)	(0.128)	(0.224)

Table 3: Continued

	(1) log (Total CR)	(2) log (Average gravity CR)	(3) log(Grave CR)
Year2014	-0.132*	0.075	0.218
	(0.077)	(0.084)	(0.146)
Year2015	-0.070	-0.136	0.135
	(0.095)	(0.104)	(0.181)
Constant	2.711	17.371	11.630
	(10.491)	(11.417)	(19.901)
Adj R-squared	0.940	0.947	0.501

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(statistically significant at 1% level), which supports the findings of Oliver (2002). Also, share of age group of 50-64 years indicates a statistically significant negative sign. A possible explanation might be the deterioration of physical abilities with age which in turn implies a decrease in criminal activity. However, share of age group 65+ years indicate a significant positive sign for average gravity crimes, which is difficult to explain.

One percentage point increase in GDP per capita leads to 1% decrease in grave crimes. A higher GDP per capita is an indicator of higher production which implies increases in amount of available jobs and wages. Therefore, incentive to commit grave crimes decreases.

Year dummies for 2008-2012 compared to 2016 indicate negative statistical significance at 1% level for total and average gravity crimes. This might be related to the implementation of policies in 2011 making reporting crimes easier and more effective. For example victims can report incidents by text messages or online.

Controlling for a-weights by locality population, the estimation can be generalized for the whole country. The results are provided in Table 4. Firstly, women share in population significantly and positively affects not only total crime rate, but also average and grave crime rates.

In comparison with regional estimates, net internal migration indicates statistical significance with respect to grave crimes. If net internal migration increases by one percentage point, grave crime rate increases by 7%. One explanation for this might be the fact that labor competition in municipal cities is higher and migrants might commit crimes under

financial distress. Moreover, the probability of deterrence would be lower due to high population density. Another explanation might be committing a crime at a new place has a lower cost since reputation is not tarnished.

The effect of unemployment for the general estimates is similar with the locality level estimates for total and average gravity crimes except that unemployment at 65+ age group does not exacerbate its negative overall effect. For grave crimes, unemployment rate and share of unemployed people aged above 65 turns out to be significant (at 10% level). People who can not find a job might get involved in criminal organizations since they do not require education or experience, and award high income. Interaction terms for unemployment and age groups 35-49 and 50-64 years indicate negative influences; however, they only mitigate the overall positive effect of unemployment for grave crimes.

Share of age groups 0-14 and 50-64 years negatively correlate with total and average gravity crimes which is in line with the hypothesis stated above about children and elderly people. However, differently from regional level estimates, I observe a positive effect for share of age group 35-49 years and negative effects for shares of age groups of 15-19 and 65 years old on grave crimes. It might be connected with the fact that committing grave crimes requires physical strength.

A percentage point increase in inflation leads to a 3.3% increase in total crime rate. When inflation is high, goods and services become more expensive and less accessible. Therefore, people become more likely to commit little grave crimes like thefts.

Labor force participation rate and GDP per capita have negatively statistically significant estimates at 1% level for grave crimes. Higher rate of labor force participation and higher GDP per capita imply higher levels of production. With more opportunities in labor market, people might be less likely to commit grave crimes.

GDP per capita positively affects total crime rate at 10% significance level; however, it is not economically significant (A 10% increase in real GDP per capita decreases total crime rate by 0.5%).

Almost all year dummies have significant negative effects for total and average gravity crimes compared to year 2016. The same reasoning should hold with regional estimates.

