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Indirect Effects of a Policy Altering Criminal Behavior: Evidence from the Italian Prison Experiment†

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We exploit the 2006 Italian prison pardon to evaluate peer effects in criminal behavior. The pardon randomly commutes actual sentences to expected sentences for 40 percent of the Italian prison population. Using prison and geographical origin to construct reference groups for former inmates, we find large indirect effects of this policy. In particular, we find that the reduction in the individuals' recidivism due to an increase in their peers' residual sentence is at least as large as their response to an increase in their own residual sentence. From this result we estimate a social multiplier in crime of two. (*JEL* D12, K42, Z13)

Estimating the impact of peer effects on criminal behavior and understanding the mechanisms through which peers affect individual criminal participation are of primary importance in the design of effective policies to prevent crime (Manski 1993; Glaeser, Sacerdote, and Scheinkman 1996). Anecdotal evidence and casual empiricism suggest that peer effects exist and are important with regard to criminal activity. However, well-known identification issues and inherent difficulties in running randomized experiments for relevant criminal policy variables make empirical evidence on peer effects quite difficult to produce.

In this paper, we use the July 2006 Italian (natural) prison experiment in order to study the indirect effects of a policy which dramatically changed incentives to commit a crime and to evaluate whether criminal activity is subject to peer effects. The Italian prison experiment occured with the Collective Clemency Bill, which was passed by the Italian Parliament in July 2006 and provided an immediate 3-year reduction in detention for all inmates who had committed a crime before May 2,

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2006. Upon approval of the bill, almost 22,000 inmates were released from Italian prisons. Of direct importance to the objective of this study, the bill stipulates that if a former inmate commits another crime within 5 years of their release from prison, they will be required to serve the residual sentence suspended by the pardon (varying from 1 to 36 months) in addition to the sentence for the new crime. In other words, the policy effectively transforms one month of an original sentence into an additional one month of sentence for future crimes committed at the individual level.

Our main variable of interest is the residual sentence at date of release, which varies at the individual level. Conditional on inmates' original sentences, variation in the residual sentence (and hence in the expected sentence for a future crime) depends only on the date of an inmate's entry into prison, which is plausibly exogenous.[1] As reported by Drago, Galbiati, and Vertova (2009), former inmates' residual sentences at date of release represent an incentive which effectively decreases the propensity to reoffend.

As a first step, we explore whether former inmates' decisions to reoffend are influenced by the residual sentences of those inmates with whom they are most likely to be in contact. More specifically, we define reference groups for foreign inmates, based on prison and nationality (40 percent of the sample is of foreign origin); and Italians, based on prison and region of residence. Inmates released from the same prison who are also of identical geographical origin are thus placed in the same group. The central underlying idea driving this analysis is that inmates who served time together will tend to interact outside prison once they are released. In this case, peer effects may occur for a variety of reasons (e.g., imitation or complementarities in criminal activities), leading to the following basic prediction, the incentive (the residual sentence) to an individual to reoffend will influence not only his behavior but also the behavior of other members of his group.

We find empirical support for this prediction. Peers' residual sentences greatly impact individual recidivism. The estimated impact of the average residual sentence of the group (excluding the individual himself) is comparable to the direct effect of the individual residual sentence. In particular, an average residual sentence of one additional month decreases the probability of being rearrested by 0.16 percentage points.[2] The considerable size of the indirect effects is consistent with a social multiplier of two in crime. In other words, individual-level shocks to criminal activity were amplified by social interactions by a factor of two for the population of released inmates following the bill. A plausible mechanism underlying this effect is the maintenance of prison peer groups after release and the presence of complementarities in post-release behavior (e.g., joint crime production). Sociological and qualitative research on prison gangs (Skarbek 2010; Leeson and Skarbeck 2010; Fleisher and Decker 2001) and on former Italian inmates' post-release networks (Baccaro and Mosconi 2004; Santoro and Tucci 2006) supports this interpretation. Moreover, an examination of the date of entry into prison and inmates' province of

[1] In support of this hypothesis, we find evidence that conditional on original sentence length, inmates' observable characteristics are balanced for individuals below and above the median of the remaining sentence.

[2] In order to examine the appropriateness of using geographical origin and prison to identify peer groups, we experimented with several different falsification tests in which we constructed peer groups according to randomly generated prisons or nationality and region-based identifiers. In all cases the indirect effects of the policy are essentially zero.

residence allows us to obtain additional results using alternative definitions of peer groups, providing further evidence consistent with this mechanism.

This paper contributes to the literature on peer effects and crime. In particular, our identification strategy builds on the Italian prison experiment by providing exogenous individual level variation in incentives to recidivate. This key feature allows us to create exogenous variation in group level incentives even in the presence of endogenously formed peer groups. Few studies to date contribute to the identification and measurement of this phenomenon. Bayer, Hjalmarsson, and Pozen (2009), for example, exploit the exogenous assignment of individuals to peer groups. They find that inmates build criminal capital behind bars that increases post-release criminal activity. Using aggregate data, Glaeser, Sacerdote, and Scheinkman (1996) and Ludwig and Kling (2007) find positive peer effects in criminal behavior but only for less serious crimes. One limitation to the existing literature is that it is not always possible to discriminate between endogenous and exogenous social interactions. This distinction is, however, crucial given that endogenous interactions are generated by the contagious behavior of peers, while exogenous interactions are generated by the characteristics of peers influencing individual behavior (Manski 1993). A policy that alters individual criminal behavior will have indirect effects only in the presence of endogenous social interactions. This paper sheds light on these types of interactions and the ways they represent an important determinant of criminal activity.

The paper is structured as follows. In Sections I and II, we describe the institutional setting and the identification strategy. We present the data in Section III, our results in Section IV, and a discussion of the mechanism in Section V, followed by our conclusions in the final section.

I. The Italian Prison Experiment

In what follows, we briefly describe the motivations and the provisions detailed in the collective pardon law approved by the Italian Parliament in July 2006.[3]

Due to substantial overcrowding in prison facilities,[4] the Italian Parliament passed a collective pardon on July 30, 2006 (Law 241/2006), a legislative measure considered to be of exceptional nature. According to the Italian Constitution, any law providing for the implementation of amnesty or collective pardon must be approved by both Chambers of Parliament with a majority of two-thirds in favor of each article of the law (Section II, Art. 79 of the Italian Constitution). These conditions are identical to those required for approval of a constitutional reform (Art. 138).

