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Drugs Prices and Systemic Violence: An Empirical Study

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Abstract This study proposes an empirical analysis of the relation between the prices of illegal drugs and the use of violence to administrate the markets of illegal drugs. The study hypothesizes that the prices of illegal drugs affect the level of violent crime, since changes in profitability of the drugs' markets affect the offenders' expected utility of using violence to operate in these markets. An increase (or decrease) in prices would raise (or reduce) the offenders' expected utility of making use of violence, for instance, to solve disputes over drugs, to conquer more market shares, to defend ones own market share, in short to make use of systemic violence (Goldstein, P.J. Journal of Drug Issues, 39:143–179, 1985). The study will analyze the relation between the dynamics of cocaine and heroin's prices and systemic violence in the United States of America and in Europe over two decades. The correlational and inferential analyses do support the hypothesis for certain offenders' profiles and certain murders' circumstances.

Keywords Drug prices · Offender's utility · Rational choice · Systemic violence

Introduction

Trafficking in illicit drugs remains the most lucrative criminal activity. According to a 2005 report of the *United Nations*, the value of the illegal drugs market is on the same scale in the global market as both meat and all types of cereals put together (UNODC 2005). The value of this market is uniquely determined by the high prices of illicit drugs at wholesale, retail and street level. The number of illegal drugs' consumers is by far less than the number of food consumers (UNODC 2005).

The involvement of illegal and criminal actors in such a valuable and profitable market explains the frequent use of violence. Goldstein explores the nexus between illegal drugs and violence in "*The Drug/Violence Nexus: a Tripartite Conceptual Framework*" (Goldstein 1985). According to this study, violence and drugs are related one to the other

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in three forms. Two of these forms of violence are operated by the consumers under withdrawal syndrome or seeking for resources to purchase drugs. The third form Goldstein identifies is the "systemic violence" which the author relates to the violent behaviour used by the drugs' suppliers for the administration of the market. This type of violence includes disputes over territory, homicides to enforce normative codes, violent retaliation, elimination of the informers, punishments for adulterated drugs, punishments for debts unsolved, disputes over drugs, violence related to social ecology of copping areas. In short all sort of violence operated by organized crime in the administration of the illegal market of drugs.

This paper applies the rational choice paradigm to the concept of systemic violence defined by Goldstein, and hypothesizes that systemic violence is somehow affected by the profitability of the illegal drugs' market. The market of illegal drugs is the greatest illegal market in the world and for its great part it is in the hands of organized criminals. It is imaginable that economical variations in this market have an impact on crime rate.

According to the rational choice theory, organized forms of crime, such as drugs' trafficking, is rational *par excellence*, since it is *"highly planned and organized, directed and committed by older, more determined offenders, usually with strong economic motivation"* (Clarke and Cornish 2002). The violence operated by such offenders is frequently finalized, directly or indirectly, to improve their welfare. The evaluation of benefits and costs remains in the perceptions of the author of the crime and will depend upon several factors, and *"the impact of monetary return on the crime level changes according to the age, intelligence and education."* (Becker 1968).

Hypothesis and Methodology of the Research

As argued by Clarke and Cornish (2002), this study starts from the strong assumption that drugs' traffickers are rational, thus they behave in terms of maximization of their utility. The hypothesis discussed in this paper is the price of illegal drugs, *rebus sic stantibus*, affects the level of violent crime, since changes in profitability of the drugs markets affect the expected utility of using violence to operate in these markets. The hypothesis is based on the neo-classical approach theorizing that the level of any crime is function of the expected utility, in monetary terms, deriving by the commission of that crime. As a consequence an increase (or decrease) of the prices could rise (or reduce) the utility of murdering, for instance, the counterpart in an illegal drug's transaction, in order to gain the entire money at stake, or to conquer more market shares in a competitive illegal market, in short to make use of what Paul J. Goldstein has defined as systemic violence:

> "…the traditionally aggressive patterns of interaction within the system of drugs distribution and use…1) Disputes over territory, 2) Homicides to enforce normative codes, 3) Violent retaliation, 4) Elimination of the informers, 5) Punishments for adulterated drugs, 6) Punishments for debts unsolved, 7) Disputes over drugs, 8) Violence related to social ecology of copping areas…" (J. Goldstein (1985) in "The Drug/Violence Nexus: a Tripartite Conceptual Framework", p. 149).

Assuming that the offender is a rational subject, according to Becker's *Crime and Punishment* model, the use of violence in the illegal drugs market occurs if it is adequately remunerated by the economic returns. Systemic violence will be committed only when the utility, in monetary terms, will reward the risk and costs of such crime. According to Becker, this behaviour is synthesized by the following equations:

$$O = O(p, f, u), \tag{1}$$

(Becker 1968),

$$u = pU(Y - f) + (1 - p)U(Y). \tag{2}$$

"O" indicates the offending rate, in this case systemic violence, "u" the offender's utility which is a function of the monetary returns "Y", "p" the risk of being arrested, and "f" the harm of the punishment.

Let's consider the rational choice-making process of a single (potential) offender facing the decision to commit or not a single action of systemic violence. The subject, being rational, will always seek to maximize his or her utility function, expressed by Eq. (2).

Hypothesis at Constant Risk

Assuming that ´f´ and ´p´ related with the commission of systemic violence remain constant, it is possible to imagine two possible contexts. The first context refers to a rational individual that in moment T has committed an act of systemic violence $O_{t,}$ related, for instance, to a drug transaction. From the commission O_t the offender received a marginal monetary return: $Y=Y_t$.

If in moment T+1 the price of the illegal drug rose, the same offender would receive greater marginal monetary returns connected to an act of systemic violence O_{t+1} related to a new drug transaction as compared to the moment T:

$$Y = Y_{T+1} \geq Y_T. \tag{3}$$

As a consequence of Eq. (3), the offender's utility in T+1 (u_{T+1}), will be greater or equal than that derived in T (u_T):

$$u = u_{T+1} \geq u_T > 0. \tag{4}$$

Under these conditions, aiming at maximizing Eq. (2), the trafficker will decide to commit O_{t+1}.

On the contrary, if in moment T+1 the price of the illegal drug decreased, the marginal monetary returns connected to any act of systemic violence would decrease:

$$Y_{T+1} < Y_T, \tag{5}$$

O_{t+1} will be committed only if the offender still finds it convenient to commit the crime instead of doing otherwise as expressed by the following:

$$u_{T+1} \leq u_T \; ; \; u_{T+1} > 0. \tag{6}$$

Let's now consider a second context, referring to a rational individual who in the moment T did not commit any act of systemic violence, even when he had the opportunity. If in moment T+1, the marginal monetary returns decreases, as in Eq. (5), *rebus sic stantibus* O_{T+1} will not be committed, since the utility connected will be negative:

$$u_{T+1} \leq u_T < 0. \tag{7}$$

Whereas, if in moment T+1 the marginal monetary returns increase, as in (3), then $u_{T+1} \geq u_{T,}$ and the offender may or may not commit the crime, based on whether the utility is $u_{T+1} > 0$, or < 0.

Thus when the offender's risks are constant, an increase (or decrease) of illegal drugs prices will increase (or decrease) the probability that a rational offender will make use of more violence in the administration of the market.

Hypothesis at Increasing Risk

The assumption that ´f´ and ´p´ remain constant might not be applicable in reality. It appears likely that the marginal risks related to a marginal act of systemic violence would differ from the risks connected to the previous act of violence. It would be reasonable to assume that the marginal probability of being arrested increases by increasing the number of acts of violence.

