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"Incarcerate one to calm the others? Spillover effects of incarceration among criminal groups"

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Incarcerate one to calm the others:
Spillover effects of incarceration among criminal groups

Abstract: This paper documents the effect of peers' incarceration on an individual's criminal activity within small criminal groups. Using established criminal groups, I built a 48-month panel that records the criminal status, Individual imprisonment status and imprisonment status of group members. Panel regressions with individual fixed effects allows me to document five facts. First, the incarceration of a peer is associated with a 5 per cent decrease in the arrest rate among groups composed of two persons. No effect is observed among bigger groups. Second, this effect is present even for incarceration following lone crimes, ruling out an explanation based on common shocks. Third, the probability of committing a group crime strongly decreases, and there is no shift to crime with other peers or lone crimes. Four, this general effect hides significant within-group heterogeneity. The results are consistent with the idea that 'leaders' are not affected by the incarceration of 'followers'. Five, the effect seems to be driven by lower risky behaviour among offenders who remain free, and not by 'criminal capital' loss or deterrence.

1. Introduction

In 2016, the police registered more than 3.6 million crimes in France,[1] which led 19.5 per cent of the population to feel insecure in their neighbourhood.[2] A similar pattern is observed in most of the Western world.[3] Imprisonment is a major tool used to punish crime. Because of its central position in the criminal system and the significant amount of resources dedicated to it – around 3 billion per year in France,[4] and at least 80 billion in the United States – the cost–benefit analysis of this public policy is the object of recurrent political debates, administrative evaluation and research papers. However, while the effect of prison on criminals is frequently compared to the cost of the infrastructures, the effect of prison on the people who used to

[1] Almost 2 million of these crimes were thefts; 400,000 were violent crimes. Data on the number of crimes per county and per month are available at: https://www.data.gouv.fr/fr/datasets/chiffres-departementaux-mensuels-relatifs-aux-crimes-et-delits-enregistres-par-les-services-de-police-et-de-gendarmerie-depuis-janvier-1996/

[2] https://www.interieur.gouv.fr/Interstats/Themes/Sentiment-d-insecurite/Chiffres-cles-Sentiment-d-insecurite

[3] See, e.g., in Europe: http://ec.europa.eu/eurostat/fr/web/gdp-and-beyond/quality-of-life/data/economic-physical-safety

[4] http://www.justice.gouv.fr/prison-et-reinsertion-10036/les-chiffres-clefs-10041/

interact with the incarcerated persons – parents and relatives, friends, children, partners in crime – has rarely been addressed. Yet those spillover effects could drastically change the results of a cost–benefit analysis.

This paper investigates the effect of incarceration on criminal partners who remain free. Indeed, crimes are not always committed by a single person. In addition to well-known criminal organizations like mafias and gangs, a large share of everyday crimes is committed by small groups of people. For example, in France, 15 per cent of all crimes are considered 'in-group' crimes (i.e., committed with at least one other person).[5] When offenders commit some of their crimes with others, their partners are likely to be affected by their incarceration.

This paper uses a rich administrative data set reporting detailed descriptions of all convictions and sentences imposed in France between 2003 and 2010. Criminal partners are defined as people who were convicted together. Using this method generates a sample of 24,735 groups of two offenders and 9,276 groups of 3–7 offenders from 2003–06. Then, starting from when all the members of the group are released from prison after serving their sentences, I built an individual-level panel (up to 48 months long) recording the imprisonment status and criminal activity of individuals and their peers that led to a conviction.

A person who belongs to a criminal group could be in one of three situations: (1) in prison, (2) free but with a partner(s) in prison or (3) free with a free partner(s). The individual-level panel structure of the data allows the use of regressions with individual fixed effects to study people's criminal activity in those three situations. I am mainly interested in measuring the correlation between peers' incarceration and the probability of an individual's arrest. The identification relies on varying the incarceration status – own and peers' – within an offender's period of observation. This strategy has the important advantage that it can overcome self-selection bias arising from the fact that people with high crime rates also tend to have high incarceration rates.

The first and most important finding is that people are less likely to commit a crime that leads to a conviction if their peers are incarcerated. All the effect comes from duos (groups composed of two offenders). Among them, the decreasing effect of peers' incarceration represents 4–7 per cent of the effect of an individual's own incarceration (which drives crime rates to virtually zero). The effect is robust to a large set of controls, in particular those for

[5] In France, committing a crime with other people is generally an aggravating circumstance. The 15 per cent rate excludes road-related offences.

other types of sentences and time-varying conditions. No effect is observed for larger groups (3–7 members).

While difficult to imagine, it is theoretically possible that this correlation was not causal but derives from a common shock inducing both the incarceration of the members of a group and the decreasing criminal activity of the others. To test this hypothesis I run several exercises. I first control for calendar month fixed effects, police force activity and conviction rates. Those controls do not change the effect or the significance of the effect. Second, and more importantly, I measure the effect of incarcerations following individual crimes or road-related crimes. While those incarcerations have a very low chance of being related to the dynamic of the group, they have the same decreasing effect on the criminal activity of the peer. For those reasons, an explanation based on common shocks is very unlikely.

The effect of the incarceration of a peer(s) could be due to either a decrease in people's criminal activity or a decrease in the probability of being arrested, conditional on committing a crime. The latter is possible if the effect on all crime hides a shift from criminal activity associated with a high arrest/conviction rate to activities with a lower arrest/conviction rate. This would be the case if people tend to commit more crimes alone or with a new partner when their peers are in prison, and if those crimes have lower chances of leading to a conviction than in-group crimes.

To test this hypothesis, I measure the effect of peers' incarceration on different measures of in-group and lone crimes. The probability of committing an in-group crime clearly diminishes when peers are in prison. The probability of committing a lone crime marginally diminishes or remains constant when peers are in prison, depending on the group's characteristics. Lastly, the probability of committing a crime with a peer from outside the original criminal group does not seem to be affected. These results reject the hypothesis of a transfer from one type of crime to another with a lower arrest/conviction rate. Thus, the main result could be interpreted as a decreasing effect of peers' incarceration on offenders' criminal activity.

Among duos, the influence is not symmetrical: some offenders' behaviour affects that of their peers more than the other way around. Offenders who were identified by judges at the initial trial (used for the group identification strategy) as the most responsible – i.e. those who received the most severe sentence or who were convicted of the most crimes – or those with the longest criminal records are not affected by the incarceration of their peers. Instead, *their* incarceration affects the criminal activity of their peers. In addition, men and French citizens

affect women and foreigners, respectively, more than the contrary. Those results are consistent with a leader–follower dynamic. Other mechanisms – e.g., the quality of the lawyer, path dependency – can explain some (but not all) of the results.

