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Law and Order Efficiency Measurement – A Literature Review

WORKING PAPERS

Law and order efficiency measurement – a literature review

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Abstract

This paper surveys the recent literature on law and order efficiency measurement. Law and order services include the services provided by the police, by the prison system and also by the judicial system ("the courts"). Key concepts prevalent in the efficiency measurement literature are presented. Decision making units most often found in the efficiency evaluation literature on law and order are charcterized. Inputs used by these units, and output measurement are examined and control and environment variables that explain or condition efficiency are dealt with. Methods of efficiency measurement are shortly presented. A synthesis of the main results and a short description of two important international databases on law and order are included.

Keywords: efficiency measurement, law and economics, government expenditures

**JEL classification:** D24, K40, H59

1. Introduction

This paper surveys the recent literature on law and order efficiency measurement. Law and order services include the services provided by the police, by the prison system and also by the judicial system ("the courts"). Efficient use of resources in providing law and order services is important in two different but complementary perspectives – because of their importance, and because they are essentially financed by the taxpayer.

Law and order is part of a civilised society, and the quality of the judicial system is likely to have an influence in economic growth (see Levine (1998)). As a public expense item, it is generally below education, health or defence. However, it is not an item unworthy of attention. Figure 1 shows that a part of it, expenditure with courts and legal aid, varies between 0.5 and 3 percent of public expenditure when European countries are considered.

Figure 1

Public expenditure on courts and legal aid as a percentage of the national budget
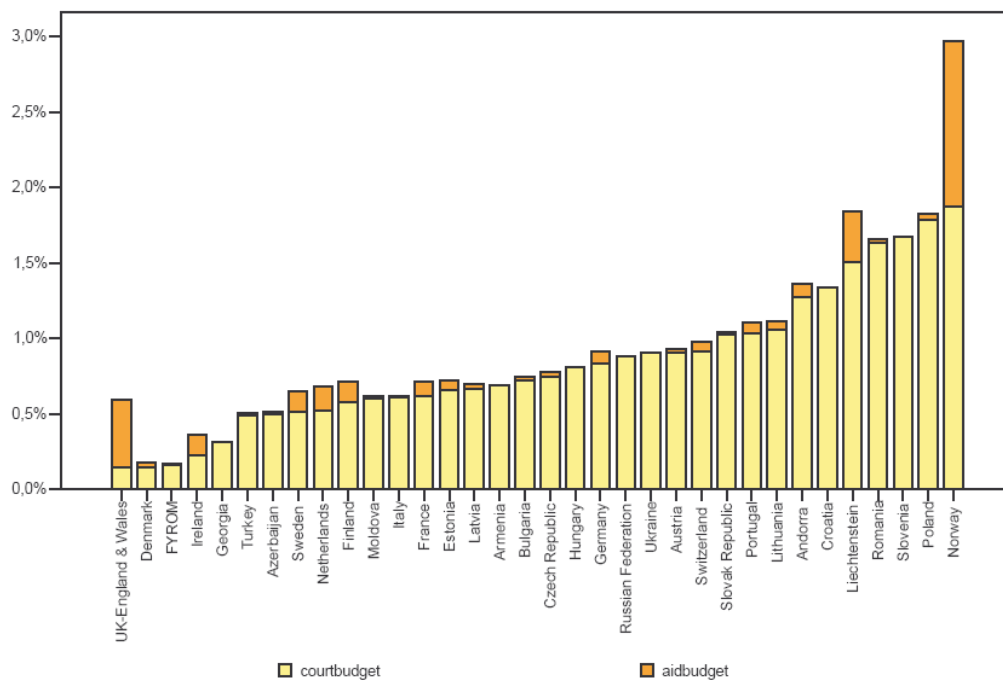
Source: CEPEJ (2002).

This survey is structured as follows. Section 2 presents some key concepts prevalent in the efficiency measurement literature. Section 3 characterises the decision making units most often found in the efficiency evaluation literature on law and order. Section 4 includes an examination of the inputs used by these units, and section 5 analyses output measurement. Section 6 deals with control and environment variables that explain or condition efficiency. Methods of efficiency measurement are shortly presented in section 7, and section 8 includes a synthesis of the main results. Section 9 presents the need for more international comparable data, and includes a short description of two important international databases on law and order. Conclusions are presented in section 10.

2. Some key concepts

A relatively small number of concepts is prevalent in the efficiency measurement literature, and they will be used several times in the following sections. So, it is convenient to provide some definitions of what is meant by a decision making unit, the inputs, the outputs, a production possibilities frontier, efficiency (and inefficiency) and non-discretionary factors.