In such a situation, the rational offender faces a difficult choice between making use of violence when needed for effective administration of the market and the greater risk of being arrested if he or she made use of violence. Like in any trade off situation, the offender will have his or her personal structure of curves of indifference related to his utility function, Eq. (2) according to Becker.

Borrowing the concept of "indifference lines" from Micro-Economics, the utility function (2) could be represented Fig. 1. The horizontal axis represents the level of monetary returns derived by making use of violence. The vertical axis measures the level of risk connected with the activity of the drug dealer.

The shape and inclination of the indifference lines depend on the offender's preferences towards the use of violence, his or her attitude in taking or rejecting risk, and other factors such as income and education. The higher the utility function in the Cartesian space (U1, U2, U3…), the more the offender's utility is connected to it. Assuming that the offender is rational, he or she will always try to get to the higher curve, to achieve more utility.

Figures 2, 3 and 4 represent the rational offender's choices in the case of an increase in drug prices from T to T+1. More monetary return would be connected with the act of violence O_{T+1}. This change in prices will change the inclination of the line representing the frontier of the combination of risk and money accessible to the offender. The same amount of violence in T+1 will provide the offender with more monetary returns than in moment T. If in moment T, the offender was able to access a combination of risk and money included graphically within the area O-D-C, in T+1 the price increase would allow the offender to access more risk and money, represented in the graph by the area C-D-E. The offender will be able to access higher utility.

The level of violence operated by the offender under these new conditions will depend on his function of utility, hence graphically on the shape and inclination of the indifference curves. Figure 3, for instance, represents the extreme case of an offender totally adverse to

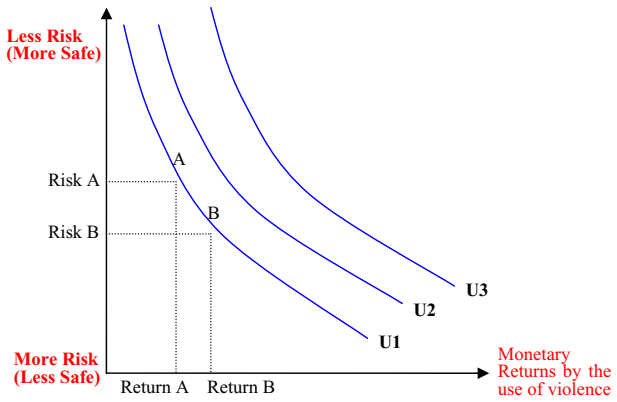

Fig. 1 Offender's indifference lines

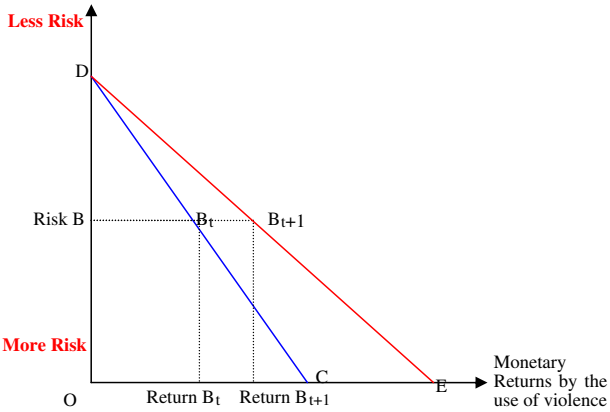

Fig. 2 Increase in price of illegal drugs

risk. This structure of indifference lines implies that the offender would prefer to limit the risk at a certain level, irrespective of the level of monetary returns. Under these circumstances, in T+1, this offender will take advantage of the price rise to reduce risk and enjoy the same level of monetary returns he enjoyed in T.

On the contrary, in Fig. 4, is represented the case of an offender that is extremely attracted by money and who is not concerned about the risk. The offender, in this extreme case, will find in the increase of prices, an incentive to use more violence. In this case, the increase of monetary returns will push the offender in T+1 to take much more risk than in T.

To conclude, in the context of increasing levels of repression equilibrated to the quantity of violence committed, an increase in profitability may or may not increase the level of violence, depending on the propensity of the offender to risk.

Methodology and Data

Correlational and inferential analyses are conducted on a time series of secondary data. According to Goldstein "*UCR data on homicide, due to the presence of the body, is the*

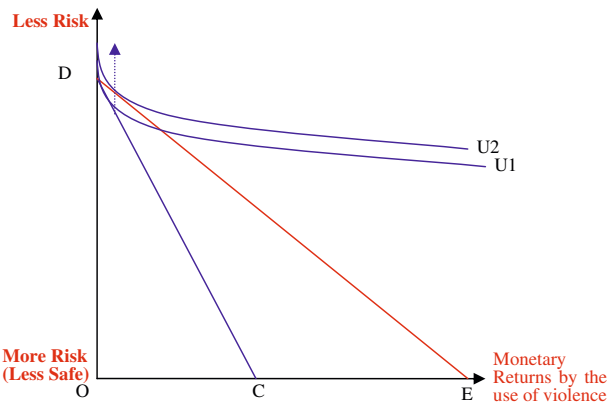

Fig. 3 Increase in drug prices for offenders adverse to risks

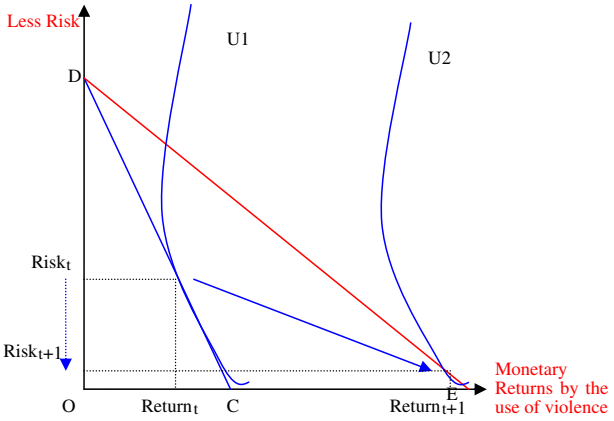

Fig. 4 Increase in drugs prices for offenders prone to risks

most reliable crime incidence category" (Goldstein 1985). Following Goldstein's suggestion, systemic violence will be approximated mainly by the use of official statistics on homicide rate and specifically "drug-related homicides".

In particular, the dependent variables used are time series of homicide rate in the United States of America from 1980 to 2000[1], and for drug-related homicides, the UCR data available for the years between 1987 and 2000. These variables are also disaggregated according to the profiles of the victims and offenders, circumstances of the murder, and geographical areas[2]. In Europe, the homicide rates used are those elaborated and published by the *European Sourcebook*, from the first to the third report, presenting the official records of intentional homicide rates for selected European countries from 1990 to 2003. In addition, the hypothesis was tested with specific reference to Italy. The data concerning the Italian homicides were made available by the Italian National Statistics Institute (ISTAT). Unfortunately, there are no time series records for drugs-related homicides in Europe.

The independent variables considered are prices of heroin and cocaine per pure gram[3]. Also these indicators are differentiated according to geographical areas and levels of distribution.

Different factors might intervene in the hypothesized relation between drugs prices and systemic violence. These factors could be theoretically unlimited. Here, three factors will be considered as likely intervenient, thus controlled during the analysis.

[1] The source of all this information is the FBI's Uniform Crime Reporting Program (UCR), published in a report conducted by the Bureau of Justice Statistics of the Office of Justice Programs from the U.S. Department of Justice. Fox and Zawitz (2004). http://www.ojp.usdoj.gov/bjs/homicide/homtrnd.htm#contents.

[2] Homicide rates at State level are published by the online database Bureau of Justice Statistics http://bjsdata.ojp.usdoj.gov/dataonline/Search/Homicide/Homicide.cfm.

