Is Baltic Crime Economically Rational?

Jørgen Lauridsen

Abstract

The purpose of this study is to investigate whether crime in the Baltic countries is governed by economic rationality. According to a simple economic model of rational behaviour, it is expected that the propensity to commit criminal activities should be negatively related to the risk of deterrence. Potential presence of higher risk profiles for certain population segments (urban groups, males, foreigners, the unemployed, and low-income earners) are controlled for. Panel data aggregated to regional levels and observed annually for the years 2000 to 2005 are applied. Controls are applied for endogeneity among criminal activity level and risk of deterrence, intra-regional correlation, inter-temporal heterogeneity and spatial spillover. The expected negative effect of risk of deterrence on criminal activity is found for all countries, whereby the hypothesised economic rationality is confirmed.

JEL Classification: K42, C21, C23

Keywords: Crime, panel data, illegal activities, Baltic, spatial spillover

1. Introduction

The investigation of determinants of crime is important not only because of the serious nature of the problem in itself but also in terms of public policy implications (e.g. income, immigration, employment). The study by Becker (1968) represents a starting point on the economics of crime. His paper explains how changes in the probability and severity of punishment can alter the individual’s decision to commit crime. Later, Ehrlich (1973) extended the Becker model by considering how individuals divide their time between illegal and legal activities. If legal income opportunities are scarce relative to the potential benefits of crime, people allocate more time to illegal activities and crime is likely to occur. Since then, an extensive empirical literature has attempted to test the central results of the Becker-Ehrlich model for a number of countries. These studies have focused on Canada (Avio and Clarke, 1976), Finland (Wahlroos, 1981), the UK (Car-Hill and Stern, 1973; Wolpin, 1978), Australia (Whithers, 1984; Bodman and Maultby, 1999), the US (Trumbull, 1989; Cornwell and Trumbull, 1994; Baltagi, 2006), New Zealand (Small and Lewis, 1996; Papps and Winkelman, 1998), Italy (Marselli and Vannini, 1997; Buonanno and Leonida, 2006), Sweden (Sandelin and Skogh, 1986), Germany (Entorf and Spengler, 2000), and Norway (Aasness et al., 1994). This formal literature estimates the supply of crime employing different types of data set

---

1Professor, PhD
Institute of Public Health – Health Economics
University of Southern Denmark
Campusvej 55
DK-5230 Odense M
E-mail jtl@sam.sdu.dk
(aggregate data, cross-sectional data, and panel data) where the crime rate is related to some
deterrence as well as socio-economic and demographic variables. So far, the empirical literature
has provided mixed evidence; see Eide (2000) for a review. More recently, some papers have
addressed the importance of controlling for other socio-economic factors in criminal behaviour,
such as drug abuse (Entorf and Winker, 2001), guns possession (Miron, 2001), juvenile
delinquency (Mocan and Rees, 1999), income inequality (Fajnzylber et al., 2002), immigration
(Butcher and Piehl, 1998), social capital (Dilulio, 1996), and minimum wages (Hansen and
Machin, 2003).

The present study examines the determinants of crime rates in each Baltic country based on data
aggregated to regional levels for a number of regions during the period 2000 to 2005. Data were
collected from the national statistical agencies of each country. Certainly, data availability at the
regional level and variations in definition put some restrictions on the set of determinants which
could be included. The study thus includes the key variable risk of deterrence. Further, some
variables are included to control for varying risk profiles across certain population segments.
These are population density, percentage of males, wages, unemployment (except for Latvia),
and percentage of foreigners.

As pooled data are analysed in order to allow for more variability and to improve efficiency of
estimation, a Seemingly Unrelated Regression approach is called for in order to account for intra-
regional heterogeneity and inter-temporal correlation. Further, as data are observed at regional levels,
potential presence of spatial spillover has to be controlled for. Finally, potential endogeneity among
the risk of deterrence and crime rates are controlled using an instrumental variable estimation.

The study provides support for the hypothesised economic rationality of criminal activity.
Specifically, the expected negative impact of risk of deterrence is found for all three Baltic
countries, although the effect is not statistically significant for Lithuania.