Decision making unit (DMU). A decision making unit, or DMU, is the organisation that makes direct use of a number of resources in order to provide some services to third parties. The DMU has a degree of autonomy in what concerns the way it is internally organised and the effort it puts on goals achievement. In the law and order field, different DMUs have been considered in empirical studies of efficiency. Some examples are: the 43 autonomous police forces in England and Wales, by Thanassoulis (1996), or, and more to the justice side of the law and order system, the 9 German Labour Courts of Appeal, by Schneider (2005). In efficiency studies DMUs are usually compared to each other, so that some degree of homogeneity has to be observed. It is possible to consider whole national systems as DMUs. This has been done before in other fields, as education and health, by Afonso and St. Aubyn (2005a, 2005b, 2006). For the justice system, Djankov, La Porta, Lopez de Silanes, and Shleifer (2002) and Blank, van der Ende, van Hulst and Jagtenberg (2004) are international comparisons with countries as DMUs.

Inputs. Inputs are the resources used by a DMU in its activity. One may think in terms of a production function, such that, for instance, a police force offers a number of services using labour and capital goods. In the police example, "labour" would be both the labour provided by police officers and by other workers with the police, and capital goods would be the vehicles, weapons, buildings, and all equipment used by the forces. Note that in some studies inputs have been measured in financial terms, and sometimes the total expense of a DMU is the sole input considered. Other studies have included physical measures of the more important inputs. As a matter of fact, the way inputs are measured is an important issue to be discussed later.

Outputs. Measuring the production of any public activity is a difficult task, as most publicly provided services are nonmarket – this is clearly the case of the safety that is provided by a law and order system. Empirical studies on efficiency have relied on production proxies – variables that are supposedly correlated to an outcome that cannot be properly measured. Examples of output variables that have been considered in the law and order field are the number of cleared offences, the number of arrests done by the police, or the number of finished cases by a court.

Figure 1
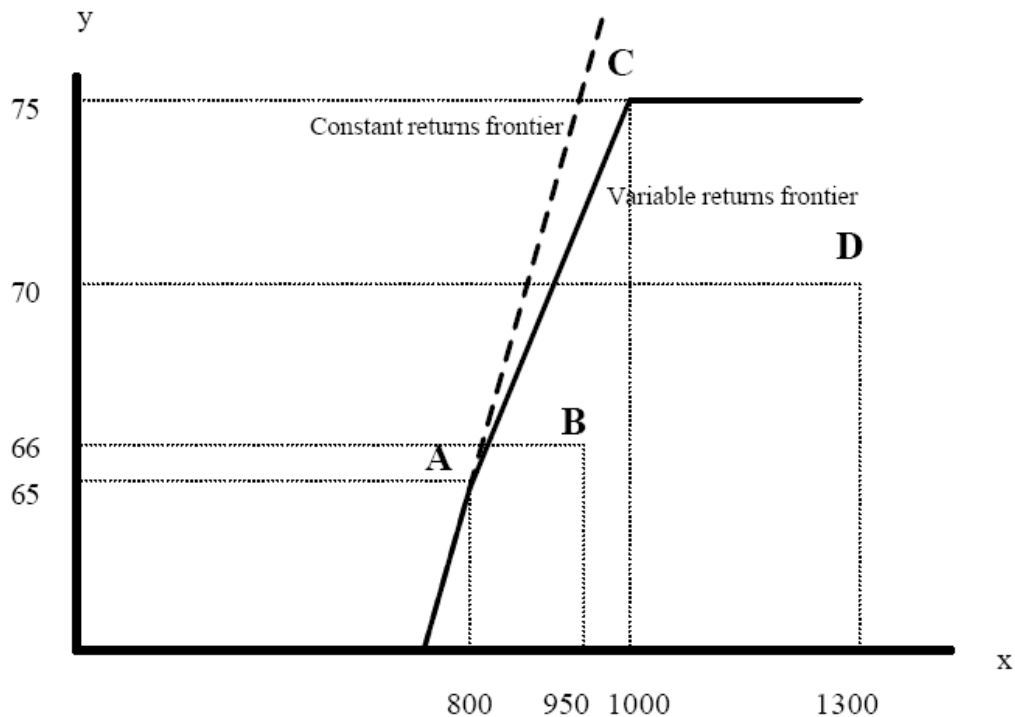
Production possibilities frontier. Although not all efficiency studies have considered this conception as such, it is a very convenient tool to convey the efficiency idea. Without losing any generality, it is easier to think in a one input – one output simplified framework. In figure 1, based on Afonso and St. Aubyn (2005b), x is the input, for example the number of police officers in a force, and y is the output, for example the number of arrests in a given period. A, B, C and D depict four DMUs – four police forces, in our example. Police force A arrested 65 criminals, employing 800 police officers. Police force C employed more policemen (1000) and arrested more criminals (75). if we assume variable returns to scale, then any linear combination of technologies used by A and C are available, and the *production possibilities frontier* passes through A and C. In fact, and unless constant returns are imposed, there are no reasons to think that DMUs A and C are not efficient[1]. Unit D, however, is not efficient, as it produces less than unit C with more inputs. Also, unit B is not efficient, as it is located below the production possibilities frontier.