[3] For further details concerning the USA please see the DEA website. http://www.dea.gov/foia/stride.html. Abt Associates, Inc (2001). The report is available online at < www.WhiteHouseDrugPolicy.gov >. For further details concerning Europe please consult the UNODC website: www.unodc.org, UNODC (2007), "World Drugs Report-2007".

The offender's risk of being arrested in connection with the commission of systemic violence is an intervenient factor. As discussed above, the hypothesis may or may not be confirmed when the risk is proportionate to the offending rates. This factor will be approximated by the variable *percentage of violent crime cleared by the police*[4]. Another intervening factor is *arrest rate* (Bureau of Justice Statistics). Arrests operated by the law enforcement agencies could cause a temporary vacuum or disequilibrium in the illegal market. In this context, different criminal groups would compete to fill this vacuum, hence the rise in violence. At the same time prices would rise due to the temporary shortage of supply in the market[5]. Other factors likely affecting the relation under hypothesis are of socio-economic nature. It is reasonable to think that crime rates and prices of drugs are affected simultaneously by the macroeconomic dynamics at country level. As a consequence the GDP pro capita will be controlled during the analysis.

All the results presented in the following sections, referring to the American data, have been derived by isolating these intervenient factors during the analysis. Information concerning these three factors were not available for Europe, thus the analysis for the European countries were conducted considering just the dependent and independent variables, and possible intervening factors were not taken into consideration.

Analysis-Results

Results at National Level

Strong and positive Pearson's coefficients are obtained between drug-related homicide rate and pure heroin prices. No significant results could be established between drug-related homicides and pure cocaine prices at any level (Fig. 5).

At the same time, the overall homicide rate is positively and significantly correlated with the price of pure heroin. The results for pure cocaine prices are either not significant or reject the hypothesis (Fig. 6).

The results are similar in Europe. At least for four European countries, Austria, France, Italy and The Netherlands, the correlation between heroin prices at street and wholesale levels, and intentional homicide rates are positive and strong, as Fig. 7 represents.

The following tables summarize the significant results of the correlations conducted between the prices of heroin and cocaine at different levels of distribution, drug-related homicide rate and homicide rate at country level (Tables 1 and 2).

Profiles of the Offenders and the Victims

Correlations have been conducted between prices of illegal drugs and US homicide rate related to offenders' and victims' specific characteristics. By comparing the resulting

[4] This variable measures the percentage of the violent crime, officially reported to the police that have been concluded with the arrest of the potential offender. Published by Fox and Zawitz (2004).

[5] Thanks to Prof. Jan Van Dijk for suggesting this passage of the analysis.

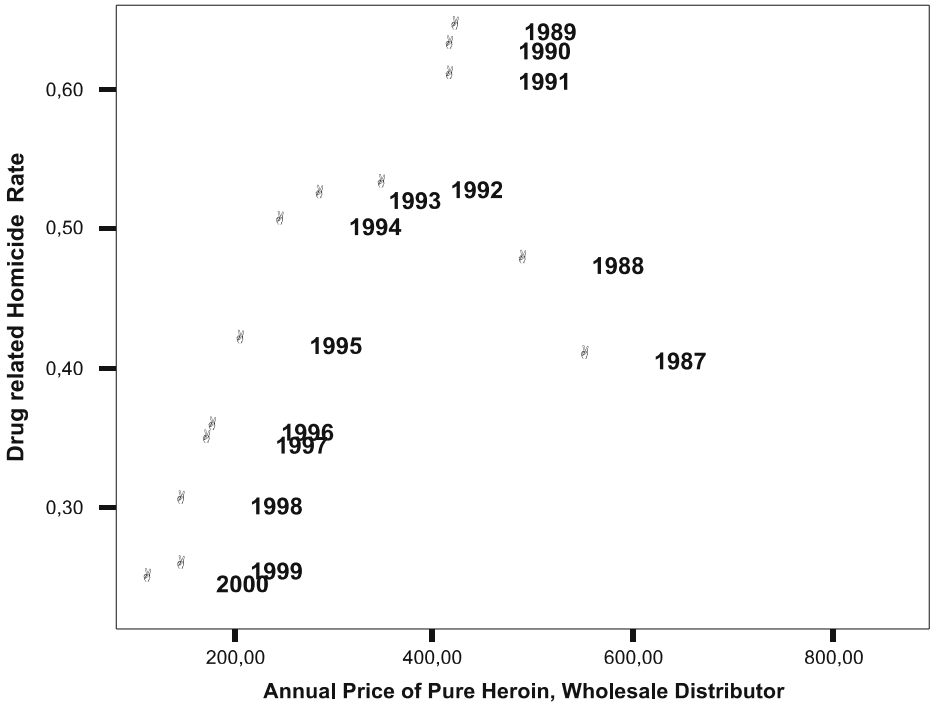

Fig. 5 Historical relation between pure heroin prices and drug-related homicide rate in the USA (1987–2000)

coefficients it is possible to understand which of these characteristics would or would not satisfy the hypothesis. This type of analysis could be conducted just with the American data, since there are no data as such for Europe.

Results show that homicide rate characterized by offenders' and victims' age between 25 and 34, of white and black ethnic background, and murders occurring in large cities (in particular above 1,000,000 inhabitants), are more strongly correlated with heroin prices.

Moreover, homicides committed without guns, and homicides recorded under the circumstances of "argument", "felony" and "unknown", as well as for circumstances defined as "others" and ethnic-mixed murders, are significantly and positively correlated with heroin prices.

A specific consideration has to be done on the age profile of the offenders satisfying or not the hypothesis of the study. Youngsters and gangs related homicides are not significantly correlated with the prices of illegal drugs, suggesting that illegal drugs may not be a relevant cause to use systemic violence for gangs. This result is supported by recent studies reporting that the involvement of gangs in the US market of illegal drugs is minimal. According to the *National Youth Gang Center*, only 34% of all US gangs (Papachristos 2005) are actually trading in illegal drugs. At the same time, it is possible that gangs and young peers, do not make use of violence rationally, or according to economic incentives. To confirm this, a possible reason behind the fact that the age category between 25 and 34 is more strongly reacting to the variation of the prices

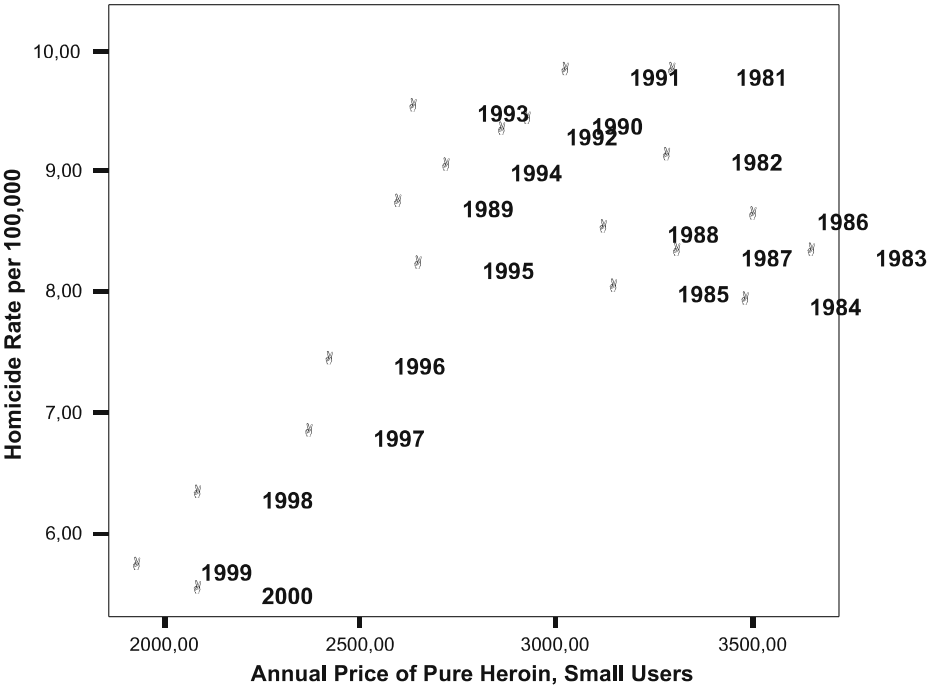

Fig. 6 Historical relation between heroin prices and homicide rate in the USA (1980–2000)