Several mechanisms could explain the negative spillover effect of incapacitation. They lead to different predictions. First, the effect could come from a decrease in 'criminal human capital'. If this is the case, crimes that require certain skills – like theft or drug dealing – should be more affected than others, such as violence, property damage or drug consumption. Second, crime could decline because the perceptions of the risk or the harshness of the sanctions are affected. In this case, offenders with short criminal careers (especially first offenders) should be more affected than repeat offenders, as they have less knowledge of the judicial system. Third, crime could decrease because people tend to exhibit less risky behaviour – e.g., reduced drug or alcohol consumption – when their peer is in prison. If this is true, impulsive crimes, like destruction or violence, should be more affected.

I present evidence consistent with the idea that crime decreases for duos because people tend to exhibit less risky behaviour when their partner is in prison. Groups convicted for 'impulsive' crimes (violence, destruction, drug consumption) are affected, while groups convicted for 'human capital intensive crimes' (robbery, drug dealing) are not. The perceptions of the risk and the perceptions of the harshness of sanctions do not seem to be affected.

Several aspects of the social dimensions of crime have been documented in recent years.[6] For example, various papers have modelled the importance of social interaction in crime (Glaeser et al., 1996; Zenou, 2003; Calvó-Armengol et al., 2007). Empirically, the importance of the surrounding environment (Freedman and Owens, 2011) and norms (Cook, Ludwig, 1997; Ludwig et al., 2001; Ludwig and Kling, 2007; Fisman and Miguel, 2007; Damm and Dustman, 2014) as well as peers' preferences (Kremer and Levy, 2008; Carrell et al., 2008; Corno, 2015) or perceptions (Pogarsky et al., 2004; Matsueda et al., 2006; Lochner, 2007) have been pointed out. In addition, the criminogenic effect of prison (Bayer et al., 2009; Ouss, 2011; Damm and Gorinas, 2013; Stevenson, 2015), and the effect of prison on the social organization of a neighbourhood (Rose and Clear, 1998; Clear et al., 2003) or the spillover effect of suspended prison sentences (Drago Galbiati, 2012) have been documented.

[6] I mainly talk here about recent empirical papers in economy. However, other fields have extensively discussed the social dimension of crime for a very long time, especially in sociology (see Durkheim, 1893; Durkheim, 1894; Becker, 1963 or Foucault, 1975).

This paper expands the existent literature in several ways. First, it documents an unexplored channel of peer effects on crime. While the effect of the network size (Corno, 2015), the quality of the peers (Corno, 2015), their criminal capital (Grund and Desley, 2014; Bayer et al., 2009; Ouss, 2011; Damm and Gorinas, 2013; Stevenson, 2015), their perceptions (Pogarsky et al., 2004; Matsueda et al., 2006; Lochner, 2007) and what they risk if they commit a crime (Drago and Galbiati, 2012) have already been documented, the spillover effect of the incapacitation of a peer through imprisonment have not yet been explored empirically. This question is not trivial. Indeed, among criminal groups, the incarceration of one person could, *a priori*, restrain others from offending – e.g., by increasing the perceived cost of crime or decreasing the criminal opportunities – or encourage them to – e.g., by transferring crimes that should have been committed by the incarcerated person to the others. Therefore, it is especially important to document the direction of the effect.

By documenting this question, this paper directly measures the effect of what is happening to the peer (in a dynamic way, as in Lochner, 2007), instead of the standard approach of measuring the importance of peers' characteristics (Grund and Desley, 2014; Bayer et al., 2009; Ouss, 2011; Damm and Gorinas, 2013; Stevenson, 2015; Drago and Galbiati, 2012).

Second, this paper is the first to provide consistent empirical evidence of a leader–follower dynamic among criminal groups (few theoretical papers deal with this question; see Ballester et al., 2006; Liu et al., 2012). Peer effects are not considered symmetrical; rather, they depend on the characteristics of the members.

Third, this paper uses a novel and simple way to define peer groups. While most of the literature defines a peer group as comprising people 'in the same place, at the same time, sharing same characteristics' (Bayer et al., 2009; Damm and Gorinas, 2013; Stevenson, 2015; Drago Galbiati, 2012) or people from the same family (Case and Katz, 1991; Hjalmarsson and Lindquist, 2012; Lochner 2007), this paper defines peer groups as groups of offenders who have already been sentenced together. This strategy has several advantages. First, the link between offenders is certain, and there is no need for an incremental search for the characteristics that could define the peers. Second, groups are already settled, and the effect of the relations can be measured net of the question of their creation. Several papers in sociology or criminology have studied settled criminal groups, but they mainly focus on large gangs and document the common dynamic of the groups (Papachristos, 2009; Papachristos et al., 2013;

Levitt and Venkatesh, 2000) or the difficulties of desistence (Mohammed, 2012; Pyrooz, 2014).

The rest of the paper is organized as follows. Section 2 presents the data. Section 3 presents the identification strategy. The main results are presented in section 4. Section 5 presents the effect for different types of crime – in-group, commit with another peer or alone. Section 6 presents the effects depending on offenders' position within the groups. Section 6 addresses the mechanisms, and section 7 concludes.

2. Data description

2.1. Identifying peer groups

The original data set used in this paper is the criminal record compilations from the statistics service of the French Ministry of Justice (Sous-Direction de la Statistique et des Études). These compilations contain the results and details of all criminal cases judged each year. Each individual is identified by a single ID (constant through the period), which enables the reconstruction of his or her penal history. Data from the 1998 to 2012 are available. However, because a large amnesty took place in 2002, I used only the years from 2003 to 2012.

In this paper, I define people as belonging to the same criminal group if they were convicted of a crime committed together. This information is not directly registered in the data set, as there is no ID per crime (but per criminal). However, one variable of the data set for each individual indicates whether the person was convicted of a crime committed "in group"[7]. This does not necessarily mean that the rest of the group was arrested. A crime could be registered as a "robbery in group" even if only one of three robbers working together was arrested.

To identify criminal groups, I proceeded as follow. First, I kept only records of people convicted of crimes committed "in group". Those people had criminal partners even if their peers were not necessarily arrested. Second, among this group, I considered that people were convicted of the same crime when they were judged in the same place (of 175 courts), on the same date (of approximately 1200 possible dates), and for the same type of crime (of 200 categories that could be "in-group") committed on the same day. Those criteria are restrictive. For example, people could have committed a crime together and been judged on two different

[7] People convicted of a crime "en réunion", "en association", as "complice" or in a "trafic".

days. However, those cases are hard to identify, and the strict criteria limit the number of false matches. For the same reason, the groups I identify could be sub-parts of bigger groups.