The bill grants a reduction in the length of detention for those who committed a crime before May 2, 2006. The backdating of the collective pardon, announced immediately after the Parliament began to debate the bill, rules out any possible effect of the collective pardon on crime rates during the months leading up to the approval of the law. The ruling reduces prison sentences by three years for a large number of

[3] See Drago, Galbiati, and Vertova (2009) for a more detailed description of the Italian criminal justice system and additional background concerning the design and approval of the collective clemency bill.

[4] By the end of the 1990s, the average overcrowding ratio in Italian prisons was 131 inmates for every 100 prison places.

inmates, but does not entirely ignore the offense. More specifically, on August 1, 2006, all those with a residual prison sentence of less than three years were immediately released from residential facilities. However, a number of criminal acts are excluded from the collective pardon, in particular those related to the mafia, terrorism, armed gangs, mass murder, destruction and ransacking, usury, felony, sex crimes (in particular against juveniles), kidnapping, and the exploitation of prostitution.

The bill's provisions with regard to the reduction of incarceration length foresee that an inmate convicted of a crime (other than those listed above) committed before May 2, 2006 is eligible for immediate release from prison as long as his residual sentence is less than three years. As a result, the prison population dropped from a total of 60,710 individuals on July 31, 2006 to 38,847 on August 1, 2006.

As far as our research question is concerned, the crucial consequence of the bill is the variation in prison sentences at the individual level. The bill declares that all those who recommit a crime within five years of July 31, 2006 and who receive a further sentence greater than two years lose their right to clemency. This means that within the five-year period following their release from prison, former inmates granted collective pardon face an additional expected sanction equal to the residual sentence pardoned by the bill. Take for instance two criminals convicted of the same crime who both had a residual sentence of less than three years on August 1, 2006. They are then both released from prison on August 1, 2006. Suppose that the first individual entered prison one year before the second individual and thus has a pardoned sentence of one year, while the second individual has a pardoned residual sentence of two years. Over the following five years, for any crime category, they face a difference in expected sentence of one year. For example, for a robbery with an expected sentence of 10 years, the first individual would be sentenced to 11 years in prison (10 years for the robbery plus 1 year residual sentence pardoned by the Collective Clemency Bill), while the second individual would be sentenced to 12 years (10 years plus 2 years of residual sentence).

II. Empirical Strategy and Identification

In this section, we present our empirical strategy. Let y_{ijk} denote the post-release outcome of individual i of nationality k (region of residence if Italian) who served his former sentence in prison j (y_{ijk} takes value 1 if the individual was rearrested during the period under consideration, and 0 otherwise). As we explain in further detail in the next section, prison and nationality (region of residence for Italians) define the reference group. Moreover, let $sentres_{ijk}$ and $sentence_{ijk}$, respectively, denote an individual's residual sentence (pardoned) and original sentence.[5] The basic regression model used in this paper is thus

$$(1) \quad y_{ijk} = \beta_0 + \beta_1 sentence_{ijk} + \beta_2 sentres_{ijk} + \beta_3 avgsentence_{(-i)jk} + \beta_4 avgsentres_{(-i)jk} + X'_{ijk}\phi + avgX'_{(-i)jk}\varphi + \varepsilon_{ijk},$$

[5] Throughout the analysis both the original sentence and the residual sentence and their averages are expressed in months.

where $avg\,sentres_{(-i)jk}$ and $avg\,sentence_{(-i)jk}$ are individual-level variables, or the average residual sentence and the average original sentence for the group of individuals of nationality (region of residence for Italians) k in prison j, excluding individual i, respectively. In other words, $avg\,sentres_{(-i)jk}$ represents individual i's peers' average residual sentence, which, as a result of the design of the collective pardon is potentially part of individual i's peers' incentive to recidivate. With X_{ijk} we denote a set of individual-level control variables and with $avgX_{(-i)jk}$ their averages in the group, excluding individual i. Given that in the basic regression model we condition on individual original sentence, individual residual sentence, and average original sentence, variation in the variable of interest (average peers' residual sentence) is obtained from groups of inmates who entered prison during the same span of months but have different original sentences or who entered during different months but have the same original sentences.

The estimated coefficient of interest is β_4, or the response of individual i to an additional month in the average residual sentence of his group, i.e., the indirect response to the policy. The coefficient β_2 is the direct response to the conversion of one month of original sentence into one month of expected sentence for individual i. It is worth remarking that unlike other papers, such as that by Bayer, Hjalmarsson, and Pozen (2009), where the interest lies in understanding the effect of peers' characteristics on individual behavior, our focus here is on peers' incentives rather than peers' characteristics. Consequently, our framework of analysis does not require us to assume that selection of individuals into groups (and hence also in a given prison) is random. Rather, the assumption needed is that peers' residual sentences are orthogonal to individual and peer characteristics. Hence, in order to obtain a consistent estimate of β_4, the conditional independence assumption is that once we control for individual sentence, residual sentence and average sentence, the average residual sentence is orthogonal to unobservables. Namely, the assumption is $\text{cov}\,(avgsentres, \varepsilon \mid sentence, sentres, avgsentence) = 0$. Although we cannot directly test this hypothesis, in the next section, we provide evidence consistent with the latter based on different tests on observables.

III. Data, Peer Groups, and Evidence for the Identification Assumption

A. *Individual-Level Data*

Data for this study come from an internal database maintained by the Italian Department of Prison Administration (DAP) on offenders under its supervision. We were granted access to DAP records on all individuals released as a result of the collective pardon law between August 1, 2006 and February 28, 2007. The full sample includes 25,813 individuals, 81 percent of whom were released on August 1, 2006. For each individual, we have information on whether or not the ex-inmate reoffended between the date of release from prison and February 28, 2007. This means that for most of the sample, the available data report recidivism for the first seven months following release from prison. Moreover, the data contain information concerning a wide range of variables at the individual and facility level. The following information is reported for each individual: facility where the sentence was served, official length

of the sentence, actual time served, kind of crime committed (i.e., most recent offense in an individual's criminal history before the pardon), age, sex, level of education, marital status, nationality, province of residence, and employment status before being sentenced to prison. As data on successive convictions are not available, we use subsequent criminal charge and imprisonment as our measure of recidivism.