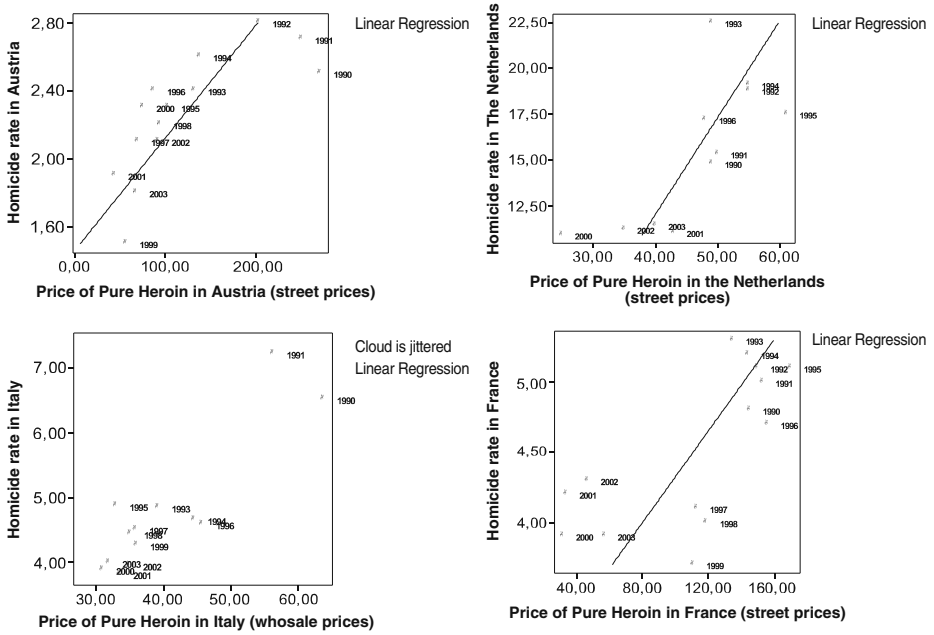

Fig. 7 Historical relation between heroin prices and homicide rate in Austria, The Netherlands, Italy and France (1990–2003)

Table 1 Correlation coefficients as a result of the statistical analysis applied at country level in the USA (in parenthesis the significance of the result)

	Heroin-small consumers, in USA	Heroin-large consumers, in USA	Heroin-mid level distribution, in USA	Heroin- wholesale distribution, in USA	Cocaine-small consumers, in USA	Cocaine-large consumers, in USA	Cocaine-mid level distribution, in USA	Cocaine- wholesale distribution, in USA
Drug Homicide rate in USA*			0.723 (0.012)	0.836 (0.001)				
Homicide rate in USA*		0.511 (0.036)	0.668 (0.06)					-0.510 (0.036)

*This result is derived by applying a partial correlation, controlling for GDP per capita at constant prices, arrests rate at country level, and the percentage of violent crime cleared by the police

Table 2 Correlation coefficients as a result of the statistical analysis applied at country level in Europe (in parenthesis the significance of the result)

	Heroin-street level in Austria	Heroin- wholesale distribution, in Austria	Heroin-street level in the Netherlands	Heroin- wholesale distribution, Netherlands	Heroin-street level in Italy	Heroin- wholesale distribution, in Italy	Heroin-street level in France	Heroin- wholesale distribution, in France
Intentional Homicide rate in Austria	0.755 (0.02)	0,.651 (0.012)						
Intentional Homicide rate in The Netherlands			0.736 (0.010)	0.461 (0.153)				
Intentional Homicide rate in Italy					0.688 (0.007)	0.677 (0.008)		
Intentional Homicide rate in France							0.706 (0.023)	0.600 (0.005)

could be found in the hypothesis of this research. Offenders below 25 years are normally highly risk taking, whereas offenders above 35 tend to reject risks. For both these two age categories, the impact of monetary return could be less important in the decision of committing a violent crime, compared to offenders between 25 and 34, who tend to balance more rationally the risk and the monetary return deriving from the use of it, hence the correlation between the offending of this age category and heroin's prices (Table 3).

Geographical Profile

The analysis confirms the correlation between heroin prices and homicide rate as significant, positive and strong at US country level. However, not all areas of the United States of America, as well as not all European countries follow this pattern. In particular, Pearson's coefficients support the hypothesis in just 16 US states. In the rest of the country the statistics are either not significant or reject the hypothesis. The 16 states where the hypothesis is supported, in *bold* and *italics* in Table 4, have the greatest concentration of the country's population, hence the result at country level. Similarly, the correlational analysis support the hypothesis for four European countries out of 13 where data was available. The four European countries where the hypothesis is supported, are in *bold* and *italics* in Table 6.

A possible explanation is that the relation is confirmed stronger where there is greater diffusion and concentration of illegal drugs. It is possible that in areas where there is a minor diffusion of illegal drugs, systemic violence is so rare that variations of systemic violence do not affect the general trend of homicide rate. On the contrary, where illegal drugs are extremely diffused, a variation in systemic violence determined by the variation in heroin prices will be strong enough to affect the entire trend of homicide rate. Another element that could justify why in some areas the statistics do confirm the hypothesis, and in some areas this is not supported by the results, is the specific role that organized crime plays in these specific regions or the phase of the drugs trafficking the area has in the overall supply chain.

Table 4 reports the ratio of heroin seized per 100 persons for each US state. The states with a greater ratio have a greater density of heroin as compared to the others.

In six of the nine states having a ratio above the country average, the Pearson's coefficients are supporting the hypothesis of this study. The scarce dimensions of the drugs' market easily justify the no-significance of the results for the majority of the states where the hypothesis is not confirmed.

Another element to notice is that all the states where the relation is confirmed are all areas at the border of the country, with the exception of Nebraska. Border states are necessarily transit for everything that is imported into the country, also illegal drugs.

Under this rationale according to a recent report[6] produced by the U.S. Government, heroin is imported into the United States of America from the different areas of the world mainly through four states, defined in this study as 'importation points'. The states are, in order of estimated quantity transiting, New York, Florida, California and Texas. Just 10% of the heroin is imported into the country transiting from other minor importation points. In relation with the hypothesis of this research it is important to notice that, in three of these

[6] Office of National Control Policy, "*What America's Users Spend on Illegal Drugs, 1988–1998*", December 2000.