Among the 199,082 persons who committed a crime "in group" between 2003 and 2006, I found at least one partner in 55.6 per cent of the cases. In comparison, the same strategy applied to offenders who did not commit a crime described as "in group"[8] led to the discovery of a "partner" in 17.13 per cent of the cases. This rate could be viewed as high and problematic if it were interpreted as a "false match rate" equal to one-sixth. However, this interpretation is not correct. First, the latter group is five times larger than the former (1,075,497 vs. 199,082). In a large group, there is, statistically, more chance of finding two persons convicted the same day in the same court for a crime of the same type committed on the same day. If 17.13 per cent represents the proportion of false matches among 1,075,497 offenders, then this rate is 3.1 per cent in the group of interest. Second, a large proportion of the "false matches" may be real matches that were rejected from the main data set because of the strictness of the criteria. For example, approximately 23 per cent of the matches were found in the categories "robbery with two aggravating circumstances" and "violence with two aggravating circumstances". They probably represented crimes committed "in group" even if this aggravating circumstance was not clearly mentioned because of the presence of a second one[9].

Juveniles are dropped, as specific courts, under specific rules, judge them. Moreover, the dynamics of groups composed of juveniles are probably different. Descriptive statistics of the population are presented in table 1. In 2003-2006, offenders who belonged to a group (first 4 columns) were younger than those who committed crimes alone (last two columns): 26.4 years old vs. 32.7 years old. They were mainly men (88 per cent), French (83 per cent) and almost 50 per cent had been previously convicted in the past 5 years. Among groups, robbery and drug-related offences were overrepresented. Drug crimes were more represented among groups, and especially among "large" groups: 19 per cent for groups with more than 3 persons compared to 13 per cent for duos and 10 per cent for crimes committed alone. Criminals who belonged to a group got higher sentences: average prison sentences were twice as long (3.9 months vs. 1.8 months). The larger the group, the longer the sentences.

[8] Road-related offences are omitted here because they could not be committed "in group". They are mainly composed of driving under influence and driving without a license or insurance.
[9] Another 16.5 per cent is composed of drug use without the mention of trafficking. In France, the difference is driven mainly by the quantity seized by the police.

2.2 Homophily

Before describing the construction of the Panel data I use in the rest of the paper, it is interesting to measure how state variables—e.g., age, sex—are distributed among groups. The underlying question is to understand how characteristics of offenders of the same group are correlated and how offenders are self-selected in groups. As mentioned earlier, some papers already partly document this point (see, e.g., Young, 2011 on racial homophily).

I document homophily among duos by measuring the proportions of groups with similar or different characteristics. As a benchmark, I calculate the same proportion for 100 random rearrangements of the database. In one rearrangement, each offender is randomly matched with another who has been convicted in the same calendar month in the same county. Then, each rearrangement is composed of random groups.

The results are presented in table 2 for the following characteristics: sex, age, nationality and past conviction. For all of those characteristics, real duos are less frequently mixed and more frequently similar than expected. For example, 78 per cent are composed of two French offenders and 10 per cent of one French and one non-French offender. As a comparison, among the random rearrangements, the duos are, on average, 69 per cent French and 28 per cent non-French. Comparisons with theoretical distribution (based on means in the sample) are presented in appendix A, which provides results similar to those based on random rearrangements.

2.3. Panel data

The procedure described in section 2.1. allowed me to identify partners in crime. However, the goal of this paper is to study the dynamics of those groups. More precisely, the central research interest is to document the effect of peers' incarceration on an individual's criminal activity. To address this question, I use the groups identified in section 2.1 and build a monthly panel recording criminal activity and incarceration in the four years following the joint conviction day.

Although the initial trial is used to identify criminal groups, I do not want the results to be distorted by this first joint conviction, for which offenders' outcomes are necessarily closely

related. For this reason, and except where otherwise specified, I start the construction of the Panel after the end of all the group's prison terms resulting from the first trial. The offenders are followed in the 48 months following the initial trial. Then, the panel is, at max, 48 months long (48 months minus the time during which members of the group serve sentences following the joint trial). A stylized form of the data is presented in Figure 1.

The presence of an individual ID allows me to reconstruct a person's criminal career. I use it to record all crimes committed[10].

For each month of the Panel, I also measure if people are in jail or if they are 'in jail with possibility of full parole'. Indeed, the data set precisely records pre-trial detention length and dates, sentences and procedural variables.[11] The latter indicate whether prison sentences are enforced just after the trial (the offender is sent directly to jail, and the entry date is the trial date) or whether the opportunity to transform the prison sentence into probation or community service is left open – that is, the offender goes home and is summoned a few days later by another judge who eventually modifies the sentence. In the second case, offenders have less than one chance in four of going to prison. The sum of pre-trial detention and prison sentences that could not be modified represents 85 per cent of the total time spent in jail each year in France. Additional information on the construction of these variables is provided in Appendix B.

I also gather information about the criminal activities and incarcerations of peers. The three most important variables of the Panel answer the following questions: did person *i* commit a crime during month *t*? Is person *i* in jail during month *t* (with or without the possibility of conversion into probation)? Are person *i*'s peers in jail during month *t* (with or without the possibility of probation)?

I distinguish according to the size of the group: duos or groups of three to seven. The final sample contains 24,735 duos, i.e., 49,470 offenders and 2,267,048 observations (48 months x

[10] Observations are registered in the database according to the trial date. This means that crimes for which offenders have been arrested but not yet convicted are not registered in the database. In order to avoid a mechanical decrease in criminal activity (because some new offences have not yet been judged), I homogenized the construction of the panel. For every offender, I searched for new crimes committed in the following 4 years *and judged in the following 6 years*. This period is long enough to identify the vast majority of the new crimes: more than 80% of crimes are judged in less than 2 years, so the last period of the panel is not distorted. Moreover, data for groups composed in 2003 are similar to those for groups composed in 2008.

[11] The procedure is called *mandat de dépot*. If the judge uses it, the criminal is sent directly to jail. He will not be allowed to ask for adjustment before a certain amount of time has passed, and he will usually spend his entire sentence in jail. If there is no *mandat de dépot*, the judge's will is clearly to avoid prison but to give a strong warning.

49,470 offenders minus prison term resulting from initial trial), and 9,037 groups[12] of three to seven persons[13] (31,098 offenders and 1,373,284 observations)[14].

The table 3 presents descriptive statistics of the Panel. The first two columns present the statistics for all groups while columns 3 and 4 presents describe duos and bigger groups separately. Offenders commit at least one crime in 2.1 per cent of the months (2.2 per cent among duos, 1.9 per cent for bigger groups). Crimes explicitly labelled 'in-group crimes' are relatively rare (0.3 per cent of the months/15 per cent of the crimes). Some of those crimes are committed with the same peer (0.03 per cent of the months/1.3 per cent of the crimes and 8.8 per cent of in-group crimes) and some with other offenders (0.16 per cent of the months/7.6 per cent of the crimes and 50 per cent of in-group crimes). In the remaining cases, the identity of the other offenders is not identified. These low rates are explained by the fact that in-group crimes are not always flagged by the criminal justice system, either because other members have not been identified or because the classification is not important.