Our analysis is restricted to those individuals serving their sentence in prison, i.e., we exclude individuals carrying out their terms in a penal mental hospital (98 individuals). Moreover, we exclude any individual with a residual sentence greater than 36 months. This occurs in the case of individuals who have accrued several different charges and are serving their sentence for at least one, while awaiting verdicts on others. We also do not consider individuals for whom sentence data are missing. Because we preferred to conduct the empirical analysis with a homogenous sample both in terms of date of release and period of observation (7 months), we exclude individuals with a residual sentence equal to 36 months. While we do not know the exact date of release of each inmate, we do know that any inmate released after August 1, 2006 necessarily had a residual sentence of 36 months. The final sample used in the empirical investigation is made up of 20,950 individual-level observations.

B. *Reference Groups*

Using the individual-level data, we construct reference groups using inmates from the same facility with identical nationalities. Italians are instead grouped by region and facility.[6] With this procedure, we obtain 1,778 groups with more than one individual. The large number of groups derives from the fact that there are many inmates serving their sentence in a jurisdiction different from that of their hometown for reasons ranging from overcrowding in the closest prison to the Italian Prison Administration's view that a certain facility is incompatible with the inmate (see Drago, Galbiati, and Vertova 2011). The average size of the group is 10.59 (SD = 28.12), for Italians it is 18.06 (SD = 43.38), and for foreigners it is 5.91 (SD = 7.18).

The underlying assumption is that speaking the same language and sharing similar characteristics and values are factors that facilitate interaction, especially in an isolated environment, such as prison. In fact, Italians from the same region are very likely to share similar values and cultural backgrounds (see Guiso, Sapienza, and Zingales 2008). Bertrand, Luttmer, and Mullainathan (2000) and Aizer and Currie (2004) use language as the defining characteristic of reference groups in their study of welfare use participation. In our study, we feel it is more appropriate to adopt nationality as the defining feature of a group. In fact, Italy is a country of very recent immigration, making it likely that non-Italian speakers have only recently arrived. In addition, the literature on migration (Boyd 1989) shows that it is common for recent immigrants to create and maintain strong ties with people of the same nationality in their new destination country. In addition, using language as the reference variable to construct groups would mean including, for example, Mozambicans and Brazilians in the same

[6] Note that women and men belong to distinct groups given that they always carry out their sentences in different prisons or in separate branches of the same prison. See Drago, Galbiati, and Vertova (2011) for a description of the characteristics of the facilities in our sample.

Table 1—Individual Characteristics for Average Residual Sentences Above and Below the Median

	Whole sample	Whole sample, individuals belonging to groups with at least two individuals	Average peers' residual sentence below the median	Average peers' residual sentence above the median	Difference	OLS	OLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Other group members' average original sentence (in months)		38.697	38.336	39.046	−0.709		
		(0.121)	(0.153)	(0.187)	(0.739)		
Other group members' average residual sentence (in months)		14.474	12.409	16.470	−4.061		
		(0.032)	(0.035)	(0.045)	(0.249)		
Individual recidivism	0.115	0.117	0.123	0.112	0.011		
	(0.002)	(0.002)	(0.003)	(0.003)	(0.005)		
Individual original sentence (in months)	38.982	38.681	39.20	38.18	0.990		
	(0.225)	(0.235)	(0.334)	(0.330)	(1.213)		
Individual residual sentence (in months)	14.511	14.471	14.834	14.121	0.710		
	(0.070)	(0.073)	(0.105)	(0.102)	(0.664)		
Age on exit	38.764	38.734	38.574	38.889	−0.303	0.070	0.087
	(0.069)	(0.073)	(0.109)	(0.109)	(0.326)	(0.030)	(0.030)
Married	0.284	0.286	0.294	0.279	0.014	0.000	0.000
	(0.003)	(0.003)	(0.005)	(0.005)	(0.013)	(0.001)	(0.001)
Permanently employed	0.339	0.341	0.337	0.345	−0.008	0.001	0.001
	(0.005)	(0.005)	(0.007)	(0.007)	(0.0162)	(0.002)	(0.002)
Percentage of males	0.954	0.962	0.976	0.948	0.029	−0.003	−0.003
	(0.001)	(0.001)	(0.002)	(0.002)	(0.010)	(0.001)	(0.001)
Share of Italians	0.621	0.657	0.645	0.669	0.024	0.009	0.009
	(0.003)	(0.003)	(0.005)	(0.005)	(0.038)	(0.004)	(0.003)
Area of Residence:							
North	0.425	0.415	0.416	0.415	−0.001	−0.004	−0.004
	(0.003)	(0.004)	(0.005)	(0.005)	(0.047)	(0.004)	(0.004)
Center	0.185	0.179	0.147	0.21	−0.064	0.004	0.004
	(0.003)	(0.003)	(0.004)	(0.004)	(0.042)	(0.003)	(0.003)
South	0.378	0.395	0.431	0.36	0.070	0.000	0.000
	(0.003)	(0.004)	(0.005)	(0.005)	(0.048)	(0.004)	(0.004)

(*Continued*)

category. Relative to nationality, this would be a noisier proxy for identifying cultural and contextual differences. In light of these considerations, in Section IV, we explore how our results change when the definition of the reference group is modified.

C. *Summary Statistics and Evidence for the Identification Assumption*

Table 1 reports descriptive statistics for the entire original sample (column 1) and for individuals belonging to groups with more than one inmate, which we exploit to estimate the basic regression model (column 2). The table reports the results of several tests, providing evidence consistent with our identifying assumption. Our empirical strategy is based on the assumption that peers' residual sentences are orthogonal to unobservables once we condition on peers' original sentences (and individual original and residual sentences). This is equivalent to saying that once we fix individual i's original and residual sentence, and the average original sentence of his peers, the average residual sentence determined by his peers' date of entry into prison is as good as random.