Figure 2
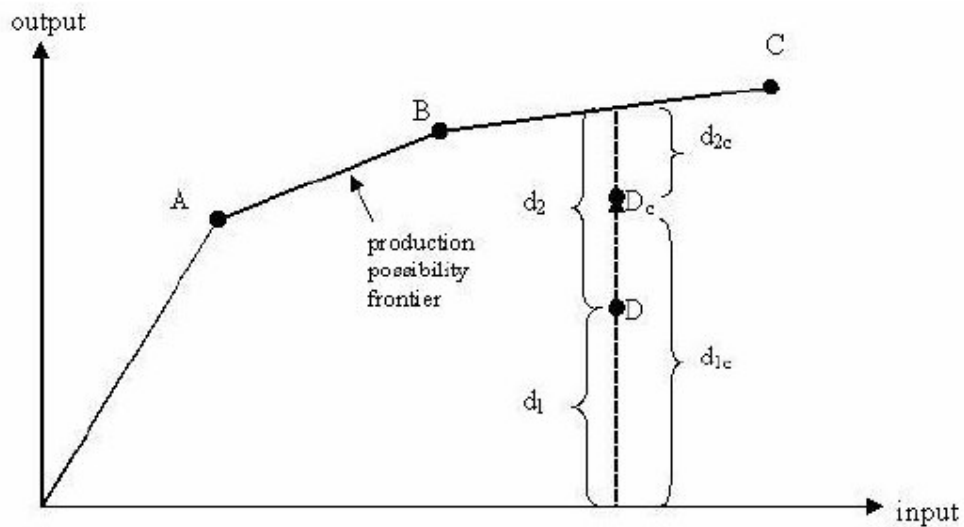
Efficiency. A DMU is deemed to be efficient if it is performing on the production possibilities frontier. It is inefficient otherwise, i. e., if it is operating under the frontier. If an estimate of the production frontier is available, then it is possible to measure the degree of inefficiency as the distance towards the frontier. In figure 2, borrowed from

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[1] Constant returns to scale would imply that production is strictly proportional to inputs used.

Afonso and St. Aubyn (2006), DMU *D* is not efficient, and a measure of its degree of inefficiency is given by $(d_1+d_2)/d_1$. This so called efficiency output score is higher than one, indicating that DMU *D* produces less than efficient output for a given input[2]. If an efficiency is measured this way, an efficient DMU scores 1, and an inefficient DMU scores more than 1.

Non-discretionary factors. For a given quantity of inputs, it is sensible to assume that the quantity of outputs supplied or attained by a DMU depends not only on its degree of efficiency but also on a number of factors that are not under its control. For example, it is possible that location factors affect the performance of a police force in comparison to other police forces in the same country. Sometimes these factors are called "environment factors" – a particularly adequate designation for completely exogenous determinants, like, for example, population density. Non-discretionary factors seems to be a more encompassing term, as some organisational characteristics could be considered as well under this heading.

3. What decision making units have been considered?

Studies differ in what concerns the way decision making units are considered. In some cases, the decision making unit is a country. The CEPEJ (2004) and Blank, van der Ende, van Hulst and Jagtenberg (2004). are attempts to compare several countries in what concerns the judicial system. However, by far the most common framework in the literature is the comparison of a number of police forces within a country or a region – see, for example, Carrington, Puthucheary and Rose (1997) for New South Wales in Australia, Diez-Ticio and Mancebon (2002) for Spain or Drake and Simper (2001, 2002, 2005) for England and Wales, just to cite a few. Gyimah-Brembong (2000) has dealt with the prisons sector. A few studies have dealt with the efficiency of courts within countries– see Beenstock and Haitovsky (2004) for Israeli courts, Pedraja-Chaparro and Salinas-Jiménez (1996) for Spanish tribunals and Schneider (2005) for German labour courts.

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[2] Note that a rather similar input score could be computed if the horizontal distance to the frontier is to be considered.

Researchers have tended to use essentially homogeneous DMUs, the reasoning being that detected differences in the relationship between inputs and outputs could be assigned either to unit inefficiency or to differences in the operating environment. If less homogeneous units are considered, as is surely the case when country systems are compared, then care should be taken of including in their study variables that characterise differences across units. In principle, these variables could be treated in the same way as environment variables. Djankov, La Porta, Lopez de Silanes and Shleifer (2002) can be seen as an example of this perspective, when they discriminate between civil and common law countries in order to explain differences in procedural formalism in the judiciary.

4. Measuring the inputs

In what concerns the police forces, the most widespread input used by researchers has been employment. Some measure of employment has been used by five of the seven studies mentioned in the appendix table. Other common used inputs are capital/equipment related ones – examples are the number of vehicles, or transport related costs, and also measures related to the premises used by the police. When courts are considered, the number of judges is a prevalent input, and sometimes the other staff as well.