Table 3 Correlation coefficients as a result of the statistical analysis applied at country level, related to circumstances of the homicides and profiles of the victims and the offenders*

	Heroin-small consumers, in USA	Heroin-large consumers, in USA	Heroin-mid level distribution, in USA	Heroin- wholesale distribution, in USA	Cocaine-small consumers, in USA	Cocaine-large consumers, in USA	Cocaine-mid level distribution, in USA	Cocaine- wholesale distribution, in USA
Homicides for felony with a gun in USA		0.4850 (0.049)	0.6073 (0.010)					
Homicides for felony without a gun in USA		0.5598 (0.019)	0.8522 (0.000)			-0.583 (0.014)	-0.779 (0.000)	-0.702 (0.002)
Homicides for argument with a gun in USA		0.496 (0.043)	0.530 (0.028)					
Homicides for argument without a gun in USA		0.701 (0.002)	0.882 (0.000)				-0.574 (0.016)	-0.589 (0.013)
Homicides in other circumstances with a gun in USA	-0.529 (0.029)		-0.630 (0.007)			0.601 (0.011)	0.502 (0.012)	0.626 (0.007)
Homicides in unknown circumstances without a gun in USA	0.481 (0.050)	0.501 (0.041)	0.820 (0.000)		-0.541 (0.025)	-0.692 (0.002)	-0.856 (0.000)	-0.785 (0.000)
Offending rate age 25–34 in USA		0.705 (0.002)	0.722 (0.001)	0.506 (0.038)				
Victimization rate age 25–34 in USA		0.635 (0.006)	0.816 (0.000)					

Just the significant results are reported (in parenthesis the significance of the result).

*The following results are derived by applying partial correlations, controlling for GDP per capita at constant prices, arrests rate at country level, and the percentage of violent crime cleared by the police.

Table 4 Quantity of heroin seized by the federal agencies per inhabitant in 2003, (States sorted in descending order)

State	Kilograms of heroin seized*	Population	Grams of heroin seized per 100 people
District of Columbia	33.80	528,759	6.39
Florida	445.10	17,397,161	2.55
New Jersey	157.90	8,503,294	1.85
New York State	350.70	19,227,088	1.82
Washington State	84.00	6,131,445	1.36
Texas	281.40	22,118,509	1.27
Louisiana	32.50	4,496,334	0.72
Tennessee	41.50	5,748,379	0.72
Wyoming	3.00	501,242	0.59
Country average	1690.78	289,233,568	0.58
Delaware	4.60	830,364	0.55
Illinois	48.30	12,713,634	0.37
Alaska	2.00	635,963	0.31
California	93.70	35,055,227	0.26
Maine	3.20	1,317,253	0.24
Minnesota	11.70	5,100,958	0.22
Maryland	10.70	5,558,058	0.19
New Mexico	3.10	1,838,277	0.16
Oregon	5.70	3,559,596	0.16
Georgia	11.50	8,581,489	0.13
Mississippi	3.40	2,902,966	0.11
Kentucky	4.70	4,117,827	0.11
Alabama	4.90	4,500,754	0.10
South Carolina	4.40	4,147,152	0.10
Massachusetts	6.80	6,416,505	0.10
Michigan	9.70	10,112,620	0.09
Hawaii	1.10	1,262,840	0.08
Missouri	4.00	5,586,114	0.07
Colorado	3.00	4,498,611	0.06
Connecticut	2.20	3,371,241	0.06
Utah	1.50	2,351,467	0.06
New Hampshire	0.80	1,287,678	0.06
Pennsylvania	7.38	11,922,023	0.06
Arizona	3.20	5,470,843	0.05
Rhode Island	0.50	1,076,164	0.04
North Carolina	3.10	8,541,221	0.03
Virginia	2.10	7,223,519	0.02
Wisconsin	1.30	5,316,215	0.02
Nevada	0.50	2,207,574	0.02
Kansas	0.50	2,735,502	0.018
Vermont	0.10	619,107	0.016
Ohio	1.00	11,435,798	0.008
Idaho	0.10	1,393,262	0.007
Indiana	0.10	6,058,930	0.0016
Arkansas	0.00	2,725,714	0
Iowa	0.00	2,851,165	0
Montana	0.00	926,865	0
Nebraska	0.00	1,747,214	0

Table 4 (continued)

State	Kilograms of heroin seized*	Population	Grams of heroin seized per 100 people
North Dakota	0.00	634,366	0
Oklahoma	0.00	3,412,202	0
South Dakota	0.00	770,883	0
West Virginia	0.00	1,766,196	0

*Data reported per State by the Office of National Control Policy http://www.whitehousedrugpolicy.gov/statelocal/index.html

four states the hypothesis is confirmed, and with a strong statistical result; Florida is the exception.

Table 5 reports the estimated amount of metric tons of heroin passing through the major importation points.

It is logical to think that importation points are more prone to systemic violence for several reasons, most importantly because the quantity of illegal drugs in these areas is much greater than in the rest of the country. The quantity of illegal drugs needed to "feed" the entire US market, the biggest in the world, is passing through four bottle necks, as a consequence in these four geographical areas the economic interests are much higher compared to other states. Moreover, 'importation' is a specific transaction phase of the illegal drugs market distribution, where different segments of the market, hence different criminal groups, are getting in contact to do business, for this reason it is possible to assume that there is more probability to have disputes over drugs. To conclude, it appears that the hypothesis is more strongly confirmed in areas where there is a greater circulation of illegal drugs, heroin in particular, and in those areas where illegal drugs are entering into the country. For states which recorded high seizures/population ratio, and where the hypothesis is rejected, such as Florida, a 'Buchanan effect'[7] cannot be excluded.

In Europe the scarcity of data availability does not allow for long time series, thus there is an objective limited probability to find significant statistical results. Nevertheless, when possible similar patterns have been found also in Europe, the hypothesis is confirmed for four countries out of 12 where data were available. All four countries are border countries, and in particular Austria was, during the 1990s, transit for heroin into Western Europe from the Balkan route. Italy was a transit point for heroin trafficked from Turkey and Albania, and the Netherlands was an important transit point for illicit drugs both by air and by sea. In addition, these three countries have a very high ratio heroin seized-population, among the top five in Western Europe. As a consequence, also in Europe, as in the USA, the geographical patterns of the relation between systemic violence and drugs prices is affected by the dimension and the structure of the market of the illicit drugs of the areas under consideration (Table 6).

When considering the Italian homicide data, the picture is getting more interesting. As reported above, the hypothesis is confirmed for the entire country. In addition, the

[7] Buchanan theorizes that, in areas where a monopolizing organized crime group has a well established power, a reduction of the violence and an increase of the prices in the illicit markets would be a result of such a monopolistic structure of the supply (Buchanan 1980).

Table 5 Estimated amount of heroin (Metric Tons) entering the United States by source areas and importation points, 1995–1998

Source areas for heroin imported in the USA	Importation points			
	California	*Florida*	*New York*	*Texas*
Mexico	2.0	0.0	0.0	0.5
South America	0.2	3.3	2.6	0.1
Southeast Asia	0.1	0.0	1.0	0.1
Southwest Asia	0.0	0.0	0.4	0.0
Unknown	0.1	0.5	0.3	0.1
TOTAL	2.4	3.8	4.2	0.7

hypothesis was tested at regional level by correlating the number of homicides recorded in each of the 21 Italian regions during the short period 1990–2002[8], and the price of heroin at wholesale distribution and small users distribution at country level. The results are presenting a situation very similar to the one registered in the United States of America and in Europe as a whole, with a vast area of the country where the hypothesis was not confirmed, and specific areas where the correlations were strong and positive to the point to impact the whole national results. As for the USA, also in Italy the regions where the hypothesis is confirmed are those where organized crime and trafficking in heroin have a specific importance. Sicily, Calabria and Puglia are all well known transit areas for illicit drugs' trafficking during the considered period, and also the only regions in Italy where the statistics support the hypothesis of this study, with a Pearson's coefficient ranging between 0.6 and 0.8.

Figure 8 reports the results for these key Italian regions. Unfortunately heroin seizures data were not available at regional level.