Table 1—Individual Characteristics for Average Residual Sentences Above and Below the Median (*Continued*)

	Whole sample	Whole sample, individuals belonging to groups with at least two individuals	Average peers' residual sentence below the median	Average peers' residual sentence above the median	Difference	OLS	OLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Education:							
Compulsory	0.901	0.909	0.916	0.903	0.013	−0.001	−0.001
	(0.003)	(0.003)	(0.004)	(0.004)	(0.006)	(0.001)	(0.001)
High School	0.079	0.074	0.067	0.081	−0.013	0.001	0.001
	(0.002)	(0.002)	(0.003)	(0.003)	(0.005)	(0.001)	(0.001)
College (Degree or equivalent)	0.009	0.009	0.009	0.009	0.000	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(.002)	(0.000)	(0.000)
Kind of offense:							
Drug Offenses	0.404	0.401	0.403	0.398	0.005	0.004	0.003
	(0.003)	(0.004)	(0.005)	(0.005)	(0.014)	(0.002)	(0.002)
Crime against Property	0.412	0.417	0.412	0.421	−0.008	−0.001	−0.001
	(0.003)	(0.004)	(0.005)	(0.005)	(0.014)	(0.001)	(0.001)
Violent Crimes	0.095	0.095	0.098	0.092	0.006	−0.001	−0.001
	(0.002)	(0.002)	(0.003)	(0.003)	(0.005)	(0.001)	(0.001)
Immigration bill	0.029	0.026	0.027	0.025	0.001	−0.002	−0.001
	(0.001)	(0.001)	(0.002)	(0.002)	(0.003)	(0.001)	(0.001)
Crime against Public Safety	0.005	0.005	0.004	0.006	−0.002	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
Gun Law	0.012	0.012	0.013	0.012	0.001	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.000)	(0.000)
Observations	20,950	18,872					

Notes: Standard errors in parentheses. Robust standard errors in columns 5, 6, 7 clustered by group indicator. Column 1 reports summary statistics for the whole sample calculated. Column 3 reports summary statistics for those observations where the average peers' residual sentence is below the median for that original sentence length, and column 4 reports summary statistics for those observations where the average peers' residual sentence is above the median for that original sentence length. Column 5 reports the point estimates of the differences between the means in columns 3 and 4. Column 6 reports coefficients on average peers' residual sentences from regressions with individual level observables as dependent variables controlling for average peers' original sentence. Column 7 reports coefficients on average peers' residual sentences from regressions with individual level observables as dependent variables controlling for average peers' original sentence, individual residual sentence, and original sentences.

As a first step, in columns 3–4 of Table 1, we report the averages of the observed characteristics for those observations where the average residual sentence of those sharing the same reference group is either above or below the median for that average original sentence length.[7] In column 5, differences in the means are reported. This is equivalent to a test of observables being balanced for individuals with an average residual sentence below and above the median, conditional on the original sentence. This test is nonparametric in that it tests the equality of means between two groups without imposing any assumption on the relationship between observables and average residual sentence. As shown in column 5, in nearly all cases there is no significant relationship between the demographic variables and the average residual sentences. The few point estimates that are statistically different from zero reveal extremely small

[7] As average original sentence is a continuous variable, for each individual observation, we condition on the closest higher integer (e.g., for average group original sentences between one and two months, we condition on the value two, for average group original sentences between two and three months, we condition on the value three, etc.).

differences and fall well below 5 percent of the standard deviation from the mean. These results support the idea that the average residual sentence of a group is a variable uncorrelated to unobservables once we condition on the average original sentence.

In column 6, we perform the same test, but we impose a parametric structure, presenting the point estimates of the OLS regressions of each individual characteristic on average residual sentence and average original sentence. In column 7, we present the estimate of the same OLS regression conditioning on individual original and residual sentences. Compared to the previous test, the OLS weighting scheme tends to overestimate some differences in observables between individuals with low and high average residual sentences.[8] There are in fact many reasons why the results of a nonparametric test may differ from the results of a linear regression, including the distribution of regressors and the degree of heterogeneity in the relationship of interest (Yitzhaki 1986, and Angrist and Kruger 1999). For the sake of completeness, we report the results from the linear regressions, although we argue that the most informative results are gained from the first test reported in columns 3–5. Our treatment variable is continuous, and the key assumption is that the treatment is caused by random fluctuations in peers' dates of entry into prison. The most transparent and practical way to provide support for this assumption is to show that the observables are balanced without imposing a linear relationship between the latter and the date of entry into prison.[9]

IV. Results and Discussion

A. *Results*

Before presenting the regression results, in Figure 1, we report individuals' responses to both their expected sentences and their peers' expected sentences. Figure 1A reports the recidivism rate for each original sentence for former inmates with residual sentences both above and below the median for that original sentence length. Each point on the figure corresponds to the original sentence, the x-axis is recidivism rate for below median residual sentence and the y-axis is recidivism for above median residual sentence.[10] The recidivism rate for individuals with residual sentences above the median is systematically lower for each original sentence (most points are to the right of the 45-degree line). Thus, the figure provides graphical representation of the direct effect of residual sentence on individual recidivism. Figure 1B reports recidivism rates for former inmates whose peers' residual sentences are above and below the median, conditional on peers' original sentence.[11] The emerging picture is one of higher recidivism for former inmates whose peers' expected sentences are lower than the median, conditional on peers' original sentence.

[8] Although in this case as well, the few point estimates that are precisely estimated are very small.

[9] In fact, when we regress, as in column 6, the fraction of Italians on average residual sentence and average original sentence, we ask if, conditioning on average original sentence, an increasing fraction of Italians' peers enter prison earlier or later than foreigners. This is a test of whether a monotonic relationship exists between the date of entry in prison and the share of Italians over the entire range of dates of entry into prison.

[10] We report only those groups whose sentences range between 20 and 50 months, the range characterizing the majority of the individuals.

[11] As the average original sentence is, in this case, a continuous variable, for each individual observation, we condition on the closest higher integer.