Table 4: OLS: aweight

VARIABLES	(1) log(Total CR)	(2) log(Average grav CR)	(3) log(Grave CR)
Women_share	0.137***	0.137***	0.390***
	(0.034)	(0.040)	(0.060)
Net_migr	0.019	0.020	0.071**
	(0.020)	(0.024)	(0.036)
Unemployment	-2.059**	-2.645**	3.077*
	(0.988)	(1.159)	(1.739)
Unemp15_19	0.048***	0.061***	-0.015
	(0.012)	(0.014)	(0.022)
Unemp35_49	-0.027	-0.043	-0.139**
	(0.037)	(0.043)	(0.065)
Unemp50_64	0.112***	0.158***	-0.086*
	(0.029)	(0.034)	(0.051)
Unemp65+	0.024	0.026	0.170***
	(0.033)	(0.038)	(0.057)
Age0_14	-0.314***	-0.393***	0.076
	(0.071)	(0.084)	(0.126)
Age15_19	0.032	0.065	-0.207***
	(0.034)	(0.040)	(0.060)
Age35_49	0.210	0.309	0.678*
	(0.213)	(0.250)	(0.375)
Age50_64	-0.569***	-0.794***	0.408
	(0.147)	(0.173)	(0.259)
Age65+	-0.241	-0.263	-1.030***
	(0.174)	(0.204)	(0.306)
Gini	-0.531	-0.545	0.974
	(0.904)	(1.061)	(1.591)
Inflation	0.033*	0.035	-0.014
	(0.018)	(0.021)	(0.032)
LFPR	0.000	-0.000	-0.029***
	(0.005)	(0.006)	(0.008)
Log(GDP_per_cap)	0.059*	0.055	-0.259***
	(0.033)	(0.039)	(0.059)
Year2008	-1.511***	-1.752***	0.985**
	(0.227)	(0.266)	(0.399)
Year2009	-1.534***	-1.806***	0.969**
	(0.216)	(0.253)	(0.380)
Year2010	-1.509***	-1.704***	0.829***
	(0.172)	(0.202)	(0.302)
Year2011	-1.011***	-1.092***	1.028***
	(0.141)	(0.165)	(0.248)
Year2012	-0.570***	-0.548***	0.458**
	(0.121)	(0.142)	(0.212)
Year2013	-0.226**	-0.184	0.405**
	(0.109)	(0.128)	(0.193)

Table 4: Continued

VARIABLES	(1) log(Total CR)	(2) log(Average grav CR)	(3) log(Grave CR)
Year2014	-0.245***	-0.142	0.055
	(0.074)	(0.087)	(0.130)
Year2015	-0.265**	-0.393***	0.177
	(0.112)	(0.132)	(0.197)
Constant	8.894	11.265	-24.146**
	(6.051)	(7.101)	(10.650)
Adj R-squared	0.926	0.921	0.734

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

However, almost all year dummies for grave crimes are positively significant though decreasing over the time. This implies a structural decrease in grave crimes over the years.

Even after decreasing the dimensionality of the problem at hand via PPCA, I am still left with macroeconomic variables such as inflation, GDP per capita, and labor force participation rate, in addition to overall and age specific unemployment variables. Given very high estimates of R^2 and insignificance of some of these macroeconomic variables, I might still have an over-parametrization problem. In order to address this, dropping age specific unemployment variables, I follow a general-to-specific modelling approach and eliminate the most insignificant variables one-by-one in each consecutive estimation round. Eventually, I add back age specific unemployment variables to get my parsimonious model.

Starting with the locality level regression, labor force participation rate, net internal migration, Gini coefficient, and inflation rate are excluded sequentially to obtain my parsimonious model. The estimates are given in Table 5. I then conduct the same analysis for the generalized regression and drop labor force participation rate, Gini coefficient, and net internal migration sequentially. The estimates are given in Table 6.

Findings from the parsimonious model at the locality level and the country level are virtually the same with previous estimates given in Tables 3 and 4, respectively, except unemployment for the age group 50-64 years loses its significance for grave crimes.