2. Methodology

For each of the three countries, the point of departure is a linear regression model defined for
each year for the \(N\) regions of the country by

\[
y_t = X_t \beta + \nu_t, \quad \nu_t \sim N(0, \sigma^2 I)
\]

where \(X_t\) is an \(N\) by \(K\) dimensional matrix of \(K\) explanatory variables, \(y_t\) an \(N\) dimensional
vector of endogenous observations, and \(\beta\) a \(K\) dimensional coefficient vector. While pooled
data for \(T=6\) years are applied, the residuals between years are correlated, and the variances
within each year will vary across years, i.e. between any two years, the residual covariance
reads as

\[
E(\nu_t' \nu_s) = \sigma_k^2, \quad t,s = 1, \ldots, T.
\]

To obtain efficient estimates of \(\beta\), we apply the Feasible Generalised Least Squares (F-GLS)
estimation to obtain the Zellner (1962) Seemingly Unrelated Regression (SUR) estimates for \(\beta\).
As the model is estimated for each country using regional data, spatial dependencies between the regions of the country in question have to be taken into account. It is intuitively clear that crime is not restricted to realising itself within a single region, but rather flows over regional borders. Operationally, the crime rate ($y_t$) may not only be determined by explanatory variables in the region itself ($X_t$), but also by values of $X_t$ in the surrounding regions. Further, if criminal activity in surrounding municipalities is high, this activity may spill over and induce criminal activities in the municipality in question. As with any other omission of relevant variables, ignorance of spatial spillover may bias the results obtained (Anselin, 1988). Operationally, spatial spillover is specified as part of the residuals, thus obtaining the spatially autocorrelated (SAC) specification (Anselin, 1988).

$$y_t = X_t \beta + \varepsilon_t, \quad \varepsilon_t = \varepsilon \lambda W + \nu_t$$

where $\lambda$ is a parameter specifying the magnitude of spillover, formally restricted to the interval between (-1) and (+1), but for most practical purposes restricted to be non-negative, while $\varepsilon W$ denotes the average of $\varepsilon_t$ in the neighbouring regions. Combining the features of the SUR specification (1)-(2) with the SAC specification (3) leads to an integrated specification conveniently denoted the SAC-SUR.

Next, potential endogeneity among crime rate and risk of deterrence has to be accounted for. This is done by applying a two-stage least squares instrumentalisation. Specifically, the risk of deterrence is in a first step regressed on the lagged values of crime rates and predicted values of risk of deterrence obtained. In the second step, the above estimations are performed, replacing risk of deterrence with these predicted values.

Finally, to provide devices for comparison of alternative models, some quantities are applied. One is a pseudo-R-square ($R^2$), calculated as the square of the correlation between $y$ and its predicted values. A second device applied is the familiar Akaike Information Criterion (AIC) calculated as (-2LogL + 2K).