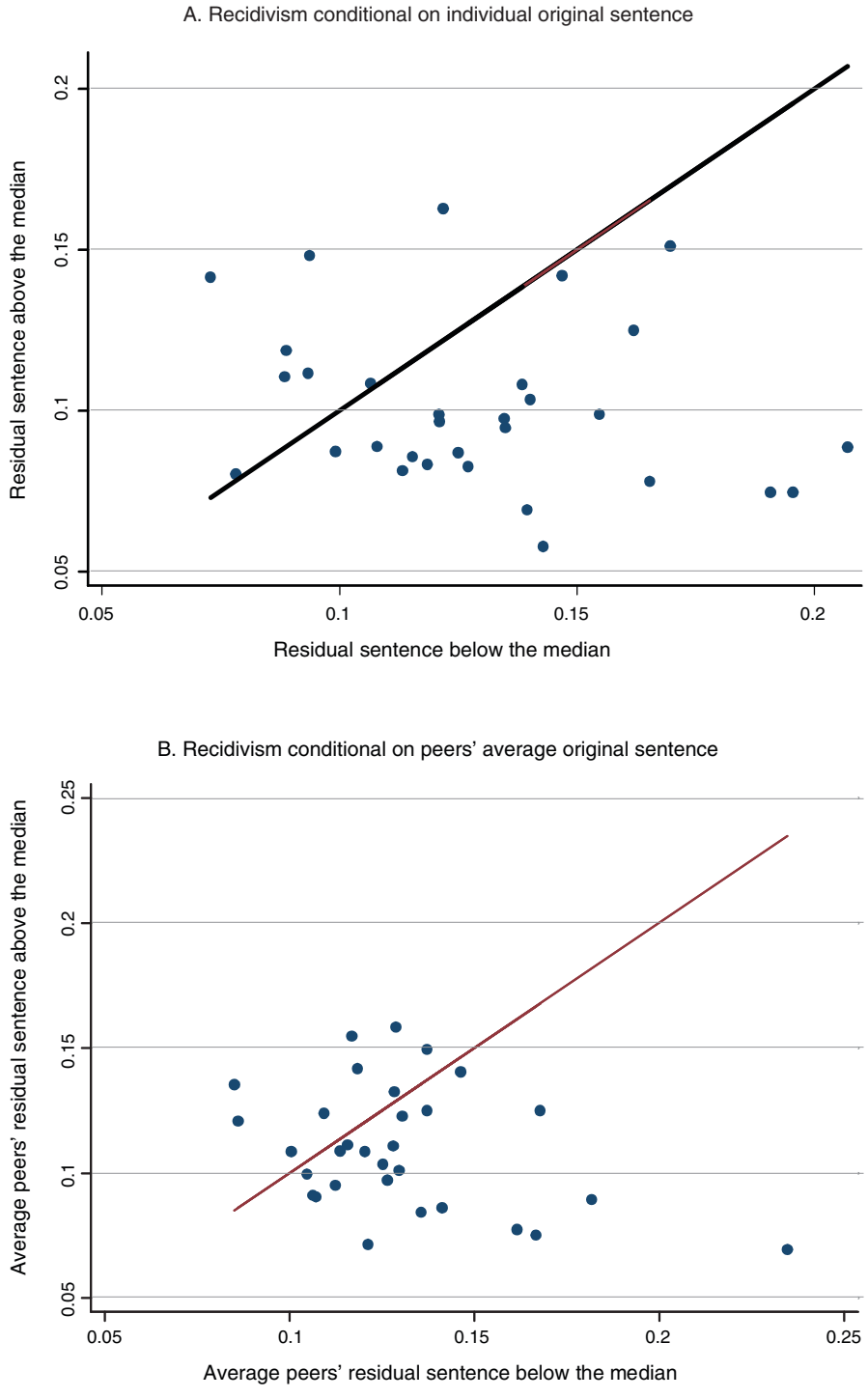

FIGURE 1. DIRECT AND INDIRECT EFFECT OF RESIDUAL SENTENCE ON RECIDIVISM

Table 2—Baseline Results

	(1)	(2)	(3)	(4)
Individual residual sentence	−0.0016	−0.0018	−0.0018	−0.0018
	(−6.00)	(−6.35)	(−6.36)	(−6.25)
Average peers' residual sentence	−0.0020	−0.0016	−0.0016	−0.0015
	(−3.16)	(−2.45)	(−2.51)	(−2.22)
Individual original sentence	−0.0001	0.0003	0.0003	0.0003
	(−1.19)	(3.27)	(3.29)	(3.27)
Average peers' original sentence	0.0001	−0.0000	−0.0001	−0.0001
	(0.33)	(−0.14)	(−0.48)	(−0.60)
Individual characteristics	No	Yes	Yes	Yes
Average peers' characteristics	No	No	Yes	Yes
Individual type of crime	No	Yes	Yes	Yes
Peers' averages of type of crime	No	No	Yes	Yes
Prison fixed effects	No	No	No	Yes
R^2	0.004	0.021	0.024	0.038
Number of groups	1,778	1,769	1,666	1,666
Observations	18,836	17,399	17,296	17,296

Notes: OLS estimates are reported. The dependent variable is equal to one if the individual returned to prison after release and zero otherwise. Robust *t*-statistics in parentheses. Standard errors are clustered at the group level. Individual variables include education levels, age at date of release, a dummy indicating marital status, nationality, employment condition before imprisonment, and geographical area of residence. Values of average groups' characterisitics are constructed starting from the individual values of the same variables.

Table 2 reports the baseline results of variations in model (1). Standard errors are clustered at the group level. In the first column, we present the results of a specification of the model that includes only individual original sentence ($sentence_{ijk}$), average original sentence of the group excluding the individual i ($sentence_{(-i)jk}$), individual residual sentence ($sentres_{ijk}$), and average residual sentence of the group excluding individual i ($avgsentres_{(-i)jk}$). The coefficient β_2 is negative and precisely estimated; an additional month of residual sentence decreases the probability of recidivism by 0.16 percentage points. The coefficient β_4 on average residual sentence is also negative and precisely estimated. It appears that the average effect of peers' residual sentence is at least as important as individual residual sentence. The results suggest that a 1 month increase in an inmate's peers' residual sentence decreases the probability of recidivism by 0.20 percentage points. In columns 2–3, we include a set of individual characteristics: age, sex, nationality, education, marital status, employment dummy, and type of crime committed before release for both the individual (column 2) and for other group members (column 3). We do not observe statistically significant differences between the various specifications, although the indirect effects in columns 2 and 3 are slightly smaller.

Although the potential nonrandom selection of groups of inmates into prisons is not an issue, we still include prison fixed effects in our specification.[12] These fixed effects control for any nonrandom selection of inmates into prison and for any

[12] If average residual sentence is orthogonal to group characteristics, then it should also be orthogonal to prison characteristics, which in turn can have an effect on recidivism after release (Chen and Shapiro 2007; and Drago, Galbiati, and Vertova 2011).

fixed differences of prison affecting recidivism rates. Results from this specification are reported in column 4 and suggest that the effect of average residual sentence remains essentially unchanged.

Overall, these results show large indirect effects of the policy commuting actual sentences into expected sentences. When considering the direct response of individuals to the policy, we observe approximately a 1.5 percent reduction in recidivism with an additional month in residual sentence. Considering the results in columns 2 and 3, we have a 1.3 percent reduction in recidivism caused by indirect effects. Overall, an increase of 1 month for all individuals in a group corresponds to a reduction in recidivism of about 2.8 percent. In the sections that follow, we further explore the heterogeneity of this estimated effect and provide evidence for interpreting the latter in terms of peer effects on crime.