Some researchers have also included the number of reported crimes (for the police) or the caseload (for the courts). Crimes or the caseload can be considered an input as far as these are the "raw material" the police or the courts transform into output – the output being solved crimes by the police or cases resolved by the judges.

Note that employment and some other inputs can be measured in either physical units, i.e, the number of persons (officers and other) that are employed by the forces, or else in financial terms (the total cost of each force's employed staff). When police forces to be compared are located in the same region, differences in pay probably are not substantially different. However, if this is not to be the case, special care should be taken, and this specially applies to studies with an international dimension. As a matter of fact, factor prices, and wages in particular, may be very different across countries. As shown by Afonso and St. Aubyn (2005a), countries may appear as efficient if resources

are measured in monetary terms but as not efficient if inputs are physically measured. This would be the case of countries where resources are cheaper, and their measured efficiency would be rather artificial.

5. Measuring the outputs

Measuring the output in public services is always a complex task, and it is probably more so in the law and order field. There are some indicators that have been preferred by a number of researchers – a list of output measures can be read in the appendix table, 4th column. Namely, and in what concerns the police, different types of crime clear up rates have been widely used as output measures. A clear up rate is essentially a ratio between offences committed and offences reported. In some cases, researchers have included the number of offences as an input. In that case, they do not consider a clear up ate as an output, but the total number of clearances instead. The clearance rate is a similar measure for the courts, a ratio between the number of cases adjudicated and the number of cases filed in a given period.

As far as the police is concerned, researchers have acknowledged that crime solving is only a part of police work. Examples of other variables that attempt to measure services provided by the police and present in the literature are: the kilometres travelled by police cars, the percentage of time officers spend patrolling or the number of drink drivers apprehended.

In what concerns the courts, some researchers have included measures related to the quality and timeliness of decisions. Namely, Schneider (2005) considered the number of confirmed and published decisions by a court, and Djankov, La Porta, Lopez de Silanes and Shleifer (2002) consider a measure of the expected duration of judicial proceedings in different countries.

6. Taking the environment into account and explaining inefficiency

The law and order output is likely to be influenced by what is sometimes called "the environment" where the decision making unit operates. Differences in the environment a unit faces contribute to different output levels, even under efficiency conditions. Alternatively, these differences may make it necessary for a unit to have more inputs in

order to achieve the required output. The environment is a restriction a unit has to deal with.

Recall figure 2. In that simplified one input - one output DMU D is operating in a non-efficient way, as point D is clearly below the production possibilities frontier, only producing a d_1 level of output. As pointed out before, DMU could, in principle produce more and still using the same level of input. If it increased its efficiency to the limit, it could provide an output as high as d_1+d_2, d_2 being therefore a measure of the output lost due to inefficiency. It is possible to conceive two quite different sources of inefficiency. One of them is the intrinsic unit inefficiency – this could be due to organisational failures, to lack of motivation, to unaccounted for technological failures, etc. The other one is the possible environment harshness that unit D faces. Suppose the unit D is a police force in action in a neighbourhood where crime is particularly acute due to demographic and social reasons (e. g. poverty, social deprivation, high school drop out rates). One could sensibly expect a smaller output for that police force, when compared to a similar one, using the same means, but operating in a more advantaged area. In the figure, one assumes that output of unit D could be corrected from D to D_c - D_c would be the level of services provided if the environment was a normal one. Intrinsic inefficiency is then to be measured by the distance D_c, or, in more precise terms, by the inefficiency coefficient $(d_{1c}+d_{2c})/d_{1c}$.

It is important to note that some studies have included control variables that explain inefficiency but that are not environment variables in the sense given below. They are usually related to some specific DMU qualities - for example, staff qualification. In terms of figure 2, these variables are meant to go further than environment variables. In fact, they provide an explanation for the distance D_c itself. To continue with our example, it could be the case that police force D was not found to be efficient because of environment factors and also because of, say, a less prepared staff.

In what concerns the law and order efficiency literature, the most common types of control variables taken into account were, as summarised in the appendix table:

     - social and demographic environment variables (for example: proportion of young people, government housing, population size, population density, proportion of lone parent households);

- regional environment variables, essentially related to DMU location (for example, the German state where a court is, as in Schneider (2005);

- control variables that are associated to the characterization of each DMU to take into account different types of heterogeneity. This may include, in the courts case, the features of the cases dealt with, as in Ostrom, and Hanson (2000), a characterization of employment (e. g. number of judges as a percentage of total employees, age of judges, percentage of judges with a PhD, health care personnel per prisoner), some quality adjustment variables (e. g. number of appeals as a percentage of concluded cases, measures of corruption, consistency, honesty and fairness in judicial decisions) and, when international justice systems have been compared, the inherent character of the law system (e. g. civil vs. common law countries).