The following table summarizes the significant results of the correlations conducted between the prices of heroin and cocaine, the homicide rate according to geographical distribution across the United States of America (Table 7).

Analysis-Model

Inferential analyses have been conducted in order to calculate the impact of drug prices on homicide rate. Significant results of this analysis are reported in the following table (Table 8).

A model to predict the dependent variable in terms of heroin prices can be derived from Regression 4:

$$\ln(Hom - Rate) = 0.157^{*}\ln(H - Price) + 0.756^{*}\ln(Arrests) - 0.186^{*}\ln(GDPpc) - 1.46^{*}\ln(Viol - Crime\,Cleared) + 4.356. \quad (8)$$

[8] Italian data at regional level were available just for these years.

Table 6 Quantity of Heroin Seized by National Law Enforcement Agencies per inhabitant in 2001, (Countries sorted in descending order)

Country	Kilograms of heroin seized-2001*	Population-2001	Grams of heroin seized per 100 people
United Kingdom	3,928,970	58,789,000	6.683172
Netherlands	739,000	15,981,000	4.624241
Austria	288,310	8,032,926	3.589103
Italy	2,004,588	57,110,144	3.510038
Portugal	316,039	10,148,000	3.114298
Greece	329,725	10,964,000	3.007342
Belgium	187,739	10,926,350	1.718222
Spain	630,600	40,037,000	1.575043
Germany	835,836	83,029,536	1.006673
France	**351,050**	**59,551,227**	**0.589492**
Denmark	25,125	5,352,000	0.469451
Sweden	32,627	9,215,000	0.354064

*Data reported per State by the Office of National Control Policy, http://www.whitehousedrugpolicy.gov/statistical/index.html

The dependent variables, but heroin prices, will be kept to their average values[9]. As a consequence Eq. (8) changes to:

$$\ln(Hom - Rate) = 0.157^* \ln(H - Price) + 1.025, \tag{9}$$

hence,

$$Hom - Rate = (e\text{^}1.025)^*(H - Price\text{^}0.157). \tag{10}$$

By applying Eq. (10) it is estimated that the reduction in heroin prices recorded between 1981 and 2000 in the USA has contributed to a 21% average reduction in the country average homicide rate during these years[10].

Providing that the relation between the two variables is of logarithmic type, the impact has been less severe in a regime of high prices, and more severe in a regime of low prices. The following chart is the graphic representation of Eq. (10), and it describes how the homicide rate develops according to the variation in heroin prices, *rebus sic stantibus* (Fig. 9).

Regressions have been carried out on drug-related homicide rate as dependent variable, and on heroin prices as independent. Unsurprisingly, as drug-related homicides are closer to the concept of systemic violence, the results prove to be much stronger. The results are reported in the following table (Table 9).

[9] The average values of the 'arrest rate for violent crime' recorded during these years is 253.023; of the 'GDPpc' is 28,257; of the 'percentage of violent crime cleared' is 46.35.

[10] Substituting the prices recorded in 1981 (1,206.81 US$), and those recorded in 2000 (268.84 US$), according to Eq. (10) the level of homicide rate should have been accordingly 8.49 in 1981, and 6.68 in 2000.

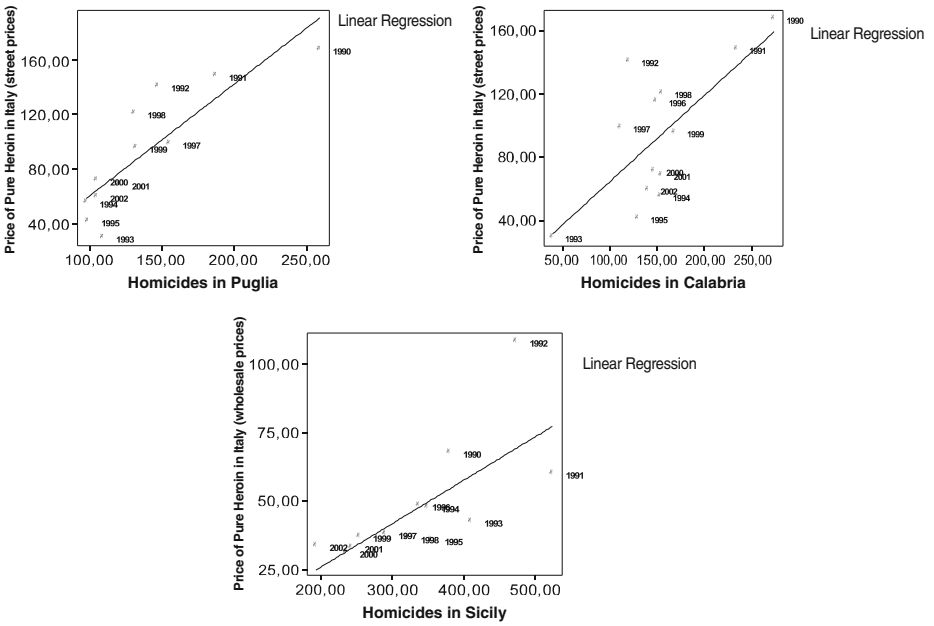

Fig. 8 Historical relation between heroin prices and homicide rate in Sicily, Calabria and Puglia (1990–2002)

Let's now consider Regression 7. In this case the resulting model would be:

$$\ln(DHom - Rate) = 0.285 * \ln(H - Price) - 5.096 * \ln(Viol - Crime\,Cleared) + 16.918. \quad (11)$$

Keeping constant the percentage of violent crime cleared, to the average value recorded during the period under analysis (46.7), Eq. (11) develops into:

$$\ln(DHom - Rate) = 0.285^* \ln(H - Price) - 2.631, \quad (12)$$

hence,

$$DHom - Rate = (H - Price)^{\wedge}0.285^*e^{\wedge} - 2.631. \quad (13)$$

It can be safely assumed that a reduction in heroin prices at mid-level distribution recorded between the years 1987 and 2000, has led to an average 35% reduction in drug-related homicide rate in the country[11].

[11] This result is determined by substituting the value of heroin prices recorded in 1981 (1,206.81 US$). In this case, according to Eq. (13) drugs homicide rate should have been 0.544. The drug related homicide rate recorded in 2000 should have been 0.354, considering the price recorded that year (268.84 US$), hence an estimated reduction of 35%. In this case it has to be kept in mind that the estimation is weaker compared to Eq. (10) since the formula is able to explain 85% of the dependent variable trend, as a consequence this result is actually a value ranging between 30% and 40%.

Table 7 Correlation coefficients as a result of the statistical analysis, derived between illegal drugs prices and homicide rate in different geographical areas of the USA (1980–2002)*

	Heroin-small consumers	*Heroin-large consumers*	*Heroin-mid level distribution*	*Heroin-wholesale distribution*	*Cocaine-small consumers*	*Cocaine-large consumers*	*Cocaine-mid level distribution*	*Cocaine- wholesale distribution*
Homicide rate in large cities		0.612 (0.009)	0.793 (0.000)					
Homicide rate in rural areas				0.5406 (0.025)				
Homicide rate in city population above 1.000.000 inhabitants		0.526 (0.030)	0.759 (0.000)				-0.540 (0.027)	-0.488 (0.047)
Homicide rate in city population between 500.000 and 1.000.000 inhabitants		0.553 (0.021)	0.621 (0.008)	0.617 (0.008)				
Homicide rate in city population between 250.000 and 500.000 inhabitants							0.525 (0.030)	
Homicide rate in the region of New England			0.531 (0.028)				-0.555 (0.000)	
Homicide rate in the region of Middle Atlantic		0.571 (0.015)	0.837 (0.000)				-0.644 (0.005)	-0.556 (0.020)
Homicide rate in the region of East North Central		0.490 (0.046)						-0.561 (0.019)
Homicide rate in the region of South Atlantic	0.554 (0.021)	0.549 (0.022)	0.523 (0.031)					
Homicide rate in the region of the Mountain			-0.483 (0.049)	-0.579 (0.015)				
Homicide rate in the region of the Pacific			0.582 (0.014)		-0.491 (0.045)		-0.497 (0.042)	-0.676 (0.003)