As I will later want to determine how people react to the incarceration of their peer for lonely crime (see section 4.3.) and whether people increase their criminal activity alone (see section 5.), defining 'in-group' crimes as only those that are flagged as such – and lone crimes as those that are not flagged – could be too restrictive. In contrast to the work presented in section 2.1, I will not need to identify peers in the case of in-group crimes, but I will be interested in the evolution of lone crimes. Thus, I will need a more conservative define a lone crime.

I classify every type of new crime as 'in-group', 'probably in-group', 'probably alone' or 'alone' based on how likely it is, for this crime identifier (2,500 identifier), to find criminals convicted on the same day in the same place for the same crime committed on the same day. If, for one crime identifier, matches are common, I can reasonably assume that a large portion of those crimes were committed in a group – even if they are not flagged as in-group crimes – and thus categorize them as 'in-group' crimes. In contrast, if I rarely find potential groups, I can label the crime as 'alone'. The 'probably in group' and 'probably alone' aggregates classified all possible offences. The first group (resp. second) is composed of offences for

[12] The breakdown is 6,211 groups of three, 1,868 groups of four, 616 groups of five, 216 groups of six, and 126 groups of seven.
[13] Larger groups exist, but they are extremely rare. They are not used in this paper.
[14] The sample sizes are slightly smaller that those given in section 2.1 because some groups are composed of offenders who all spend all the month of the panel in jail. Those groups are dropped.

which the average number of match per offender is above (resp. below) than 0.4[15]. 'In group' and 'alone' aggregates are restrictive measures of 'probably in group' and 'probably alone', respectively. The first group is composed of offences with an average number of match above 0.80, while the second group is composed of offences with an average number of match below 0.10. A more precise description of the construction of these measures is presented in Appendix C. In the rest of the paper, I'll use quote around 'alone' and 'in-group' (or 'probably alone' and 'probably in-group') to indicate that I am referring to these constructs.

Offenders commit a new crime that is probably committed in group in 0.8 per cent of the months, and a new crime that is probably committed alone in 1.3 per cent of the months (0.8 per cent and 1.4 per cent among duos, 0.7 per cent and 1.2 per cent, among larger groups). Crimes classified as 'alone' occurred in 0.7 per cent of the months, and those classified as in group occurred in 0.5 per cent of the months (0.5 per cent and 0.8 per cent among duos, 0.6 per cent and 0.4 per cent, among larger groups).

Imprisonment is slightly more frequent than crime: 2.5 per cent of the months are spent in jail (for sure), and an additional 1.4 per cent of the months are spent in prison or on probation (because some prison sentences could be converted into probation, as mentioned before). Incarceration is more frequent among duos: 2.7 per cent of the months vs. 2.2 per cent for groups of three to seven persons..

The probability of having one peer incarcerated while being free is 2.4 per cent among duos. This situation is more frequent in larger groups (4.8 per cent). 0.4 per cent of the incarcerations of the peer followed crimes classified as 'alone' and 0.11 per cent followed road related crimes. While having one peer in prison is more common among large groups, having one peer in prison for 'lonely' crime is less frequent: 0.3 per cent vs. 0.5 per cent among duos.

The second part of table 3 displays information about aggregate characteristics per offender. This is important, since when using Panel data, identification relies on intra-individual variations. More than 40 per cent of the offenders involved in a group committed a new crime during the panel (46.6 per cent for duos, 42.2 per cent for larger groups). Approximately 20 per cent spent some, but not all, of the months in jail (21.6 per cent for duos, 20.7 per cent for

[15] Note that this measure is different than the probability to find one match. This is the reason why the numbers presented in this paragraph seem high in comparison to the match rate found in section 2.1.

larger groups), and between 16.4 per cent (duos) and 30.1 per cent (large groups) spent some months free while at least one of their peers was in jail.

3. Identification strategy

3.1. Framework

The first question addressed in this paper is the effect of peers' incarceration on an individual's own criminal activity.

Among a duo composed of persons *i* and *j*, there are four possible situations regarding incarceration status. *I* and *j* could both be free, *i* and *j* could both be in jail, *i* could be in jail while *j* is free, or *j* could be in jail while *i* is free. However, regarding, e.g., person *i*'s situation, two of the situations are similar (the same is true for *j*). When *i* is in jail, person *j*'s situation is not important because whatever *j*'s incarceration status is, person *i* has a very limited capacity to commit a crime. Even though some crimes are possible in jail, they could hardly be related to former partners, as people convicted together are usually separated by penitentiary administrators. Thus, regarding person *i*'s situation, there are only three situations:

1) *i* is in jail;
2) *i* is free and can enjoy the company of peer *j*; and
3) *i* is free but cannot see *j*, who is in jail.

Because of the incapacitation effect, *i* is supposed to have a very low criminal activity in the first situation. The main focus of this paper is to measure whether *i* has lower, higher or equal criminal activity in situation 3 compared to situation 2. As previously mentioned, different reasons could explain any of those three results. First, *i* could have a lower crime rate when *j* is in jail because she missed *j*'s criminal human capital; she changed her perception of risks; or she adopted less risky behaviour (see section 7.1. for a discussion of those mechanisms).

Second, *i* could have a higher crime rate when *j* is in jail because she has to do both his criminal job and her own—for example, if she starts to sell *j*'s drugs or has to supply *j* s clients. *I* could also have a higher *detected* crime rate if she has more chances to be arrested when she commits crimes alone.

Lastly, *i* could be unaffected by *j*'s incarceration. The criminal group could be unstable over time. It is also possible that *i* replaces *j* with someone else when *j* is in jail. This is particularly likely if the duo is a small part of a large network in which offenders can easily be replaced (see section 5.1. for a discussion of those mechanisms).

Those theoretical effects of a peer's incarceration also hold for groups larger than duos. However, as the group grows, the third hypothesis—no effect of *j*'s incarceration—becomes more likely because one person's incarceration becomes more and more anecdotal.