7. What methods have been used?

It is beyond the scope of this survey to enter into details about methods used by researchers. However, a brief account only of methods is included here[3].

Econometric Regressions. Some researchers have used simple, multiple, or vector regressions to study efficiency. Usually, the dependent variable is some measure of output. Beenstock and Haitovsky (2004) is an example, where the number of cases completed in a court is regressed on the number of judges, the number of cases lodged and the number of cases pending. Some efficiency inference is then made (for example, it is studied if an increased number of judges accounts for more cases completed).

Stochastic Frontier Analysis (SFA). In SFA, proper account is taken of the fact that some units are operating under the production possibilities frontier, like unit D in figure 2. Under this approach, the distance to the frontier can be due to two different reasons, namely, lack to optimize (inefficiency) and stochastic shocks[4].

Data Envelopment Analysis (DEA). DEA is a non-parametric deterministic method to infer a production possibilities frontier. In DEA this frontier is assumed to be convex and to "envelop" observations[5]. The distance to the frontier is usually assumed to be due

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[3] The more interested reader can refer to Lovell (2000) and to Coelli, Rao and Battese (2005).
[4] See Kumbhakar and Lovell (2003) for a full book on stochastic frontier analysis.
[5] The frontier drawn in figure 2 is a DEA generated variable returns to scale frontier.

to lack to optimize (inefficiency) and to other, unaccounted, factors. Examples of DEA applied to the law and order field include Drake and Simper (2001) and Pedraja-Chaparro and Salinas-Jiménez (1996).

Two Stage Data Envelopment Analysis (DEA).

The first stage of Two Stage DEA is simply to determine a DEA production possibilities frontier. In the second stage, the first stage efficiency scores are regressed in a number of explaining factors, which can describe the environment and include some control variables, sometimes called non-discretionary inputs, that is, inputs that are not under the control of the DMU. Schneider (2005) and Drake and Simper (2005) have applied two stage DEA, respectively to courts and to the police.

Cost minimization approach.

The cost approach usually starts from the assumption that a DMU may choose its inputs in order to minimize the cost of achieving a certain level of output. Inefficiency is then a distance to the cost minimization solution. See Gyimah-Brembong, K. (2000) and Grosskopf, Hayes and Hirschberg (1995) for applications of this framework.

8. The main results – a synthesis

The literature surveyed here covers a wide spectrum of decision units, and some studies conclusions are quite specific. However, there are some common features that can be summarised in the following points:

(i) Studies tend to focus on more or less homogenous decision making units. Usually, these are units that operate in the same country, or sometimes, in the same region of a country. There are several reasons for that to happen. First, it is more straightforward to compare units that share the same targets, the same organisation rules, the same type of equipment. Second, data are usually more available in comparable terms for those types of units. Thirdly, intra-national comparisons are of the interest of policy and decision makers, concerned of with an efficient allocation of public resources. However, there are some exceptions to this, and some international studies have been made, namely Blank, van der Ende and van Hulst Jagtenberg (2004) and Djankov, La Porta, Lopez de Silanes and Shleifer (2002).

(ii) Considering that the law and order sector includes both the courts and the police forces, it is a fact that literature on police forces efficiency is more voluminous – there are not many published papers on courts' efficiency.

(iii) Usually, studies tend to conclude that there are perceptible inefficiencies across units. Clearly, and from a public purse perspective, the same or an increased level of services could in principle be provided with less expense.

(iv) Efficiency is essentially a measured comparison of inputs to outputs. The fact that inefficiencies are usually detected calls for evaluation schemes that take into account not only outputs, but also resource usage, a point forcibly made by Drake and Simper (2005).

(v) When it comes to explaining why some units are more efficient than others, environment factors have to be taken into account. A number of studies have included these factors, and in a considerable proportion they have proved significant. These factors are either physical and geographical (e. g., the area to be covered by a police unit), social (e. g. proportion of lone parent households), or organisational (procedural aspects in a court).

(vi) The fact that there is a set of studies on law and order efficiency means there are already some more or less established input and output indicators, as previously discussed. Any study on this subject should therefore to incorporate previous knowledge on measurement issues already present in the literature.

9. Going further – the need for more data and for more international comparison

Almost all studies are restricted to a single country or to regions within a country. A very limited number of studies have already compared the law and order systems of different countries as a whole.

Blank, van der Ende, van Hulst and Jagtenberg (2004) have studied eleven countries (Austria, Belgium, Denmark, England/Wales, Finland, France, Germany, Italy, The

Netherlands, Poland and Sweden). They have not used any of the most common efficiency measurement methods, as the ones mentioned in section 7. They have restricted to the judicial system, and their database was not very complete. For example, they could only consider the number of judges and judiciary system expenditures as inputs, and their environment variables were also limited (see the appendix table).