B. *Heterogeneity*

In model (1), we assume that peers' residual sentence affects the individual recidivism of potential criminals in the same way. In Table 3, we report the results of more flexible linear probability models which allow the effect of peers' residual sentence to vary with individual original sentence, individual residual sentence, nationality (Italian or foreign), type of offense before release (drug and property offense), and size of the group. In columns 1 and 2, each row represents a different model, including the full set of controls. In column 1, we report the coefficient on the average residual sentence; and in column 2, we report the coefficient on the interaction term between average residual sentence and the variable identified in the row heading. It appears from column 2 that the data do not support heterogeneity. Most of the interaction terms are close to zero and are never precisely estimated. There is some indication that the effect of the average residual sentence is larger for foreign inmates and for small groups of individuals, although the interaction terms are not statistically significant at conventional levels.

In columns 3–4 of Table 3, we explore whether the estimated effects change with peers' characteristics. Peers' residual sentences have a greater effect on individual recidivism when peers' original sentences are shorter and when the crime category committed before entering prison is a drug offence. Finally, in columns 5 and 6, we explore another form of heterogeneity deriving from different definitions of peer groups. We maintain geographical origin and prison as group identifiers but add age (by quartiles) and crime committed before entering prison. In order to guarantee a reasonable number of groups, we combine Italians (thus excluding region of residence as an identifier) and foreigners (thus excluding nationality as an identifier). The use of diverse definitions of peer groups is informative with regard to the nature of peer interactions. More specifically, when peer group is defined by age and crime committed, the estimated coefficient on peers' residual sentence is substantially smaller than that estimated above. That said, however, experimenting with different alternatives produces the same patterns.

C. *Falsification Tests*

In order to provide additional empirical support for the idea that the estimated indirect effects come from peer effects, we perform several falsification tests that

Table 3—Heterogeneity

	Average residual sentence (1)	Interaction of average residual sentence with row variable (2)		Average residual sentence (3)	Interaction of average residual sentence with row variable (4)
No interaction	−0.0016	—	No interaction	−0.00165	—
	(−2.52)			(−2.52)	
Individual original sentence	−0.0018	0.00000	Peers' original sentence	−0.0029	0.00003
	(−1.92)	(0.23)		(−2.91)	(1.85)
Individual residual sentence	−0.0014	−0.00001	Peers' committing a drug offense	−0.0006	−.00232
	(−1.32)	(−0.31)		(−0.65)	(−1.55)
Dummy on Italians	−0.0022	0.00147	Peers' committing a crime against property	−0.0020	0.00107
	(−2.74)	(1.25)		(−2.40)	(0.64)
Drug offense	−0.0013	−0.00072			
	(−1.58)	(−0.64)			
Crime against property	−0.0019	0.00055			
	(−2.47)	(−0.47)			
Size of the group	−0.0015	−0.00000			
	(−2.31)	(−0.60)			
				Peer groups defined by age (5)	Peer groups defined by type of crime (6)
Dummy if group $< = 6$	−0.0026	0.00155	Individual residual sentence	−0.0017	−0.00165
	(−1.42)	(0.82)		(−6.89)	(−6.02)
Dummy if $6 <$ group $< = 26$	−0.0026	0.00055	Average peers' residual sentence	−0.0011	−0.00075
	(−1.42)	(0.26)		(−1.37)	(−1.00)
Dummy if $26 <$ group $< = 80$	−0.0026	−0.00246			
	(−1.42)	(−0.84)	R^2	0.022	0.020
Dummy if group > 80	−0.0026	—	Number of groups	1,449	1,191
	(−1.42)		Observations	19,094	18,006

Notes: OLS estimates are reported. The dependent variable is equal to one if the individual returned to prison after release and zero otherwise. Robust *t*-statistics in parentheses. Standard errors clustered at the group level. All models include the same controls used in column 3 of Table 2.

randomly define reference groups within the same prison or of the same geographical origin. There are 129 nationalities among the foreign inmates: 20 Italian regions of residence among the Italian inmates, and 199 prisons. As a first step, for each reference group defined by prison and nationality (region of residence for Italians), we randomly assign a number between 1 and 129 for foreign and Italian inmates. This number reflects the new identification number of the "false" nationality. We then once again create reference groups defined by prison and (false) nationality. Using this procedure, we obtain randomly generated groups of inmates who served their sentence in the same prison. We now have groups made up of individuals of different nationalities as well as groups made up of both Italians and foreigners. In column 1 of Table 4, we report the results from the specification reported in column 3 of Table 2. The number of observations is reduced given that this method produces more groups composed of only one inmate.[13] The coefficient on average residual sentence is essentially zero and not statistically significant.

[13] When we experimented by randomly assigning less than 129 nationalities, and hence reduced the number of groups composed of only one individual, we obtained very similar results.

Table 4—Falsification Tests

	Nationalities (129) randomly assigned (1)	Regions (20) and nationalities (129) randomly assigned (2)	Regions (20) and nationalities (20) randomly assigned (3)	Prisons (199) randomly assigned (4)
Average peers' residual sentence	0.0000	−0.0003	−0.0000	−0.0001
	(0.10)	(−0.77)	(−0.14)	(−0.20)
R^2	0.021	0.023	0.022	0.022
Number of groups	3,184	3,056	2,430	2,709
Observations	12,659	13,928	17,274	16,674

Notes: OLS estimates are reported. The dependent variable is equal to one if the individual returned to prison after release and zero otherwise. Robust *t*-statistics in parentheses. Standard errors are robust. The specifications adopted are the same as in column 3 of Table 2. See text for the procedure employed in constructing reference groups for these falsification tests.

As a second step, we randomly generate a number between 1 and 20 (regions of residence) for each group of Italians. We do the same for foreign inmates, randomly generating a number between 1 and 129. We then once again create reference groups defined by prison and nationality for foreigners and prison and region of residence for Italians. Using this procedure, we obtain groups of inmates who served their sentence in the same prison, but unlike the previous falsification test, we allow Italians to belong only to groups of Italians (even if from different regions) and foreigners to belong only to groups of foreigners (even if of different nationalities). Column 2 of Table 4 reports the results from the specification reported in column 3 of Table 2. The coefficient on average residual sentence is very low compared to Table 2. In column 3 of Table 4, we carry out the same exercise, but randomly assign 20 nationalities instead of 129, thereby increasing the number of observations and reducing the number of groups. In neither case do we find evidence of indirect effects.