Table 7 (continued)

	Heroin-small consumers	*Heroin-large consumers*	*Heroin-mid level distribution*	*Heroin-wholesale distribution*	*Cocaine-small consumers*	*Cocaine-large consumers*	*Cocaine-mid level distribution*	*Cocaine- wholesale distribution*
Homicide rate in Alaska	0.485[a] (0.048)		-0.743 (0.001)		0.687 (0.002)	0.717 (0.001)	0.742 (0.001)	0.816 (0.000)
Homicide rate in Alabama				0.665[b] (0.004)				
Homicide rate in Arizona				-0.530 (0.029)				
Homicide rate in California			0.531 (0.032)					-0.560 (0.019)
Homicide rate in District of Columbia				0.482 (0.050)				
Homicide rate in Indiana			-0.507 (0.037)					
Homicide rate in Kansas	-0.619 (0.008)	-0.584 (0.014)	-0.757 (0.000)				0.630 (0.007)	0.610 (0.009)
Homicide rate in Louisiana	0.485[c] (0.048)		-0.6627 (0.004)			0.553 (0.021)	0.682 (0.003)	0.610 (0.009)
Homicide rate in Michigan	0.594 (0.012)		0.801 (0.000)		-0.692 (0.002)	-0.799 (0.000)	-0.872 (0.000)	-0.887 (0.000)
Homicide rate in Minnesota	0.590[d] (0.016)							
Homicide rate in Mississippi			-0.638 (0.006)			0.541 (0.025)	0.653 (0.004)	0.607 (0.010)
Homicide rate in Nebraska			0.4975 (0.042)		-0.586 (0.013)	-0.649 (0.005)	-0.671 (0.003)	-0.692 (0.002)

Homicide rate in Nevada			-0.556 (0.020)				0.640 (0.006)	
Homicide rate in New Jersey				0.497 (0.012)	0.514 (0.034)	0.637 (0.006)		0.485 (0.048)
Homicide rate in New York		0.574 (0.016)	0.892 (0.000)			-0.493 (0.044)	-0.704 (0.002)	-0.629 (0.007)
Homicide rate in Oregon				-0.511 (0.036)	-0.614 (0.009)	-0.631 (0.007)	-0.643 (0.005)	-0.640 (0.006)
Homicide rate in Rhode Island			0.503 (0.040)					
Homicide rate in Texas		0.560 (0.019)	0.647 (0.005)					
Homicide rate in Virginia		0.626 (0.007)						
Homicide rate in Washington	0.528 (0.029)				-0.519 (0.033)			-0.572 (0.016)
Homicide rate in Wisconsin		0.497 (0.042)						
Homicide rate in Wyoming	-0.517 (0.033)				0.592 (0.012)	0.634 (0.006)	0.561 (0.019)	0.721 (0.001)

*The following results are derived by applying partial correlations, controlling for GDP per capita at constant prices, arrests rate at country level, and the percentage of violent crime cleared by the police.

[a] This result is determined by applying partial correlation between the homicide rate in Alaska and the heroin prices in the Pacific Region.

[b] This result is determined by applying partial correlation between the homicide rate in Alabama and the heroin prices in the South Atlantic Region.

[c] This result is determined by applying partial correlation between the homicide rate in Louisiana and the heroin prices in the South Atlantic Region.

[d] This result is determined by applying partial correlation between the homicide rate in Minnesota and the heroin prices in the East Central Region.

Table 8 Results of different regressions having homicide rate and drug-related homicides recorded in the USA (1980–2002) as dependent variables

	Dependent variable*	Independent variables** (significance of the result)					R Squared
Regression 1	**Hom-Rate**	**H-Price *0.0018**	**+6.79**				R sq= 0.286
		Sig (0.015)	Sig(0.000)				
Regression 2	**Ln Hom-Rate**	**Ln H-Price *0.2**	**+0.76**				R sq= 0.440
		Sig (0.001)	Sig(0.043)				
Regression 3	**Ln Hom-Rate**	**Ln H-Price *0.11**	**- Ln Viol-Crime cleared * 3.20**	**+13.61**			R sq = 0.853
		Sig (0.003)	Sig(0.000)	Sig(0.000)			
Regression 4	**Ln Hom-Rate**	**ln H-Price *0.15**	**- ln Viol-Crime cleared * 1.46**	**+ln Arrests* 0.75**	**-ln GDPpc* 0.18**	**+4.36**	R sq= 0.975
		Sig (0.00)	Sig(0.00)	Sig(0.00)	Sig(0.051)	Sig(0.006)	

*The dependent variables considered in this list of regressions are: the homicide rate (Hom-Rate) and its logarithm (Ln Hom-Rate).

**The independent variables considered in this list of regressions are: the heroin prices per pure gram at mid-distribution level (H-Price) and its logarithm (Ln H-Price). The percentage of violent crime cleared by the police (Viol-Crime cleared) and its logarithm (Ln Viol-Crime cleared). The logarithm of Arrest rate for violent crime (Ln Arrest) and the logarithm of the Gross Domestic Product per person at constant prices (Ln GDPpc).

Development of the Model and Confirmation of the Hypothesis

Using Eq. (10) and multiplying both terms of the equation with the variable '*violent crime cleared by the police*', it is derived:

$$Viol-Crime\,Cleared{*}Hom-Rate = Viol-Crime\,Cleared{*}\left[(H-Price)\text{^}0.157{*}e\text{^}1.025\right]. \tag{14}$$

The variable '*violent crime cleared by the police*' closely approximates the probability of being arrested calculated as a percentage of violent crimes that have been solved by the police through the arrest of the suspect. By multiplying this variable with the number of homicides, it is possible to closely approximate the risk the offender faces when committing a marginal act of violent crime. Considering '*violent crime cleared*' as constant at its average value recorded in the years under investigation[12] at second member, Eq. (11) will change:

$$Risk = \left[(H-Price)\text{^}0.157{*}e\text{^}1.025{*}46.35\right], \tag{15}$$

hence[13]:

$$Less\,Risk = 1/Risk = 0.0077/H-Price\text{^}0.157. \tag{16}$$

[12] The value ranged between 43% and 50%, and the average value 46.35%.

[13] The risk of being arrested by the police, connected with the commission of homicides.