### 3. Data

Data on crime rates and explanatory variables were obtained at regional levels for each of the three Baltic countries from the national statistical agencies of the respective country. The regional division varied across the countries. In the case of Estonia, data were available at the county level for 15 counties, while they were available for Latvia at district level for 26 districts, and for Lithuania at the municipal level for 60 municipalities. All data were available for the years 2000 to 2005, with a few exceptions as described below.
Table 1. Definition of variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estonia</th>
<th>Latvia</th>
<th>Lithuania</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Crime rate</strong></td>
<td>Recorded criminal offences per 10,000</td>
<td>Recorded crimes per 10,000</td>
<td>Number of registered crimes per 10,000</td>
</tr>
<tr>
<td></td>
<td>inhabitants</td>
<td>in habitants</td>
<td>inhabitants</td>
</tr>
<tr>
<td><strong>Risk of deterrence</strong></td>
<td>Persons under prosecution for committed</td>
<td>Percentage of crimes</td>
<td>Number of police officers per 100,000</td>
</tr>
<tr>
<td></td>
<td>offence per 100 inhabitants</td>
<td>cleared up</td>
<td>in habitants</td>
</tr>
<tr>
<td><strong>Population density</strong></td>
<td>Inhabitants per square kilometre</td>
<td>Inhabitants per square kilometre</td>
<td>Inhabitants per square kilometre</td>
</tr>
<tr>
<td><strong>Percentage males</strong></td>
<td>Percentage of males</td>
<td>Percentage of males</td>
<td>Percentage of males</td>
</tr>
<tr>
<td><strong>Wage</strong></td>
<td>Average monthly net wage (EEK, 2000 prices)</td>
<td>Average monthly wages and salaries in public</td>
<td>Average monthly gross earnings (LTL, 2000 prices)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>sector (LVL, 2000 prices)</td>
<td></td>
</tr>
<tr>
<td><strong>Unemployment</strong></td>
<td>Unemployment rate</td>
<td>Not available at the regional level</td>
<td>Unemployment rate</td>
</tr>
<tr>
<td><strong>Foreigners</strong></td>
<td>Percentage of population who do not hold</td>
<td>Percentage of population who do not hold</td>
<td>Percentage of population who do not hold</td>
</tr>
<tr>
<td></td>
<td>Estonian citizenship</td>
<td>Latvian citizenship</td>
<td>Lithuanian citizenship</td>
</tr>
<tr>
<td><strong>Regional level</strong></td>
<td>15 counties</td>
<td>26 districts</td>
<td>60 municipalities</td>
</tr>
<tr>
<td><strong>Source</strong></td>
<td>Statistics Estonia: The Regional Development Database</td>
<td>Statistics Latvia: Annual Statistical Data</td>
<td>Statistics Lithuania: Regional Database</td>
</tr>
</tbody>
</table>

Note: Only available for population and housing census of 2001 – this figure is extrapolated to all years.

Table 1 provides definitions for the variables applied for each country. The crime rate was throughout available as recorded crimes per 10,000 inhabitants. Risk of deterrence was available in different definitions. In the case of Estonia, it was available as a percentage of the population under prosecution for committed offences, while it was available as a percentage of crimes cleared up in the case of Latvia, and as number of police officers per 100,000 inhabitants for Lithuania. Population density and percentage of males were available in similar form for all three countries. Wages were available at the regional level for all three countries, but in varying definitions. For Estonia, the average monthly net wage was available, while average monthly wages and salaries in the public sector were available for Latvia, and average monthly gross earnings for Lithuania. For each country, the measure of wages is deflated to the price level of 2000. The unemployment rate was available with the same definitions for Estonia and Lithuania, while it was unavailable at the regional level for Latvia and thus omitted from further analysis for that country. Finally, the percentage of population which is non-national was available for all regions by year in Estonia and Latvia, while it was only available at the regional level from a 2001 census for Lithuania. These 2001 figures were extrapolated to the entire period of 2000 to 2005.
4. Results

Empirical estimation of the SAC-SUR model (unadjusted for endogeneity between risk of deterrence and crime rate) for each of the three countries is provided in Table 2. Throughout, all variables (except the constant term and the time trend) enter estimation as logarithmic transformations. The results indicate that crime is negatively related to risk of deterrence for Estonia only, while the relationship is positive for Latvia and Lithuania.