In another falsification test, we focus on the role of nationality by letting the prisons where inmates served their original sentences vary randomly. For each group of inmates, we randomly generate a number between 1 and 199 (the number of prisons in our sample). We then group inmates by nationality, or region of residence for Italians, and on the basis of this classification, randomly generate a prison identification number. Column 4 of Table 4 reports the results. The coefficient on average residual sentence is again close to zero. This test further supports our initial definition of peer group by demonstrating that interaction among individuals of the same nationality is much stronger among those who carried out their original sentences in the same prison.

D. *Interpreting the Indirect Effects as Equilibrium Effects: a Social Multiplier of Crime*

A useful exercise to gauge the magnitude of the indirect effects with respect to other papers in the literature is to interpret our results in terms of a social multiplier of crime (Glaeser, Sacerdote, and Scheinkman 2003). Regressing average recidivism on average residual sentence (without excluding individual i), we find

a coefficient on average residual sentence that is double that of the coefficient on individual residual sentence in the individual recidivism regression in which we regress individual recidivism on individual residual sentence. Under the assumption that an individual's peers' average residual sentence influences his/her recidivism only through the effect that average residual sentence has on his/her peers' recidivism, we observe a social multiplier of recidivism of about two. In other words, an exogenous shock decreases individual recidivism by 1 percent, implying a 2 percent reduction in aggregate recidivism in equilibrium. The same results come from Table 2. If we could change every inmate's sentence by transforming one month of actual sentence into one month of expected sentence, we would obtain a result in equilibrium double that of the direct effect.

Although we are unable to compare this result with other findings in the literature on crime, we do observe that social multipliers equal or even greater than two and large indirect effects are present in the literature on other topics. For example, using a similar design to that employed here, Lalive and Cattaneo (2009) examine a cash subsidy encouraging school attendance, finding a social multiplier of two in schooling decisions. Glaeser, Sacerdote, and Scheinkman (2003) similarly report a social multiplier of about two in social group membership among students in Dartmouth College dorms. Duflo and Saez (2003) also find that social interactions played a prominent role in employees' decisions to enroll in a Tax Deferred Account (TDA) retirement plan in a large US university. Some (treated) employees in some (treated) departments received a letter of encouragement, an effective incentive to attend a benefits information fair. Within the treated departments, those who received the letter and those who did not were about as likely to subsequently enroll in the TDA. In all of these papers, as in our own work, the social forces that play a role in the decision to commit a crime, to attend school or to enroll in a retirement plan are at least as important as the direct costs and benefits experienced by individuals.

V. Potential Mechanisms and Interpretation

A. *Time Served in Prison*

The results reported above are consistent with two main possible explanations: the effect of peers' residual sentences mirror the existence of complementarities in post-release criminal behavior, and/or (consistent with Bayer, Hjalmarsson, and Puzen's 2009 findings) individuals are influenced by their peers because they served time together in prison.[14] In fact, one month of residual sentence corresponds to an additional month in the expected sentence and one month less time served in prison, such that inmates who have peers with longer residual sentences also have peers with whom they served less time. Thus, the observed negative effect on individual recidivism could be due to the fact that an inmate served less time with his/her peers. For example, while in prison, inmates build criminal capital and this mechanism operates through social interactions. In what remains of this section, we consider

[14] See Nagin, Cullen, and Jonson (2009) for an in-depth discussion of the effects of prison experiences and time served in correctional facilities.

the plausibility of a mechanism relating to time served, while in the next section, we discuss the second hypothesis, or that of complementarities in postrelease behavior.

In order to fix the time of interaction in prison, we use reference groups composed of inmates who: entered prison during the same month; were released from the same facilities; and are of the same nationality (or region for Italians).[15] Differences in individual residual sentences within a group are now derived only from differences in individual original sentences. However, because we fix the time served in each group, we cannot run a regression as in model (1) as individual residual sentence, individual original sentence, average original sentence, and average residual sentence would be collinear. To understand the effect of average residual sentence and get around the collinearity, we exclude average original sentence from the regression model (1). In this case, the coefficient on average residual sentence captures the joint effect of average residual sentence and average original sentence (which is excluded). Note that longer average residual sentences are associated with longer average original sentences. If, therefore, we still find a negative coefficient on average residual sentence, the latter should be a lower bound estimate of peers' residual sentences. The logic here is that the original sentence should capture the dangerousness of an inmate. Hence, if peers' average original sentence has any effect on individual recidivism, this effect should be positive.

Table 5 illustrates the results of this exercise. We observe a negative coefficient on average residual sentence between −0.0008 and −0.0010. This is lower than the coefficient in Table 2 but still reveals a sizeable effect of average residual sentence compared to individual residual sentence. Because our reference groups are constructed in such a way that peers serve the same amount of time in prison, the effect on the key variable cannot be attributed to the fact that peers with longer residual sentences served less time in prison with any one inmate. The results in Table 5 suggest that the effect of average residual sentence develops primarily through peers' incentives after release. While we cannot exclude that interactions in prison play some role in the determination of the main results (Table 2), Table 5 indicates that interactions in prison (time served) are unlikely to drive these results and that a substantial part of the effect develops through peers' incentives.

B. *Complementarities outside of Prison*

The second and preferred mechanism in line with our results consists of the notion that peer groups formed in prison remain the same after release, and thus peers' residual sentence will affect an individual's behavior due to behavioral spillovers. To clarify the mechanism that likely generates the results, it is useful to look at sociological and qualitative studies on prison, both in Italy and in the United States.

In Italy, for example, Baccaro and Mosconi (2004) report the results of 85 interviews conducted with inmates in the city of Padua's prison. Interviewed inmates are recidivists that have been imprisoned more than once. The authors show that prisoners'

[15] With this procedure, we obtain not only groups of smaller average size but also many more groups (2,888) composed of few individuals (about three on average), with a total number of observations of less than 10,000. Indeed, within in each prison facility, there are not many individuals of the same nationality who entered on the same date.