3.2. Empirical strategy

I estimate equations of the form:

$$Crime_{i,t} = \alpha_i + \gamma_t + \beta_1 * \mathbb{1}_{i's\ peer\ in\ prison} + \beta_2 * \mathbb{1}_{i\ in\ prison} + \delta * X_{i,t} + \varepsilon_{i,t} \quad (1)$$

Under the assumption that the conditional mean of the errors is zero:

$$\mathrm{E}(\varepsilon_{\mathrm{i,t}} \mid \mathbb{1}_{i's\ peer\ in\ prison}, \mathbb{1}_{i\ in\ prison}, \mathrm{X_{i,t}}, \alpha_i, \gamma_t) = 0 \quad (2)$$

$Crime_{i,j,t}$ is a measure of crime committed by person *i*, who has peer *j* during month *t*. α_i and γ_t are the individual and month of the within-spell fixed-effects. $\mathbb{1}_{i's\ peer\ in\ prison}$ is a dummy equal to one if person *i* is free but at least one of his peers is in jail.[16] $\mathbb{1}_{i\ in\ prison}$ is a dummy equal to one if *i* is in prison. $X_{i,t}$ is a set of time-dependent control variables. ε is an error term. Standard errors are clustered at the group level.

β_1 measures the effect of the incarceration of a peer (when *i* is free) on *i*'s criminal activity. It is the coefficient of interest. β_2 measures the effect of *i*'s incarceration on *i*'s criminal activity and is expected to be strongly negative and significant. The main measure of crime is a dummy equal to one if *i* commits at least one crime during month *t*.

The condition presented in equation 2 could be violated (and the estimation based on equation 1 biased) for several reasons. First, prison is not the only punishment to which people can be sentenced. If a peer's imprisonment is correlated with an individual's own probation period or a longer suspended prison term – for example, because offenders committed a new crime

[16] Having more than one peer in prison while being free oneself is too rare an event to be studied separately.

together but only one was sent to prison – the effect measured by β_1 in equation 1 will be biased downward. I overcome this problem by adding variables that control for the two other possible sentences:[17] probation and cumulative suspended prison time. In robustness checks I also control for possible cyclical behaviour: time since the last trial.

Second, both a person's incarceration and the criminal behaviour of his peer(s) could be driven by a common shock. Even if such a shock is difficult to imagine, it is theoretically possible. In a sense, this is a general problem that includes the one mentioned in the preceding paragraph. Although I cannot fully reject this hypothesis, I prove it is unlikely in several ways. First, in section 4.3, I measure the effect after controlling for time and/or local conditions. Those tests allow me to rule out the possibility of a common shock at the month or county level. Second, and more importantly, I measure the effect of incarcerations that are plausibly exogenous to the group dynamic: incarceration for a lone crime, incarceration for a road-related crime, incarceration for a crime committed several weeks before. Lastly, I present the heterogeneity of the result regarding the characteristics of the offenders in comparison to their peers (section 5) or in general (section 6). While those results fit perfectly with a story based on the spillover effect of prison, they make the alternative stories more unlikely as the set of results that should be explained increases.

4. Peers' incarceration and propensity for crime

4.1. Graphic evidence

I first document the effect of incarceration by measuring the probability of committing a crime just before and just after imprisonment or release. I run this exercise for both an individual's own and his peer's incarceration. I use a time window of three months before/after the event. For the effect of peers' incarceration, I keep only offenders who remain free during the entire period, as imprisonment among groups is correlated. The effect of one's own incarceration and release among duos is presented in graph 2. The effect of peers' incarceration and release is presented in graph 3.

[17] A fine is another type of sentence. However, since fines are paid at only a single point in time, they do not have a length or any timing dimension that could be correlated with peers' incarceration.

As expected, criminal activity sharply decreases after one's own incarceration (graph 2a) and increases after one's own release (graph 2b). The crime rate logically peaks just before incarceration: people must commit a crime to be sent to jail[18].

The picture is less sharp for the incarceration of the peer. However, the results go in the same direction (graph 3). Offenders decrease their criminal activity after the incarceration of a peer (graph 3a) and slightly increase it after the peer's release (graph 3b).

Another way to explore the question is to measure the proportion of crimes that are committed while in jail, free with the peer in prison or free with the peer also free. As criminal behaviours tend to be correlated within groups, a simple comparison over the sample would be biased. Indeed, crime rate while the peer is in prison will be high because people with high rates of criminal activity are in groups with people who have a high incarceration rate. However, it is possible to overcome this problem by measuring the crime rate for the three different situations conditionally over the sum of crimes committed during the Panel. Then, the question is as follows: for offenders who commit 1 (or 2, or 3, etc.) crimes over the period, which part of those crimes are committed while in jail, free with the peer in prison or free with the peer free?

The results are presented in graph 4. For every total number of crimes over the 48-month period (from 1 on the left to 5 on the right), the per-month probability of committing a crime while in prison is extremely low, and the probability of committing a crime while free is smaller if the peer is in prison.

The evidence of those two graphs appears in the direction of a decreasing effect of peers' incarceration on an individual's own criminal activity.

4.2. Main results

The measurements of the effects of one's own and a peer's incarcerations following equation 1 are presented in table 4. The outcome variable is a dummy equal to one if a crime was committed during the period. The decreasing effect of one's own incarceration is presented in the first two rows (coefficient and s.e.), while the effect of peers' incarceration is presented in rows 3 and 4. The first two columns present the results for the entire sample. Columns 3 and 4

[18] The time between a crime and a trial could largely exceed one month. For this reason, the crime rate the month before incarceration is not one.

present the effect of peers' incarceration among duos and the last two columns present the effect of the incarceration of at least one peer within a group of 3–7 persons.

In all six columns, rows 1 and 2 indicate that an individual's own incarceration decreases the probability that he will commit a crime by almost 100 per cent, which is consistent with a full incapacitation effect. Unsurprisingly, this result is significant at the 1 per cent level.

The most important result comes from the coefficients observed in rows 3 and 4. For the entire sample, the effect of peers' incarceration is both negative and strongly significant. In column 1, which contains only individual and within-spell fixed effects, it represents 3.5 per cent of the effect of one's own incarceration. This result holds after controlling for other possible sentences (column 2) even though the magnitude decreases slightly: 2.8 per cent of the effect of one's own incarceration.

The coefficients of the variable "Probation or suspended prison sentence" are negative and usually significant. However, they are at least 7 times smaller than those observed in the first line. This confirms the observation made in the data section: prison sentences that *can* be converted into probation usually are.

The other columns of table 4 measure the effect for different group sizes. The incarceration of the peer clearly decreases criminal activity for pairs of offenders. The effect of a peer's incarceration represents slightly more than 5 per cent of the effect of one's own incarceration, and it only marginally changes with the introduction of control variables for other sentences (column 4). These results are significant at the 1 per cent level.

By contrast, among groups of 3–7 offenders, the incarceration of one peer has no effect (columns 5 and 6). Coefficients are small – they represent less than 1 per cent of the effect of one's own incarceration when controls are added – and not significant. Note that this result means that the effect of peers' incarceration presented in columns 3 and 4 could be biased toward zero. Indeed, duos could be subgroups of larger groups.