Table 2. Estimated model for crime rate for each country, no instrumentalisation

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estonia</th>
<th>Latvia</th>
<th>Lithuania</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-2.919 (-2.02)**</td>
<td>-32.735 (-3.01)***</td>
<td>3.558 (3.20)***</td>
</tr>
<tr>
<td>Time trend</td>
<td>-0.543 (-3.81)***</td>
<td>-0.014 (-0.25)</td>
<td>-0.072 (-2.96)***</td>
</tr>
<tr>
<td>Risk of deterrence</td>
<td>-0.084 (-2.13)**</td>
<td>0.017 (0.23)</td>
<td>0.406 (4.31)***</td>
</tr>
<tr>
<td>Population density</td>
<td>-0.174 (-5.23)***</td>
<td>-0.065 (-0.54)</td>
<td>0.066 (2.81)***</td>
</tr>
<tr>
<td>Percentage males</td>
<td>0.040 (1.54)</td>
<td>9.045 (3.30)***</td>
<td>2.496 (3.01)***</td>
</tr>
<tr>
<td>Wage</td>
<td>0.959 (7.40)***</td>
<td>0.674 (2.86)***</td>
<td>0.159 (1.57)</td>
</tr>
<tr>
<td>Unemployment</td>
<td>0.021 (1.14)</td>
<td>NA</td>
<td>-0.022 (-0.54)</td>
</tr>
<tr>
<td>Foreigners</td>
<td>0.419 (18.94)***</td>
<td>0.092 (1.29)</td>
<td>0.009 (0.33)</td>
</tr>
<tr>
<td>Spatial spillover (λ)</td>
<td>0.399 (2.30)**</td>
<td>0.386 (2.56)***</td>
<td>0.216 (1.71)*</td>
</tr>
<tr>
<td>Number of observations</td>
<td>90</td>
<td>156</td>
<td>360</td>
</tr>
<tr>
<td>Log likelihood</td>
<td>177.12</td>
<td>226.86</td>
<td>489.38</td>
</tr>
<tr>
<td>AIC</td>
<td>-294.24</td>
<td>-395.73</td>
<td>-918.76</td>
</tr>
<tr>
<td>R-Square</td>
<td>0.692</td>
<td>0.226</td>
<td>0.204</td>
</tr>
</tbody>
</table>

Note: T-values in parentheses. Significance indicated by ***(1%), **(5%), and *(10%).

These results, however, may be sensitive to endogeneity bias. Therefore, Table 3 reports the estimates obtained when lagged crime rates are previously applied as instruments for risk of deterrence. When endogeneity is controlled for using this two-step procedure, the expected negative effect of risk of deterrence on crime rates is found to hold true for all three countries, although the effect is not significant at the 10 percent level for Lithuania. It should, however, be kept in mind that the definition of risk is different and potentially weaker for Lithuania, as the number of policemen is used as a measure for risk. Clearing up crime is only a part of the activity of the police force, so there are good reasons to assume that no systematic connection exists between size of police force and criminal activity.
Table 3. Estimated model for crime rate for each country. Risk of deterrence instrumentalised by lagged crime

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estonia</th>
<th>Latvia</th>
<th>Lithuania</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.948 (1.13)</td>
<td>-20.678 (-2.28)**</td>
<td>6.346 (4.99)***</td>
</tr>
<tr>
<td>Time trend</td>
<td>-0.628 (-5.04)***</td>
<td>-0.046 (-0.94)</td>
<td>-0.089 (-3.37)***</td>
</tr>
<tr>
<td>Risk of deterrence</td>
<td>-2.017 (-10.26)***</td>
<td>-0.649 (-4.21)***</td>
<td>-0.100 (-0.71)</td>
</tr>
<tr>
<td>Population density</td>
<td>-0.115 (-5.70)***</td>
<td>-0.063 (-0.63)</td>
<td>0.092 (3.88)***</td>
</tr>
<tr>
<td>Percentage males</td>
<td>0.064 (3.97)***</td>
<td>6.786 (2.96)***</td>
<td>2.277 (2.71)***</td>
</tr>
<tr>
<td>Wage</td>
<td>1.385 (21.08)***</td>
<td>0.545 (2.71)***</td>
<td>0.136 (1.34)</td>
</tr>
<tr>
<td>Unemployment</td>
<td>0.029 (3.01)***</td>
<td>NA</td>
<td>-0.051 (-1.20)</td>
</tr>
<tr>
<td>Foreigners</td>
<td>0.454 (36.72)***</td>
<td>0.077 (1.30)</td>
<td>0.023 (0.74)</td>
</tr>
<tr>
<td>Spatial spillover (λ)</td>
<td>0.481 (3.10)***</td>
<td>0.372 (2.30)***</td>
<td>0.221 (1.78)*</td>
</tr>
<tr>
<td>Number of observations</td>
<td>90</td>
<td>156</td>
<td>360</td>
</tr>
<tr>
<td>Log likelihood</td>
<td>183.37</td>
<td>228.42</td>
<td>481.99</td>
</tr>
<tr>
<td>AIC</td>
<td>-306.75</td>
<td>-398.84</td>
<td>-903.99</td>
</tr>
<tr>
<td>R-Square</td>
<td>0.570</td>
<td>0.403</td>
<td>0.160</td>
</tr>
</tbody>
</table>