Table 5—Baseline Results with Reference Groups Defined Also by the Exact Month of Entry in Prison

	(1)	(2)	(3)	(4)
Individual residual sentence	−0.0018	−0.0018	−0.0017	−0.0017
	(−4.34)	(−4.20)	(−3.91)	(−3.78)
Average peers' residual sentence	−0.0008	−0.0010	−0.0010	−0.0008
	(−1.86)	(−2.19)	(−2.06)	(−1.60)
Individual original sentence	0.0003	0.0005	0.0003	0.0005
	(1.37)	(2.14)	(1.58)	(1.98)
Individual characteristics	No	Yes	Yes	Yes
Average peers' characteristics	No	No	Yes	Yes
Individual type of crime	No	Yes	Yes	Yes
Peers' averages of type of crime	No	No	Yes	Yes
Prison fixed effects	No	No	No	Yes
R^2	0.002	0.021	0.021	0.043
Number of groups	2,888	2,849	2,652	2,652
Observations	9,401	8,598	8,401	8,401

Notes: OLS estimates are reported. The dependent variable is equal to one if the individual returned to prison after release and zero otherwise. Robust *t*-statistics in parentheses. Standard errors are clustered at the group level, where groups are defined by nationality (region if Italians), prison, and the exact month of entry into prison.

main networks outside of jail during their prior releases were made up of family members and former inmates. Santoro and Tucci (2006) analyze interviews with approximately 140 former inmates from facilities in the Tuscan region. The authors explain that many of the interviewed subjects describe meeting their "best friends" among those with whom they did time. The literature on prison gangs in the United States similarly confirms that social links developed in prison are maintained upon release (Fleisher and Decker 2001). In order to endure life in jail many inmates join prison gangs, often formed on a racial or ethnic basis. Prison gang members are not only active inside prison but also remain in contact with other gang members following release, in line with one of the basic tenets governing gang members: "blood in, blood out" (Leeson and Skarbek 2010; and Skarbek 2010) or mandatory life membership.

These cases show that ties formed in prison are maintained outside once inmates are released. As a consequence, the fact that peer effects have an impact on individual criminal behavior suggests the presence of complementarities in post-release criminal activities among peers.

In order to provide evidence for this mechanism we need two types of groups, more or less identical with respect to the degree of interaction in prison but different with regard to the degree of interaction outside prison. Ideally, we would expect to observe larger indirect effects of peers' residual sentence for the group in which interactions outside of prison are likely to be stronger.

More specifically, using inmates' province of residence, we create two types of groups. The first type is defined by nationality (region of residence for Italians), prison, and province of residence. When, for each prison and nationality (or region), we have inmates of different provinces of residence, we group these inmates together, creating the second type of group. For example, if there are four Moroccans serving time in a prison in Milan and two are from Rome, one is from Turin, and the other from Milan,

Table 6—Baseline Results with Reference Groups Defined using the Province of Residence

	First type of groups same province (1)	Second type of groups different province (2)	First type of groups same province (3)	Second type of groups different province (4)
Individual residual sentence	−0.0011	−0.0036	−0.0014	−0.0036
	(−4.21)	(−5.25)	(−4.65)	(−4.85)
Average peers' residual sentence	−0.0016	0.0004	−0.0013	0.0004
	(−2.88)	(0.47)	(−2.16)	(0.52)
Individual original sentence	−0.0001	0.0000	0.0002	0.0002
	(−1.46)	(0.10)	(2.97)	(0.75)
Average peers' original sentence	0.0001	−0.0004	−0.0000	−0.0004
	(0.93)	(−1.96)	(−0.02)	(−1.73)
Individual characteristics	No	No	Yes	Yes
Average peers' characteristics	No	No	Yes	Yes
Individual type of crime	No	No	Yes	Yes
Peers' averages of type of crime	No	No	Yes	Yes
R^2	0.002	0.021	0.022	0.038
Number of groups	2,024	925	1,877	851
Observations	15,853	2,660	14,491	2,403

Notes: OLS estimates are reported. The dependent variable is equal to one if the individual returned to prison after release and zero otherwise. Robust t-statistics in parentheses. Standard errors are clustered at the group level, where groups are defined by nationality (region if Italians), prison, and the exact month of entry into prison. See text for the procedure employed in constructing reference groups.

the inmates from Rome belong to the first group and the other two to the second group. An analysis of the first group shows indirect effects similar to those observed using the entire sample (Table 6, column 1 and 3), while indirect effects for the second group of inmates are essentially zero (Table 6, column 2 and 4).[16] Although the small sample size in columns 2 and 4 may arguably limit the precision of the results, taken together, the point estimates in Table 6 corroborate the mechanism.

VI. Concluding Remarks

In this paper, we have exploited a unique quasi-experimental dataset in order to document large externalities of a policy that manipulates individual incentives to reoffend by commuting inmates' actual residual sentences into expected sentences. Our estimates suggest that the indirect effect of peers' average incentives not to commit a crime is at least as important as the direct effect of individual incentives to reoffend. These results show that peer effects tend to have a strong impact on criminal behavior, and are consistent with the hypothesis of complementarities in post-release criminal behavior.

[16] Note that these results do not necessarily mean that using province of residence together with geographical origin and detention facility provide a better definition of peer groups. In fact, these results do not exclude the possibility that individuals in the second group actually respond to residual sanctions of individuals of the same nationality included in group 1. As shown in Table 3, we find large indirect effects when peer group is not defined by province of residence. This indicates that it is possible that individuals now in group 2 are part of the peer group defined by nationality and detention facility and are influenced by their peers, but when grouped together (in group 2) they are not subject to peer influence, in line with the mechanism we favor.

In addition to building upon research on peer effects and crime, our study contributes to debate on the effectiveness of incarceration in reducing crime (Donohue and Siegleman 1998; Owens 2009; Barbarino and Mastrobuoni 2008; Buonanno et al. 2011) and, relatedly, policies which introduce alternatives to imprisonment (Di Tella and Schagrodsky 2009). In order to gauge the actual impact of such policies, quasi-experimental studies or randomized experiments should consider the potential of social interactions to amplify the impact of interventions. From a policy standpoint, law enforcement activities can have strong spillover effects through behavioral spillovers (as in this case) or through informational spillovers, as demonstrated in other studies. For example, in their studies on Austria, Rincke and Traxler (2011) document large enforcement spillover of increasing the probability of detection of TV licence fees evaders. To this regard, these results add to the small but growing literature on the externalities of law enforcement activities.

A final issue concerns the generalizability of these results. If our main explanatory channel is complementarity in post-release criminal activities, external validity of the results depends on the possibility of future interactions. Given that the massive release of inmates observed in the Italian prison experiment was an extraordinary provision, this seems limited. Post-release interactions among former inmates are in fact facilitated when they are released together. Nonetheless, findings in the sociological literature (reported above) suggest that former inmates do maintain relationships when they are released in different periods. Leaving prison at the same time, facilitates post-release contact, but it is not a necessary condition for observing complementarities in post-release criminal activity. That said, one must certainly take this issue into account when interpreting the results.

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