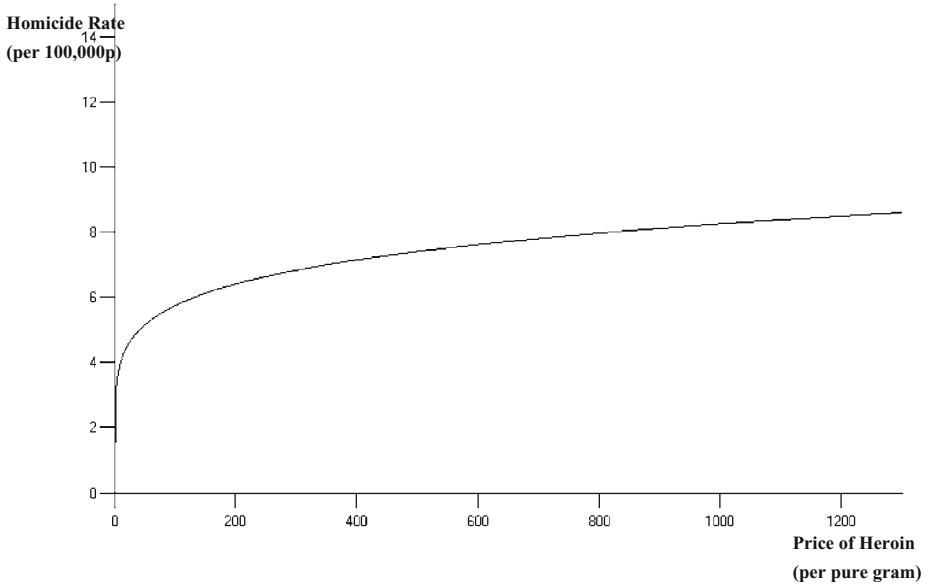

Fig. 9 Graphic representation of the relation between heroin prices (in the horizontal axis) and homicide rate (in the vertical axis), according to Eq. (10)

Equation (16) represents the indifference curves indicated in Fig. 1, based on Regression 4. It is a function of the type $Y=cost/X$, a hyperbole. Since heroin price is always greater than zero, the actual graph representing the indifference lines recorded in the period under analysis will be the following (Fig. 10).

Table 9 Results of different regressions having drug-related homicide rate recorded in the USA (1987–2000) as dependent variable*

	Dependent variable[a]	Independent Variables[b] (significance of the result)			R Squared
Regression 5	**DHom-Rate**	**H-Price *0,000293**	**+0,271**		R sq= 0.407
		Sig(0,014)	Sig(0,002)		
Regression 6	**Ln DHom-Rate**	**ln H-Price *0,496**	**-3,968**		R sq= 0.569
		Sig (0,002)	Sig(0,000)		
Regression 7	**Ln DHom-Rate**	**ln H-Price *0,496**	**- ln Viol-Crime cleared * 5,096**	**+16,918**	R sq= 0.836
		Sig (0,006)	Sig(0,001)	Sig(0,006)	

*The complete results of these regressions are in Table 1, 2 and 4 in Annex 3

[a] The dependent variables considered in this list of regressions are drug-related homicide rate (DHom-Rate) and its logarithm (Ln Dhom-Rate). The list of the variables and the values recorded for every year is presented in Annex 1.

[b] The independent variables considered in this list of regressions are the heroin prices per pure gram, at mid-distribution level (H-Price) and its logarithm (LnH-Price). The percentage of violent crime cleared by the police (Viol-Crime cleared) and its logarithm (LnViol-Crime cleared). The logarithm of Arrest rate for violent crime (Ln Arrest) and the logarithm of the Gross Domestic Product per person at constant prices (Ln GDPpc). The list of the variables and the values recorded for every year is presented in Annex 1.

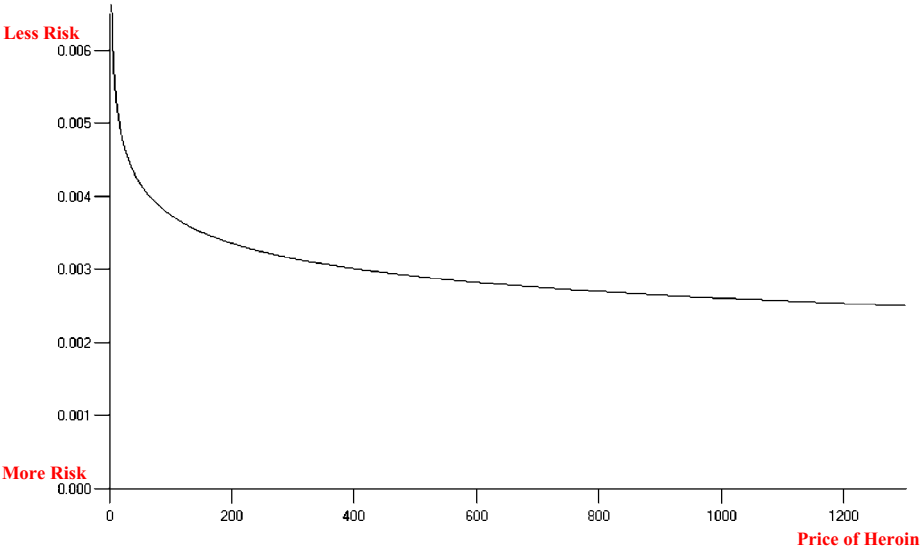

Fig. 10 Indifference curve -less risk and monetary returns connected with homicides- recorded according to the actual average offending behaviour in the USA (1981–2000)

The graph confirms the behaviour hypothesized in this study, and the basic assumption that the average US offender during the two decades under analysis has been rationally evaluating the risks and monetary benefits of his or her offending behaviour.

Conclusions

The analysis demonstrate that heroin prices are predictors of drug-related homicides, and overall homicide rate, whereas cocaine prices are not. The hypothesis is confirmed for the United States of America, as well as for Austria, France, Italy and The Netherlands, and for three relevant Italian regions (Calabria, Puglia and Sicily).

By applying the American data, it could be calculated that the impact of this predictor is quite important given that, based on the analysis, the reduction in heroin prices has contributed to more than 20% reduction in homicide rate in the last two decades in the USA. The results are stronger for drug-related homicides. There is no reason to not imagine that the same results could be determined for Europe, where the absence of data did not allow application of the model to predict the level of systemic violence as a function of the prices of heroin.

The results and development of the inferential analysis show that the average offender committing homicide, especially drug-related homicides, behaves in terms of a trade off when deciding to offend. The trade off is determined by the balance between the monetary returns and the risk connected with the committing of the crime. The decision to commit a crime or not, would also depend on the absolute amount of money involved, and on the total intensity of the violence involved. The offender would reduce the marginal increase in violence when the absolute level of violence is high, and at the same time it would reduce drastically the level of risk to be taken when the monetary returns fall below a certain level.

This study also proves that not all the systemic violence can be framed within the rational choice paradigm. The regression at the base of the model defined by this study is able to explain about 83%, but not all of the drugs-related homicides in terms of prices of heroin and risks to be arrested. In addition, the hypothesis is not supported for certain profiles of offenders, such as youngsters or gangs, who normally are more impulsive than adult offenders. Moreover the hypothesis is confirmed in regions where the market of drugs is larger, and where the presence of organized crime dealing with drugs' trafficking is more relevant, such as Texas and New York in the USA, or the Southern Italian regions.

Considerations have to be made on the fact that, according to this model, the level of systemic violence is also affected by the probability that a violent crime is cleared by the police, which for the purpose of this study has always been maintained constant.

The evaluation whether crime pays is based not only on the monetary revenues but also on the perceived risks that he is taking in committing the crime. So, even though this analysis shows that a 10% increase in the price of heroin referring to the price of heroin of the year 2000 would cause an increase in the average homicide rate by 1.8% in the USA, on the other hand, it would suffice to increase the level of violent crime cleared by the police by 2.1%[14] to compensate such an increase in violence.

The model presented in this study could be easily applied by policy makers to predict and prevent raises in systemic violence caused by an increase of prices of the most relevant drugs (or other illegal commodities) for the considered territory. By monitoring the level or the prices, it could be possible to intervene and leverage the law enforcement activities during periods when more systemic violence is foreseen.

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[14] Results were derived by applying Eq. (8), the values recorded in the year 2000, and the prices of heroin recorded in the year 2000 plus 10%, and being percentage of violent crime cleared as dependent variable. The result, 49.6% is then compared with the actual value recorded in the year 2000, 47.5%.