Table 5: Fixed effects: parsimonious model

VARIABLES	(1) log(Total CR)	(2) log(Average grave CR)	(3) log(Grave CR)
Women_share	0.334**	0.194	0.300
	(0.140)	(0.153)	(0.266)
Unemployment	-3.485***	-5.090***	-2.603
	(1.081)	(1.175)	(2.049)
Unemp15_19	0.049***	0.071***	0.040
	(0.014)	(0.016)	(0.027)
Unemp35_49	0.042	0.064	0.020
	(0.038)	(0.041)	(0.072)
Unemp50_64	0.150***	0.204***	0.053
	(0.025)	(0.027)	(0.047)
Unemp65+	-0.054*	-0.064**	0.072
	(0.028)	(0.031)	(0.053)
Age0_14	-0.186**	-0.256***	-0.118
	(0.075)	(0.081)	(0.142)
Age15_19	0.115**	0.166***	0.132
	(0.045)	(0.049)	(0.085)
Age35_49	-0.201	-0.345	-0.203
	(0.232)	(0.253)	(0.440)
Age50_64	-0.760***	-1.013***	-0.131
	(0.126)	(0.137)	(0.239)
Age65+	0.200	0.263	-0.246
	(0.152)	(0.165)	(0.287)
Log(GDP_per_cap)	0.119	0.054	-1.171***
	(0.144)	(0.157)	(0.273)
Year2008	-1.171***	-1.170***	0.347
	(0.253)	(0.276)	(0.480)
Year2009	-1.316***	-1.345***	0.315
	(0.254)	(0.276)	(0.482)
Year2010	-1.297***	-1.264***	0.249
	(0.206)	(0.224)	(0.391)
Year2011	-0.812***	-0.665***	0.617*
	(0.166)	(0.180)	(0.314)
Year2012	-0.449***	-0.246*	0.454*
	(0.135)	(0.147)	(0.256)
Year2013	-0.170	0.014	0.535***
	(0.106)	(0.115)	(0.200)
Year2014	-0.144*	0.065	0.224
	(0.075)	(0.082)	(0.142)
Year2015	-0.026	-0.089	0.117
	(0.057)	(0.062)	(0.109)
Constant	2.763	17.043	4.851
	(10.162)	(11.048)	(19.261)
Adj R-squared	0.939	0.946	0.505

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6: OLS: aweight (parsimonious model)

VARIABLES	(1) log(Total CR)	(2) log(Average grave CR)	(3) log(Grave CR)
Women_share	0.138***	0.137***	0.366***
	(0.033)	(0.039)	(0.062)
Unemployment	-1.778*	-2.349**	4.078**
	(0.941)	(1.103)	(1.766)
Unemp15_19	0.046***	0.058***	-0.034
	(0.012)	(0.014)	(0.022)
Unemp35_49	-0.038	-0.053	-0.158**
	(0.035)	(0.041)	(0.066)
Unemp50_64	0.112***	0.157***	-0.061
	(0.028)	(0.033)	(0.053)
Unemp65	0.025	0.026	0.108*
	(0.031)	(0.036)	(0.058)
Age0_14	-0.302***	-0.380***	0.149
	(0.069)	(0.081)	(0.130)
Age15_19	0.021	0.053	-0.251***
	(0.032)	(0.038)	(0.060)
Age35_49	0.271	0.371	0.714*
	(0.203)	(0.238)	(0.381)
Age50_64	-0.567***	-0.794***	0.243
	(0.144)	(0.169)	(0.270)
Age65	-0.258	-0.276	-0.687**
	(0.163)	(0.192)	(0.307)
Inflation	0.030*	0.033	-0.008
	(0.018)	(0.021)	(0.033)
Log(GDP_per_cap)	0.063*	0.060	-0.238***
	(0.032)	(0.037)	(0.060)
Year2008	-1.514***	-1.755***	1.070**
	(0.225)	(0.263)	(0.422)
Year2009	-1.537***	-1.807***	1.005**
	(0.214)	(0.251)	(0.401)
Year2010	-1.505***	-1.700***	0.839***
	(0.170)	(0.199)	(0.319)
Year2011	-1.014***	-1.094***	1.040***
	(0.140)	(0.164)	(0.262)
Year2012	-0.576***	-0.555***	0.451**
	(0.119)	(0.140)	(0.224)
Year2013	-0.235**	-0.193	0.385*
	(0.108)	(0.127)	(0.203)
Year2014	-0.248***	-0.145*	0.057
	(0.073)	(0.085)	(0.137)

Table 6: Continued

VARIABLES	(1) log(Total CR)	(2) log(Average grav CR)	(3) log(Grave CR)
Year2015	-0.256**	-0.385***	0.132
	(0.111)	(0.130)	(0.208)
Constant	7.703	9.969	-29.306***
	(5.707)	(6.691)	(10.717)
Adj R-squared	0.927	0.923	0.702

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

6 Conclusion

Identifying the factors which have impact on crime rate is important for the economy of Kazakhstan as it can help develop and implement policies and programs targeted on combating crime. The current paper is the first empirical research on that topic in Kazakhstan.