As table 4 indicates that all the effect comes from groups of two persons, the rest of the paper will present the results for this sub-group. Similar results for the entire sample, and for groups of 3–7 persons, are presented in appendix E and F, respectively.

4.3. Common shocks and exogenous incarcerations of a peer

The most straightforward explanation of the results presented in table 4 is that the incarceration of one's partner causes a decrease in the arrest rate among pairs. However, it is also possible that a common shock induced both the incarceration of one offender and a decrease in the criminal activity of the other. While a shock that causes such different effects in each member of a criminal pair is difficult to imagine, it is theoretically possible.

The main alternative explanation is that the results could derive from an increase in police surveillance of peers when one member of a group has been arrested and convicted. If this is the case, the main results should be interpreted as the deterrence effect of police surveillance, rather than the spillover effect of prison. However, such an increase in police surveillance is unlikely for two reasons. First, while an increase in police surveillance of peers when one member of a criminal group has been arrested is possible, it is necessarily limited to very specific (and severe) cases. Indeed, surveillance is extremely costly and could not be enforced on numerous criminals. For example, following the Paris bombing, police authorities stressed that close surveillance of the 4,000 suspects would require more than 40,000 policemen, which was not possible at that time.[19] Second, if the effect were driven by an increase in police surveillance, I would observe a decrease in all forms of recidivism and plausibly for all offenders. Yet this is not the case. As shown in section 5, the effect is different for different types of recidivism, and sections 6 and 7 explain that the effect is different for different types of offenders; those who are the most likely to be targeted by police surveillance are those who react the least (see section 6 mainly).

In order to more systematically test the hypothesis of a common shock, I run several exercises. I first measure the effect of the incarceration of the peer after controlling for different measures of context. In the first three columns of table 5, I run regressions of the form presented in column 4 of table 4 with additional control variables: calendar month fixed effects in column 1, controls for the number of crimes committed in the county during the month as registered by the police (number of very severe crimes,[20] number of crimes, number of property crimes, number of violent offences, number of drug-related crimes, number of property damages) in column 2, and controls for the number of convictions in the month in the county (total and 19 sub-categories) in column 3. The results are not affected by the inclusion of these control variables.

[19] See: http://www.lefigaro.fr/vox/politique/2015/06/26/31001-20150626ARTFIG00329-arnaud-danjean-pour-surveiller-4-000-suspects-de-terrorisme-il-faudrait-40-000-policiers.php

[20] These are defined in the French legal system as rape, murder, torture and violence causing permanent disabilities.

In columns 4 to 6 I distinguish between different origins of the incarceration of the peer. In column 4 I differentiate between incarceration of the peer following 'lone' crimes (see section 2.3) and other types of incarceration, since the former could reasonably be considered to be driven by motivations unrelated to the peer. If they *do* have an effect, this could hardly come from a common shock to the group. Note that incarcerations that do not follow `lone' crimes are not necessarily committed in-group (it is just more likely).

Column 4 indicates that a peer's incarceration following 'lone' crimes has the same effect as a peer's incarceration following other types of crime. The magnitudes are exactly the same, and the two coefficients are not statistically different (p-value = 0.855).

In column 5 I run the same exercise using incarceration following road-related offences – a lone crime by definition – vs. other incarcerations. While the coefficient of the former is not significant because the events are rare, it is not statistically different from the coefficient of the latter (p-value = 0.978), and the magnitudes are identical.

Lastly, in column 6, I distinguish between incarcerations following a crime that was not committed in either the month of incarceration or the previous month, and other incarcerations. Once again, the former event has a lower likelihood of being correlated with a decrease in crime due to a common shock. Both types of incarcerations have an effect. While one coefficient is smaller, the difference between the two is not statistically significant (p-value = 0.367).

The results presented in table 5 clearly contradict the hypothesis that the effect of the incarceration of a peer is driven by a common shock.

4.4. **Robustness checks**

Appendix D presents some robustness checks of the main results. The first test addresses the technical question of the negative bias of the coefficients in fixed-effects panel regression models with weakly exogenous regressors when the cross-section dimension is large relative to time. Following the recent econometric literature, column 1 computes half-panel jackknife fixed-effects estimators (Chudik et al. 2016). The results are similar and of the same magnitude. Column 2 presents the results using logit regressions. Column 3 measures the effect using the number of crimes committed during the month (and not a dummy equal to

one if there was at least one crime). The biggest counties – where the risk of a false match is higher – are excluded in column 4. Column 5 presents the results when all the periods following the trial used for group identification are included, even if a member of the group serves a sentence following this trial. In column 6, I control for the time since the last conviction. As previously mentioned, this control takes into account the potential monotonicity of the criminal behaviour. Lastly, column 7 presents the results when the sample is transformed into a fully balanced 36-month panel. All those tests only marginally affect the results.

In addition to the robustness checks, I conducted a permutation test exercise for duos. I use the main database to randomly reconstruct groups. Random groups must be composed of offenders who committed their first crime in the same calendar month in the same county. Those random groups are composed of offenders who faced the same conditions—same unemployment rate, same police activity, similar deterrence, etc. If the results presented in tables 4 and 5 come from common shocks at the county and month level, then we should see an effect of the incarceration of the peer in a random group composed of offenders first convicted in the same county at the same time.

I reiterate the procedure 150 times and measure the effect of one's own incarceration, peers' incarceration and control variables for other sentences. The effect of one's own incarceration is always significant and similar to the results presented in tables 4 and 5. This is not surprising, as the permutation test only changes the groups' constitutions. The kernel density of the coefficients measuring the effect of peers' incarceration is presented in graph 5. The red bars represent the coefficients obtained with real groups. The placebo distribution is normal and centered on zero. Real coefficients are largely smaller than what is obtained with random groups. None of the iterations yield coefficients that are smaller than the real ones.

The results presented in this robustness checks confirm that peers' incarceration has a sizable decreasing effect on the probability that offenders will be arrested and convicted. The magnitude of the effect represents roughly one-twentieth of the effect of one's own incarceration.

The natural way to interpret the findings presented in table 4, table 5 and in the robustness checks is that peers' incarceration decreases criminal activity. However, the observed effect could come from a decrease in the probability of *being arrested for* committing a crime rather

than a decrease in the criminal activity itself. This could be the case if the net effect masks a change in the type of crime committed. The next section discusses this issue.

5. Peers' incarceration, recidivism type and probability of arrest

5.1. Framework

A classic problem in the economics of crime literature is that we only observe crimes that lead to an arrest or/and a conviction. Authors usually make the assumption that the treatment they are interested in does not affect the probability of *being arrested conditional on* committing a crime. This assumption does not necessarily hold here.