Djankov, La Porta, Lopez de Silanes and Shleifer (2002) is also an international study on the judicial system. Again, and in methodological terms, this is not an efficiency study, albeit it carries some efficiency conclusions. Moreover, it is limited to an aspect of the judicial system - procedural formalism in dispute resolution.

Clearly, there is scope for an international study on the efficiency of the judicial system, in the same manner as the health or education systems have been considered[6]. In order to do this for OECD countries, one needs first to have a database of comparable international data, in what concerns the inputs, the outputs and the environment and other control variables.

There are two sources of comparable international data in the law and order field that deserve some analysis and from which some data can be obtained. These are the "United Nations Survey on Crime Trends and the Operations of Criminal Justice Systems" and the European Commission for the Efficiency of Justice (CEPEJ) survey. These are briefly analysed below.

<u>United Nations Survey on Crime Trends and the Operations of Criminal Justice Systems</u>

The United Nations Office on Drugs and Crime manages and publishes a periodic survey on crime and the criminal justice systems. Data is available online[7]. The last available survey (the eighth) contains data from 2001-2002. Respondent countries were:

Afghanistan, Albania, Algeria, Argentina, Australia, Austria, Azerbaijan, Belarus, Belgium, Canada, Chile, Costa Rica, Croatia, Cyprus, Czech Republic, Denmark, Ecuador, Egypt, El Salvador, England &

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[6] See Afonso and St. Aubyn (2006) for education and Afonso. and St. Aubyn (2005a, 2005b) for education and health in OECD countries.

Wales, Ethiopia, Finland, Germany, Holy See (Vatican City State), Hungary, Iceland, Italy, Japan, Jordan, Korea, Republic of, Kuwait, Latvia, Lithuania, Luxembourg, Maldives, Malta, Mexico, Moldova, Republic of, Morocco, Myanmar, Namibia, Nepal, Netherlands, New Zealand, Northern Ireland, Oman, Panama, Peru, Philippines, Poland, Portugal, Romania, Saudi Arabia, Scotland, Slovakia, Slovenia, South Africa, Sweden, Switzerland, Syrian Arab Republic, Tunisia, Turkey, United States of America, Uruguay and Venezuela.

There is thus no data for the following OECD countries: France, Greece, Ireland and Norway.

The variables included are the following:

1. Police personnel, by sex, and financial resources;
2. Crimes recorded in criminal (police) statistics, by type of crime including attempts to commit crimes;
3. Persons brought into initial formal contact with the police and/or criminal justice system by type of crime, where initial formal contact might include being suspected, arrested, cautioned etc.
4. Persons brought into formal contact with the criminal justice system, by sex and age group, where formal contact might include being suspected, arrested, cautioned etc.
5. Prosecution personnel, by sex, and financial resources;
6. Persons prosecuted, by type of crime;
7. Persons prosecuted, by sex and age group;
8. Judges, by status and sex, and financial resources, including in appeal courts;
9. Persons brought before the criminal courts;
10. Persons convicted in the criminal courts, by type of crime;
11. Persons convicted in the criminal courts, by sex and age group;
12. Adult prisons, penal institutions or correctional institutions;
13. Juvenile prisons, penal institutions or correctional institutions;
14. Staff of adult and juvenile prisons, penal institutions or correctional institutions, by sex, and financial resources;
15. Persons incarcerated, by category of incarceration, selected day;
16. Convicted prisoners, by sex and age group, selected day;
17. Adult prisoners: Average length of time actually served in prison, after conviction, by offenses
18. Persons on probation, by age group, selected day
19. Persons on conditional release / parole, by age group, selected day

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[7] See the UNODC site: www.unodc.org

<u>European Commission for the Efficiency of Justice (CEPEJ)</u>

The European Commission for the Efficiency of Justice was created in 2002 by the Council of Europe. It can be read from his website[8] that its tasks are:

- to analyse the results of the judicial systems

- to identify the difficulties they meet

- to define concrete ways to improve, on the one hand, the evaluation of their results, and, on the other hand, the functioning of these systems

- to provide assistance to member States, at their request

- to propose to the competent instances of the Council of Europe the fields where it would be desirable to elaborate a new legal instrument.

In 2002, CEPEJ has produced a collection of facts and figures about European Judicial Systems based on a survey conducted in 40 member countries. It is announced that a new evaluation report could be adopted by the CEPEJ in the course of 2006.

The following OECD countries were not considered, as they are not members of the Council of Europe: Australia, Canada, Korea, Mexico, New Zealand and the United States. Luxembourg did not reply to the survey.