Using the Committee on Statistics data, informational analytical system of the Ministry of National Economy, Taldau, and the information service of the Committee of Legal Statistics and Special Accounts, Qamqor, I estimate the influence of various macroeconomic and demographic indicators on different types of crime in Kazakhstan during the period 2008-2016.

The results of the polychoric principal component analysis showed that not all the determinants listed in the literature can be used in the context of Kazakhstan. Particularly, I exclude four variables: population density, urban population, ratio of consumption income to subsistence level, and spending on law enforcement.

Afterwards fixed effect models are utilized. At locality level the main factors affecting the crime rates are share of women, unemployment rate, age composition, GDP per capita, and year dummies. An increase in the share of women leads to higher rates of total crime. The effect of unemployment is negative to a greater extent with different signs for interaction terms with age mitigating or exacerbating this effect. Particularly, GDP per capita has a negative correlation with grave crimes. Significant estimates for the year dummies 2008-2013 show that some portion of the changes in crime rates are structural.

Controlling for a-weights generalize the findings for the whole Kazakhstan. My findings suggest that net migration and inflation have positive effects on grave crime. Unemployment rate is negatively correlated with total and average gravity crimes while the effect for grave crimes is estimated to be positive. Moreover, the influence of age groups 0-14 and 50-64 years on total and average gravity crimes are negative whereas age groups 15-19 and 65+ years indicate statistically significant negative signs. Also, age group 35-49 years positively influences grave crimes. GDP per capita have a small positive effect on total crime and is negatively correlated with grave crime. Almost all year dummies support the hypothesis that a significant reason behind current increase in crime rate in Kazakhstan is structural.

Utilizing general-to-specific method I check if my estimates suffer from over-parametrization problem in my analysis. Particularly, I drop age specific unemployment variables and step-by-step exclude least significant variables. Then I include age specific unemployment variables back into the model. The estimates from this parsimonious specification are virtually the same with my regular estimates, showing no evidence for over-parametrization.

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8 Appendix

Table A1: Prison Population Rates per 100 000 in Asia, 2007

Kazakhstan	366
Israel	313
Kyrgyzstan	283
Singapore	267
Thailand	253
Mongolia	250
Turkmenistan	224
Iran	222
Saudi Arabia	178
Lebanon	159
Tajikistan	149
Malaysia	147

Source: European Institute for Crime Prevention and Control, 2010

Table A3: Eigenvalues

k	Eigenvalues	Proportion explained	Cum. explained
1	4.275	0.389	0.389
2	1.803	0.164	0.553
3	1.333	0.121	0.674
4	0.993	0.090	0.764
5	0.895	0.081	0.845
6	0.637	0.058	0.903
7	0.526	0.048	0.951
8	0.206	0.019	0.970
9	0.172	0.016	0.985
10	0.121	0.011	0.996
11	0.039	0.004	1

Table A2: Polychoric Principal Component Analysis Correlation Matrix

	pop_dens	Women_share	Urban_share	Net_migr	Unemp	Gini	Inflation	LFPR	log(GDP_per_capita)	ratio_cnsm_sub	log(spnd_lw_enfr)
Pop_dens	1										
Women_share	0.520	1									
Urban_share	0.745	0.609	1								
Net_migr	0.576	0.116	0.634	1							
Unemployment	0.165	0.0414	0.0610	0.111	1						
Gini	0.0923	0.533	0.277	0.106	-0.0273	1					
Inflation	0.102	-0.00798	0.106	0.0663	-0.0932	0.0407	1				
LFPR	-0.302	-0.197	-0.251	-0.0396	-0.119	-0.111	-0.0119	1			
log(GDP_per_capita)	0.432	0.176	0.575	0.445	-0.161	-0.073	0.054	-.071	1		
ratio_cnsm_sub	0.426	0.621	0.588	0.324	-0.371	0.645	0.0392	-0.111	0.256	1	
log(spnd_lw_enfr)	0.612	0.331	0.819	0.565	0.0459	0.0227	0.102	-0.140	0.863	0.337	1