In section 4 I measured the effect of incarceration on registered crimes – i.e. on the probability of committing a crime that leads to a conviction. This probability can be factorized as:

P(conviction)= P(conviction | committing crime)*P(committing crime) (2)

Then, the decreasing effect on conviction could come from either a decreasing effect on criminal activity or from a decreasing effect on conviction rate conditional on committing a crime.

In order to document this alternative, it is possible to distinguish between the different types of crimes. Suppose that person A is identified as belonging to a group with person B. Person A could commit three types of crimes: in-group crime with person B, in-group crime with somebody who is not B or lone crime. Thus it is possible to re-write Equation 2 as:

$$P(conv) = P(conv\ crime\ with\ B) + P(conv\ crime\ with\ C) + P(conv\ crime\ alone) \quad (3)$$

Where C is any other criminal who is not B. Each probability of the right member of the equation could be written as the product of the probability of committing the crime times the probability of being arrested if the crime is committed. Then, it is possible to write:

$$P(conv) = P(Conv_B|C_B) * P(C_B) + P(Conv_C|C_C) * P(C_C) + P(Conv_{lone}|C_{lone}) * P(C_{lone}) \quad (4)$$

Where $conv$ denotes 'conviction' and the index indicates the type of crime. In Equation (4), the probabilities of being convicted associated with the different types of crime have no reason to be similar. Therefore, the overall decreasing effect of peers' incarceration on $P(conv)$ could hide a constant (or even an increasing) criminal activity. Indeed, if

$$P(Conv_B|C_B) > P(Conv_C|C_C) \qquad (5)$$

$$\text{or } P(Conv_B|C_B) > P(Conv_{lone}|C_{lone}) \qquad (6)$$

then it is possible to have a decrease in $P(conv)$ hiding a decrease in $P(C_B)$ and an increase (potentially bigger) in $P(C_C)$ or $P(C_{lone})$. Note that if A used to commit crimes with B, then conditions (5) or (6) are not the most likely. Indeed, if two crimes are possible, offenders probably try to avoid committing the one with the highest likelihood of a conviction, except if it is compensated by higher gains.

Even if (5) or (6) hold, it is reasonable to suppose that $P(Conv_C|C_C)$ and $P(Conv_{lone}|C_{lone})$ are not affected by B's incarceration. It is unlikely that the incarceration of B changes the probability of being convicted when committing a crime with somebody who is not B or alone. If anything, the later two probabilities would probably move upward. Indeed, if A commits a crime alone *because* B is in jail, it is a lesser evil, and is probably associated with higher risks.

If the probabilities of being convicted conditional on committing different types of crimes are (more or less) orthogonal to whether peers are incarcerated, measuring the effect of peers' incarceration on $P(conv\ for\ crime\ with\ B)$; $P(conv\ for\ crime\ with\ C)$; and $P(conv\ for\ crime\ alone)$ will give a very good proxy for the effect on $P(C_B)$, $P(C_C)$ and $P(C_{alone})$, respectively. Thus, this is a way to test the hypothesis of a shift from one type of crime to another.

5.2. Results

The effects of peers' incarceration on in-group or lone crimes are presented in table 6. All regressions include controls for other possible sentences (probation and suspended prison sentence). The sample size is restricted to groups composed of two persons (similar results for all groups and for triplet to septuplets are presented in appendix E table E2 and appendix F table F2 respectively). Columns 1 to 4 present the effect on crimes that are flagged as in-

group crimes (columns 1 to 3) or not (column 4). For crimes labelled 'in-group crimes', it is sometimes possible to identify the other members of the group. Therefore I present the results for all crimes flagged as in-group crimes (column 1), crime with the same peer (column 2) and crime with another peer (column 3). The last two cases do not cover all the crimes labelled as in-group, as the partners are not always identified.

The incarceration of the peer has a very large effect on in-group crimes. This is true both for all crimes flagged as in-group crimes (column 1) and for crimes committed with the same peer (column 2) – the effect is, mechanically, almost equal to own incarceration.[21] The effect of the incarceration of a peer on crime committed with other persons (column 3) is extremely low and not significant. The important thing is that there is no evidence of a "replacement effect", i.e. of a shift from one peer to another. If any, the coefficients presented in column 3 are negative. Lastly, the effect of peers' incarceration on crimes that are not labelled in-group crimes is both negative and significant.

Taken together, the results presented in the first four columns of table 6 do not support the hypothesis that there is a shift from one type of crime to another. However, and as I mentioned in section 2.3, the in-group flag is a good way to identify in-group crimes but a poor way to identify lone crime. Indeed, some of the crimes that are not flagged could have been committed in-group. For this reason, columns 5 to 8 of table 6 present the effect of peers' incarceration on different definitions of lone and in-group crimes based on the average matching rate for the same crime identifier (see section 2.3 and appendix C for more details). Column 6 presents the effect on crimes classified as 'probably in-group' and column 7 presents the effect on crimes classified as 'probably alone'. Columns 5 ('In-group') and 8 ('alone') present the same results when using more restrictive categories.

All the coefficients of the effect of peers' incarceration presented in columns 5 to 8 are negative. They range from approximately 7.5 per cent of the effect of one's own incarceration for in-group crimes to less than 1 per cent for lone crimes. Coefficients are significant for 'in group', 'probably in group' and 'probably alone'. The coefficients for 'alone' is not significant. Therefore, the results indicate that peers' incarceration strongly affects the probability of committing a crime in-group. Lone crimes marginally decrease or remain unaffected.

[21] Note that committing a crime with the same peer is still possible. Indeed, offenders could commit a crime during a temporary absence from prison, in the case of early release or traffic between inside and outside prison.

The results presented in table 6 clearly reject the idea of a shift from crimes committed with one peer to crimes committed alone or with other partners. Taken together, they reinforce the idea that peers' incarceration decreases offenders' criminal activity.

6. Peers' incarceration and position within groups

Up to this point, all offenders were considered to play a symmetric role in the group. However, their importance within their groups is probably not homogeneous. For example, one person may be the leader of the group, have expert knowledge, have a denser criminal network, be smarter than others, etc. In all such cases, the implication for the people in the group dynamic is heterogeneous. Thus, the incarceration of a "key player" could have more effect on others' criminal behaviour than the incarceration of less central members of the group. The goal of this section is to test this hypothesis.

6.1. Within-group heterogeneity

I measure within-group heterogeneity of the effect along two main dimensions: heterogeneity in judicial characteristics at a joint trial (the one that allows me to identify the group in section 2.1) and heterogeneity in state variables. The first dimension is composed of three sources of heterogeneity (measured at the joint trial): the sentence obtained, the number of charges,[22] and the length of the individual's criminal career. When those variables are not equal within a group, they may signal some form of heterogeneity in the influence of the members.