Several variables are included across the following themes:

1. Public expenditure on courts and legal aid;
2. The judiciary and the courts
3. Court performance
4. Public prosecutors
5. Legal professionals

An international study on the efficiency of the judicial system for OECD countries could in principle be based on some variables to be collected from these two aforementioned studies, but some important data failures should be noted. First, some countries would be absent from the analysis, as they did not respond to the UN or do not belong to the Council of Europe. Second, some potentially important variables were not

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[8] See www.coe.int/T/E/Legal_Affairs/Legal_co-operation/Operation_of_justice/Efficiency_of_justice/

considered in any of the surveys, specially control or environment variables. Examples of these are:

  – police officers qualifications;

  – police officers job training;

  – police officers career advancement factors;

  – factors affecting police financing;

  – how court fees are determined;

  – management of the court system.

10. Conclusion

This paper surveyed the recent literature on law and order efficiency measurement. The most common decision making units studied in the literature are police forces in a country, but there are also some studies on courts and on prisons. Studies that include whole national systems as units are scarce.

The most frequent methods found in the literature imply the derivation of a production possibilities frontier. Inefficiency is than a distance to that frontier. More recent studies tend to consider not only inputs and outputs, but also a number of control or environmental factors.

The law and order efficiency literature suggests a number of variables generally used as inputs or outputs that could be, in principle, adopted in different frameworks (e.g., other countries or across countries).

Efficiency measurement methods available could be adopted to a law and order international study. However, and considering OECD countries, some potentially important data is not available from the more complete sources.

Appendix Table

A synthesis of some literature on law and order efficiency measurement

Publication	decision making unit	Inputs	Outputs	Environment or other control variables	Methods	Conclusions
Beenstock and Haitovsky (2004) International Review of Law and Economics	25 Israeli courts of three court systems annual data (ex: 1964 – 1995)	- cases lodged - cases pending - number of judges	- case completions	Not considered.	Econometric regressions	- for the same caseload judges complete more cases under pressure, and complete less when new judges are appointed.
Blank, van der Ende, van Hulst Jagtenberg (2004)	11 countries: Austria, Belgium , Denmark, England/Wales, Finland, France, Germany, Italy, The Netherlands, Poland, Sweden.	- judiciary system expenditures - number of judges	- number of cases concluded	- number of appeals as a percentage of concluded cases; - number of judges as a percentage of total employees; - average personnel costs per employee; - average duration of concluded cases.	- performance measures (e. g. concluded cases per employee); - graphical analysis of simple correlations	- "Performance measures reveal no clear picture" - "far-reaching conclusions about efficient judiciary systems are not possible" - "estimating the effects of various production process aspects on performance should preferably be analysed using disaggregated data, for example, at the district court level"

Carrington, Puthucheary and Rose (1997) Journal of Productivity Analysis	Police services in New South Wales	- police officers - civilian employees - police cars	- offenses - arrests - summons - major car accidents - kilometres travelled by police cars	- the proportion of young people that live in or visit a patrol - the proportion of government housing in a patrol -the location of a patrol	DEA	- police patrols could, on average, reduce input usage by 13.5 percent through better management, and by 6 percent if the patrols could be restructured to achieve the optimal scale. - differences in environment, such as location and socioeconomic factors, do not have a significant influence
Cherchye, De Borger and van Puyenbroeck (2005)	546 Belgian municipal police forces, 2000.	- local traffic accidents - non-violent property crimes and extortion - violent crimes - all other reported crimes	- labour allocated to community policing, intervention squads, victim aid, criminal investigation, and administrative/managerial services. - the total hours per week that the local police unit could be contacted	- State police personnel - population	Non-parametric model (allows to test whether an implicit procedure of cost minimization can rationalize outcomes)	-the cost minimization hypothesis is found to provide a good fit of the data; - aggregating the labour input over task specializations entails a significantly worse fit of the data.
Djankov, La Porta, Lopez de Silanes, and Shleifer (2002)	Cross section of 109 countries		- index of procedural formalism in dispute resolution	- civil vs. common law countries; - expected duration of judicial proceedings; - corruption, consistency, honesty and fairness in judicial decisions - access to justice.	- index constructed from survey; - econometric regressions.	-procedural formalism is generally associated with inferior outcomes; - procedural formalism is higher in civil law countries.

Diez-Ticio and Mancebon (2002) Applied Economics	Spanish police service (47 observations, 1995)	- number of police per 100 000 inh. - number of vehicles per 100 000 inh.	- property crime clear-up rate - violent crime clear-up rate	- inverse of population size	DEA	- decisive importance of submitting the main influences identified at theoretical level over the police production function to empirical testing - the analysis has also allowed some of the limitations encountered in other studies of the efficiency of public services which jointly carry out different activities on the basis of shared resources to be overcome. - marked differences in the performance of the police forces studied.
Drake and Simper (2001)	Policing in England and Wales 39 observations 1996/97 and 1997/98	- labour (total cost of staff); - premises related expenses; - transport related expenses; - capital financing costs and equipment associated costs.	-percentage of time officers spend patrolling; - crime clear up rate; - burglary clear up rate; - percentage success rate relative to target in answering emergency telephone calls; - total breathalyser tests	Not considered	DEA	- substantial diseconomies of scale - no significant rank correlation with Audit Commission performance measures