Table A4: Scoring Coefficients

Variable	Coeff. 1	Coeff. 2	Coeff. 3
Population density	0.392	-0.109	-0.213
Women share	0.317	0.384	-0.179
Urban share	0.455	-0.043	-0.052
Net migration	0.324	-0.239	0.004
Unemployment rate	-0.003	-0.197	-0.731
Gini coefficient	0.178	0.580	-0.059
Inflation	0.057	-0.031	0.213
Labor force participation rate	-0.136	-0.054	0.427
log(GDP per capita)	0.325	-0.342	0.302
Ratio of cons.income & subs.level	0.333	0.435	0.229
log(spend on law enforc.)	0.404	-0.310	0.104

Table A6: Eigenvalues

k	**Eigenvalues**	**Proportion explained**	**Cum. explained**
1	1.740	0.249	0.249
2	1.368	0.196	0.444
3	1.138	0.163	0.607
4	0.965	0.138	0.744
5	0.891	0.127	0.872
6	0.562	0.080	0.952
7	0.335	0.048	1

Table A7: Scoring Coefficients

Variable	**Coeff. 1**	**Coeff. 2**	**Coeff. 3**
Women_share	0.591	-0.291	0.119
Net migr	0.415	0.480	-0.282
Unemployment	0.033	-0.234	-0.750
Gini	0.497	-0.422	0.282
Inflation	0.085	0.188	0.409
LFPR	-0.296	0.182	0.310
log(GDP per capita)	0.369	0.619	-0.032

Table A5: Polychoric Principal Component Analysis Correlation Matrix

	Women share	**Net_migr**	**Unemp**	**Gini**	**Inflation**	**LFPR**	**log(GDP per cap)**
Women share	1						
Net_migr	0.116	1					
Unemployment	0.0414	0.111	1				
Gini	0.533	0.106	-0.0273	1			
Inflation	-0.00798	0.0663	-0.0932	0.0407	1		
LFPR	-0.197	-0.0396	-0.119	-0.111	-0.0119	1	
log(GDP per cap)	0 .176	0.446	-0.161	-0.073	0 .052	0. -0.071	1