Note: T-values in parentheses. Significance indicated by ***(1%), **(5%), and *(10%)

Next, Table 3 points to negative time trends in crime rates for all three countries (although not significant at the 10 percent level for Latvia). Clearly, these tendencies are highly desirable from a policy point of view. As both sides of the equation are in logarithmic transformations, the coefficients can be conveniently interpreted as follows: For Estonia, a one per cent increase in the risk of deterrence would be connected to a 2.0 per cent reduction in the crime rate. For Latvia, the corresponding reduction is 0.65 per cent. Thus, the effect of risk of deterrence seems to be largest in Estonia. Further, the table provides evidence regarding varying risk profiles across population segments. For Lithuania, the positive effect of population density indicates that the tendency to commit crime is higher among urban groups, as expected. On the other hand, negative relationships are obtained for Estonia and Latvia. A high percentage of males is, for all three countries, found to be positively related to crime rates, as expected. Wages are positively related to crime rates, thus indicating that crime is more likely in higher income regions. This is in accordance with the arguments of Ehrlich (1973) and Entorf and Spengler (2000) who pointed out that income may be a proxy for illegal income opportunity, while it contradicts the argument of Trumbull (1989) that high incomes should provide more opportunities for engaging in legal activities. Unemployment is, as expected and in accordance with the arguments of Entorf and Spengler (2000), positively related to crime rates for Estonia, while the relation is insignificant for Lithuania. In contrast to previous studies that focused on Europe (Entorf and Spengler, 2000), the proportion of foreigners is positively related to crime rates for all three countries, although the effect is significant for Estonia only. This seems to indicate that non-national population groups in the Baltic countries possess lower opportunities for legal income, i.e. their opportunity costs of committing criminal activities are smaller than the corresponding costs of the national group.

It should be noted that the reported coefficients can be interpreted as elasticities similar to the interpretation above regarding effect of risk of deterrence. For example, a one per cent increase in the average wage would be connected to a 1.39 per cent increase in the crime rate in Estonia,
while the corresponding connection is lower for Latvia (0.55 per cent) and presumably not
significantly different from 0 per cent at the 10 per cent level for Lithuania.

Finally, a positive spatial spillover is reported for all three countries, thus indicating that
criminal activity spills over across regional borderlines.

5. Conclusions

This study is consistent with the hypothesis that crime in the Baltic countries is governed by
economic rationality, i.e. that the propensity to commit criminal activities is negatively related
to the risk of deterrence. The expected negative effect of risk of deterrence on criminal activity
is found for all three Baltic countries, although the effect is not statistically significant for
Lithuania. However, it should be noted that the measure of risk is different and potentially
weaker for Lithuania.

However, the necessity of adjusting for endogeneity among risk of deterrence and criminal
activity is underlined, as an unadjusted specification leads to erratic conclusions in the form of
positive relationships for Latvia and Lithuania.

Finally, potential presence of higher risk profiles for certain population segments is controlled
for. These profiles correspond – by and large – to what is obtained by previous empirical studies
based on European data, with one single exception. Specifically, it is found that the proportion
of non-national inhabitants is positively related to crime rates. While this positive relationship
conflicts with previous empirical studies, it is well explained by fewer opportunities of legal
income for these groups and, consequently, a lower opportunity cost of committing crime.

References

Aasness J., Eide E., Skjerpen T., 1994. Criminometrics, latent variables, panel data and
of Economic Research, Canada.
Journal of Socio Economics 24: 884-901.