Drake and Simper (2002) Applied Economics	Policing in England and Wales	- labour (total cost of each force 's employed staff) - (premises costs)/population - transport costs	- cleared up crime rate - total number of traffic offenses dealt with; - total breathalyser tests		DEA SFA DFA	- the largest police size group displayed significant diseconomies of scale; - the smallest size group displayed significant economies of scale and relatively large scale inefficiencies attributable to increasing returns to scale; - there are considerable potential efficiency gains to be made in UK policing; - Both DFA and DEA produced very similar relative efficiency rankings.
Drake and Simper (2005) Contemporary Economic Policy	Policing in England and Wales 2001-2002	- number of burglaries - number of vehicle crimes - number of robberies - net budget revenue	- total offenses cleared - total days lost to sickness	- daytime population - relative daytime population - proportion of lone parent households -	two stage DEA	- omission of resource usage costs as an input can result in biases in relative efficiency measurement; - it is extremely important to adequately incorporate the impact of environmental variables; - the performance radar relative performance measures can produce misleading assessments of performance; - technical efficiency of the police under the production approach does have a significant and positive impact on the public's perception of whether the police are doing a good job.
Gyimah-Brembong, K. (2000).	Prisons in Florida, 1997/98	- labour - energy	- prison population - level of security	- health care personnel per prisoner - age of the prison - ratio of black inmates to black prison personnel	- cost function approach	- significant cost inefficiency is found

Grosskopf, Hayes, and Hirschberg (1995) Journal of Public Economics	Dallas Police Dept., 1981-1986	- employment police (officers, sergeants and civilians).	- Corrected arrest rate for auto thefts and murders (relationship between arrests and offenses reported);	- actual numbers of reported auto thefts and murders	- distance function	- results suggest that even wasteful bureaucrats may become more efficient when resources become strained.
Northwood, Hinchcliffe, Henderson and Rawnsley (2001)			Police: - number of hours spent on patrol - number of education programs delivered to community groups - number of events managed - number of emergency operations undertaken; - number of responses to calls for assistance - number of investigations (weighted by time spent and/or outcome) - number of cases presented to court -number of drink drivers apprehended & number of other tests conducted - number of red-light and speeding offenders caught, and number of other motorists tested - number of hours spent undertaking regulatory activities justice (courts) -The number of matters finalised; - The number of counselling sessions provided to clients			- Given the lack of suitable data available, it is recommended that the current input-based measure of police services output be retained. - data does not exist for some parts of the judicial sector. - existing does not include sufficient detail to allow differentiation between different case finalisation methods or case types within a court. - Further analysis, including a comparison between this experimental measure and its input-based counterpart, will be undertaken before determining whether the new measure should be adopted.

			of the family court or victims of crime.; - The number of court order enforcement cases processed.; - The number of transcripts provided to the public.; - The number of hours court libraries are open to the public.; - The number of educational products or publications produced by courts in the year. Prisons - total prisoner days			
Ostrom, and Hanson (2000)	nine US state trial court systems, 1994.		- number of days required to resolve each case	- Severity of charge at indictment - Procedural aspects - Manner of resolution - Defendant resources		- the combined influence of a most violent felony charge, the issuance of a bench warrant, pre-trial release on bond, and resolution by trial tended to produce a significant increase in the time to resolution in all courts studied; - the nine court systems handled their common caseloads with the same relative degree of timeliness.

Pedraja-Chaparro and Salinas-Jiménez (1996) Applied Economics	21 Spanish courts (administrative litigation division)	- judges - office staff	- cases resolved through full legal process ("sentencias") - other resolved cases		DEA	- The mean efficiency of the 21 courts is 0.77 (significant scope for improvement).

Schneider (2005) Eur. Journal of Law and Economics	German Labour Courts of Appeal	- judges
		- caseload
			- number of finished cases
			- confirmed decisions/published decisions
				- regional
				- share of PhD judges
				- judges with age 60+
					two stage DEA	- Judges' qualification and their career incentives influence the productivity and the confirmation rate of the courts
						- Two suggestions:
						  (i) to learn more about the promotion rules ("tournaments").
						  (ii) Influence activities (attempts by the contestants to influence promotion decisions are likely to affect legal outcomes and should therefore be examined..

Van Tulder, F.P. (2000)	148 Dutch municipal police departments (1983 and 1986)	Fixed budget	Fixed outputs: - number of recorded serious crimes; - number of other recorded crimes; - number of traffic accidents with personal injury; - number of cases of general assistance. Endogenous outputs: - solutions of serious crimes - solutions of cases of drunk driving; - solutions of other types of crime; - number of processed minor offenses		Revenue function approach	- Recorded crimes are more appropriately seen as an input; - There are economies and diseconomies of scale - Fighting more serious crime calls for larger units as compared to other activities.

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