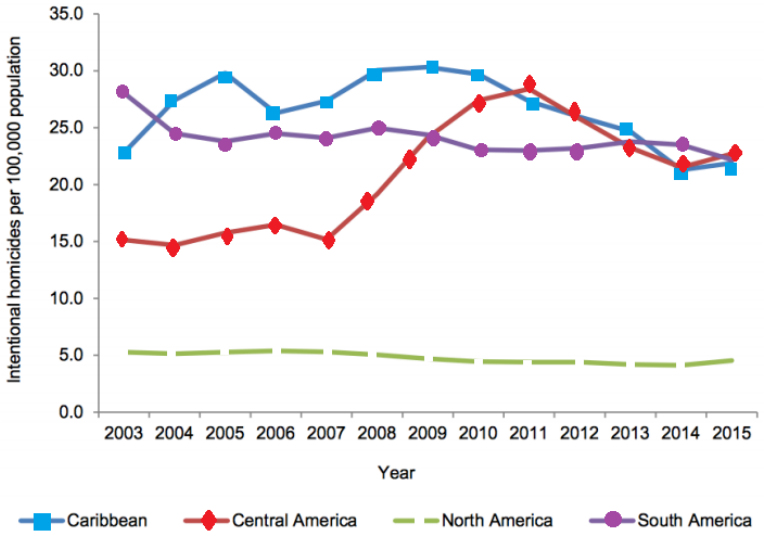

Figure A1: Intentional Homicide Rates in Americas, 2003-2015

Source: United Nations Office on Drugs and Crime (UNODC) Homicide Database

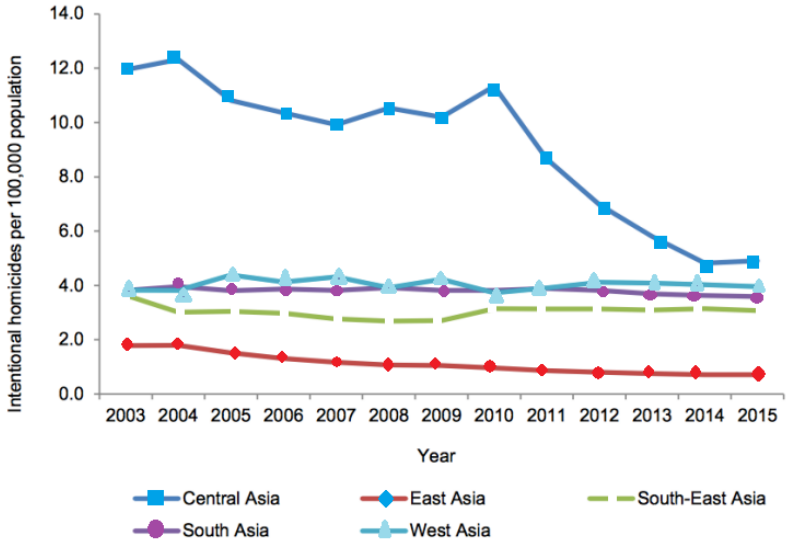

Figure A2: Intentional homicide rates in Asia, 2003-2015

Source: UNODC homicide database

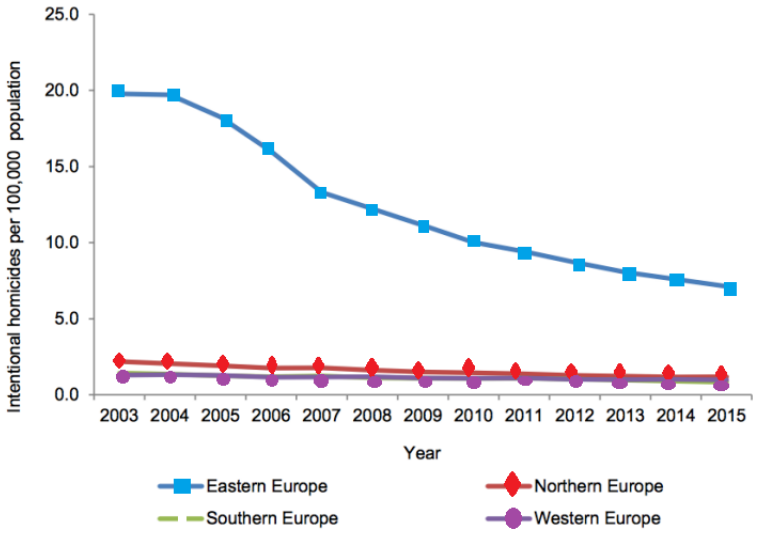

Figure A3: Intentional Homicide Rates in Europe, 2003-2015

Source: UNODC Homicide Database

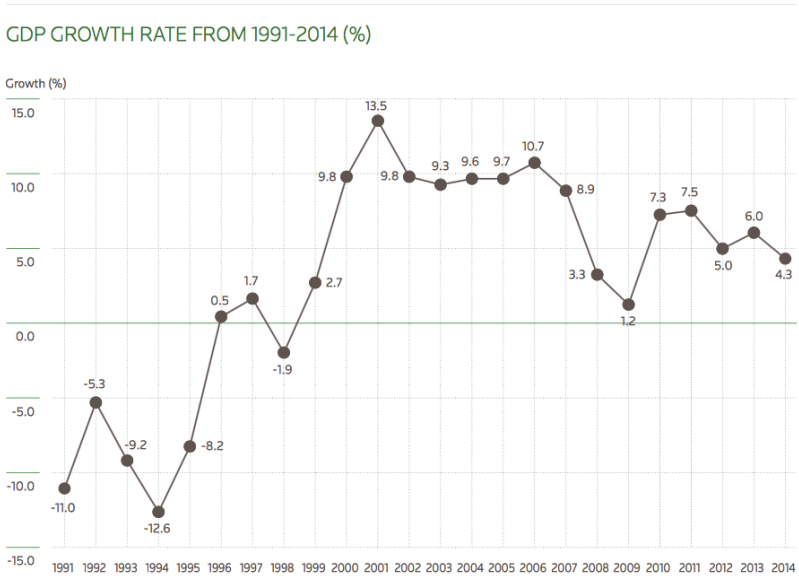

Figure A4: GDP Growth Rate in Kazakhstan, 1991-2014

Source: National Bank of Kazakhstan

Figure A5: Unemployment Rate in Kazakhstan, 1991-2017

Source: National Bank of Kazakhstan

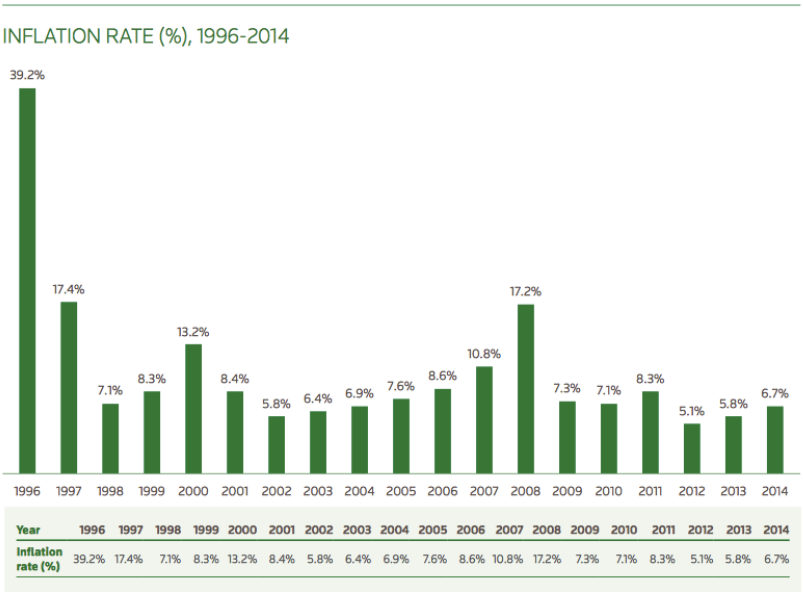

Figure A6: Inflation Rate in Kazakhstan, 1991-2014

Source: National Bank of Kazakhstan

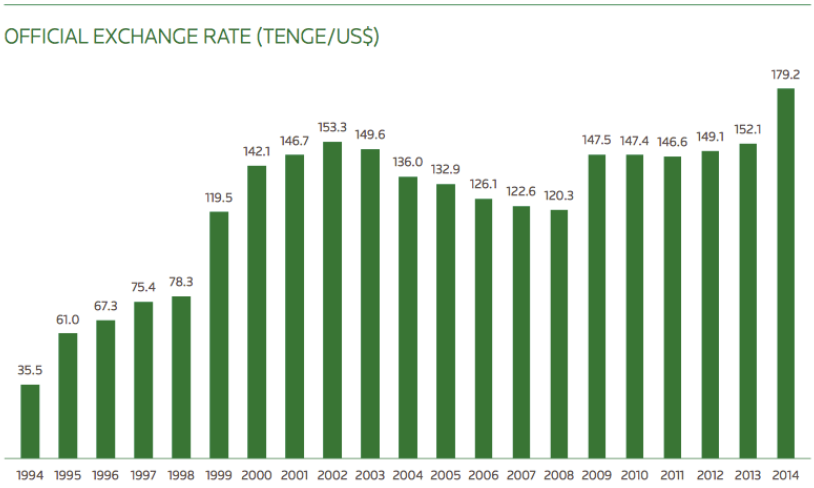

Figure A7: Exchange Rate in Kazakhstan, 1991-2014

Source: National Bank of Kazakhstan

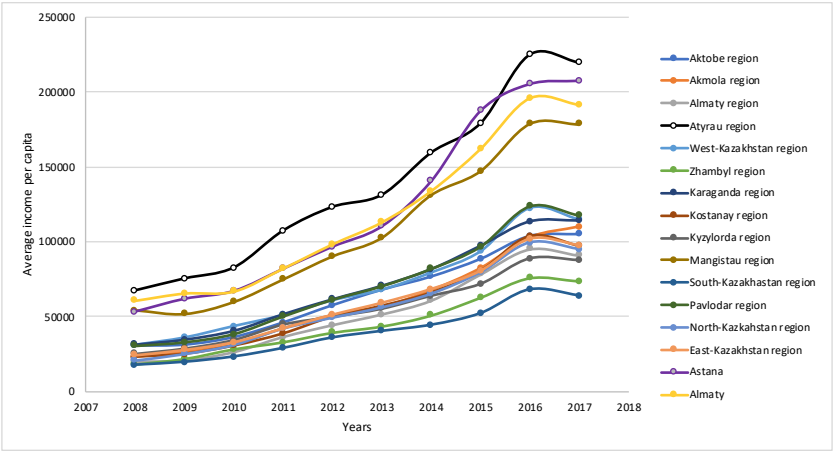

Figure A8: Real Average Income per Capita by Region (2010=100)

Source: The Committee on Statistics

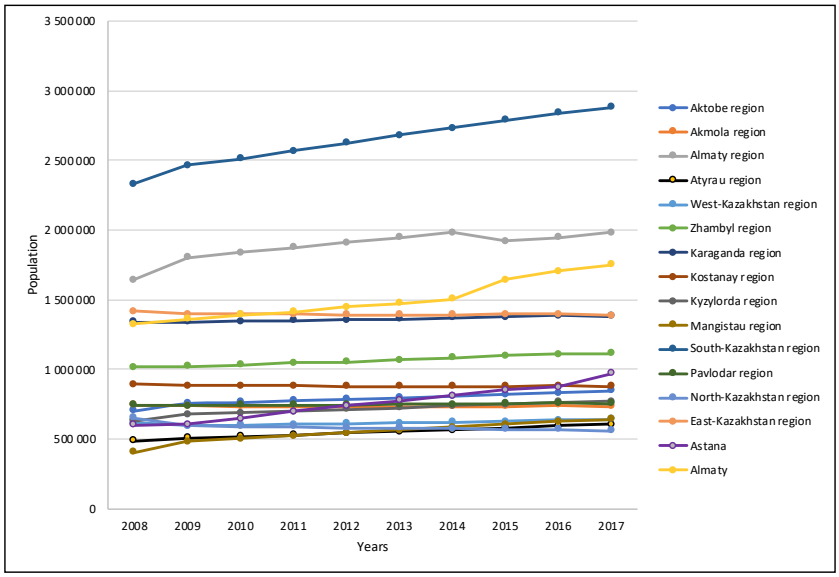

Figure A9: Regional Population Trends

Source: The Committee on Statistics

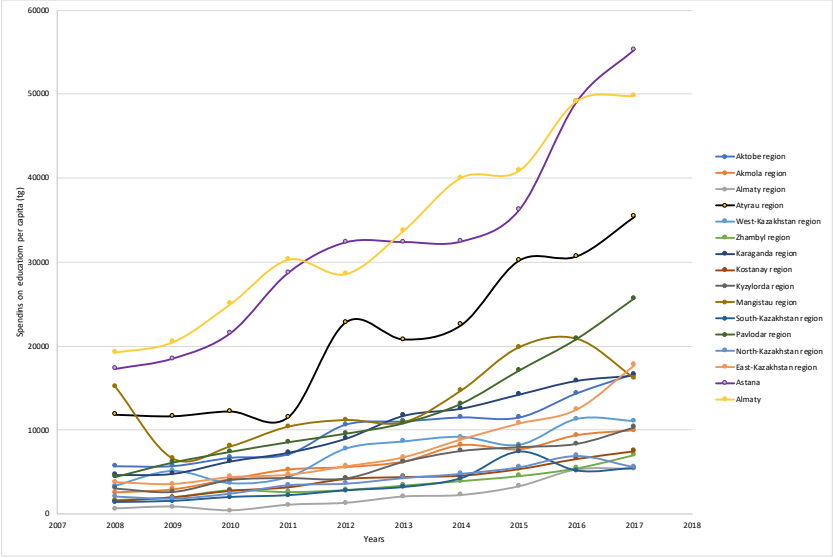

Figure A10: Real Spendings on Law Enforcement per Capita by Region (2010=100)

Source: The Committee on Statistics