Offenders who receive longer sentences at a joint trial are usually identified by the judge as having more responsibility for the crime. This difference is even clearer for offenders who are convicted (during a joint trial) of more infractions than their peers – e.g., those who are convicted for theft, like the rest of the group, but also for receiving stolen goods. Similarly, people with longer criminal records could be viewed as having more criminal experience. Alternative explanations are presented in the next sub-section.

[22] All members of the group are, by definition, convicted of the same "main" crime. Some could also be convicted of other (related) offences (e.g., theft in addition to violence).

The second dimension, based on state variables, is also composed of three sources of heterogeneity: sex, age and nationality. In those cases, the relative importance or influence of the offenders is *a priori* less straightforward. Older members of a group could arguably be considered to have more influence as they have more experience. Regarding sex, men are frequently punished more severely than women in mixed groups (see Philippe, 2017). This could be the result of gender discrimination in the criminal justice system (Schanzenbach, 2005; Starr, 2015; Philippe, 2017), but it could also signal that males are frequently leaders in mixed groups (even if it does not seem to be sufficient to explain the heterogeneity, see Philippe, 2017). Among groups of different nationalities, it is possible that French people have more influence over their peers than their foreign-born counterparts. Indeed, French citizens could have more information about crime or the judicial system, and they are usually less deterred fro committing crimes (no risk of expulsion or discrimination).

As discussed in section 2.2, groups present a strong homophily. Only a part of them presents group heterogeneity. Of the pairs, 84 per cent are composed of people convicted of the same number of crimes, 56 per cent are comprised of criminals with the same length of criminal career, 87 per cent of criminals of the same sex, and 90 per cent of offenders who are both French or both non-French. In 58 per cent of the cases, the two members receive the same sentence.

The effects of peers' incarceration on group members depending on their characteristics are presented in table 7. All regressions include controls for other possible sentences (probation and suspended prison sentence). The sample size is restricted to groups of two. Similar results for all groups and for groups of 3–7 are presented in appendix table E3 and appendix table F3, respectively.

The first two columns present the effect of peers' incarceration depending on the relative number of charges during the initial joint trial. Column 1 presents the effect for offenders who received more convictions than their peers, while column 2 presents the effect for offenders who received fewer convictions. The former are not affected by the incarceration of their peer, while the latter are. While the difference between the two coefficients is large – one is ten times bigger than the other – it is only close to significant (p-value = 0.11) because the sample sizes are small.

Regarding the sentence length at the joint trial, offenders who receive the longest sentences are not affected by the incarceration of their peers (column 3). By contrast, offenders who

receive the shortest sentences within the duo significantly decrease their criminal activity when their peers are in jail (column 4). The coefficient is twice as large for offenders who receive the shortest sentence, but the difference is not statistically significant.

The last source of heterogeneity based on judicial characteristics, the length of criminal record, is explored in columns 5 and 6. Offenders who have the shortest criminal career are significantly affected by the incarceration of a peer, while those with the longest criminal career are not. However, the point estimates of the effect are very close, and the difference between the two coefficients is far from significant (p-value = 0.899).

The last six columns of table 7 present the heterogeneity based on state variables. Columns 7 and 8 indicate that the effect of the incarceration of a peer does not depend on relative ages. The oldest and youngest offenders of the group are equally affected: coefficients are both significant and very close (p-value of the difference = 0.929).

The differences based on sex and nationality are more striking. Among mixed groups, women are affected by the incarceration of their male partner, while men are not affected by a female partner's incarceration. Moreover, the difference between the two coefficients is significant (p-value = 0.0935). When the group is composed of one French and one non-French offender, only the latter is affected by the incarceration of his or her partner. The coefficient is ten times larger for non-French offenders, and the difference between the two point estimates is close to significance (p-value = 0.105).

6.2. Interpretation of the results

The preceding results could be coherently interpreted as evidence that group leaders are not affected by the incarceration of their peers, while followers are. When offenders are not convicted of the same number of charges (in columns 1 and 2), the heterogeneity in the responsibility is straightforward. If one offender is convicted of robbery and the resale of stolen goods while the other is convicted of only robbery, it is clear that the former is more responsible than the latter, and the results shown in table 7 (column 1 and 2) are highly consistent with a leader–follower dynamic.

The results presented in columns 3 and 4 can be interpreted in the same way. The general criminal rule of "sentence individualization" mandates that sentences should depend on the

gravity of the offence, the offender's responsibility and the offender's personality.[23][24] Because of this principle, the most likely reason that offenders receive different sentences during a joint trial is that their responsibilities vary. The most severely punished criminal is usually the most responsible. Thus, this heterogeneity in sentencing identifies some form of leadership. This interpretation is consistent with the fact that followers (but not leaders) are affected by the incarceration of peers.

Lastly, the same type of reasoning could be applied to the length of criminal records even if the results presented in columns 5 and 6 are less convincing (point estimates of the two groups are of the same order). Indeed, the longer an individual's criminal record, the more deeply he or she is thought to be involved in crime, and this could be considered a form of leadership. Once again, it appears that leaders are not significantly affected by their peers' incarceration, while the opposite is not true.

The results presented in columns 9–12 could also be interpreted in terms of leader–follower dynamics. However, the idea that men or French citizens are more frequently group leaders was *a priori* speculative. Therefore, the results should be viewed more as indications than confirmations of their leadership.

Even if an explanation in term of leadership unifies the results of this section in a very simple framework, other explanations are possible. However, they are less probable and less consistent with the findings.

The first possible explanation of differences in sentence time and convictions is that one offender—the one who gets the shortest sentence or the smallest number of conviction—betrayed the other. However, this result hardly explains why some offenders are affected by the following incarceration of their peer. If one offender betrays the other, we can reasonably expect that the two criminals will no longer be part of the same group, and their future

[23] Art 132-1 of the French criminal code states, "Every sentence should be individualized. (…) Quantum should be based on the circumstances of the crime, the personality of the offender and his social, material and familial situation (…)."

[24] For example in 2007, conditional on the type of crime, accomplices received prison terms that were shorter by 9 days, and those convicted of attempted crimes received prison terms that were shorter by 25 days. Within-group differences between accomplices and "main" offenders, or between people who *attempt* to commit a crime and those who *actually* commit it, cannot be used as they are not numerous enough within the sample used here.

criminal behaviour should not be correlated. In addition, this explanation is hardly convincing for differences based on criminal record[25].

Two other possible explanations are related. Offenders could get different sentences or convictions or have different criminal records because their lawyer is more or less talented or because the offenders themselves are more or less clever. Although those reasons are not incompatible with the results, they do not convincingly explain the differences observed in the results. If a lawyer is bad, the defendant, who can compare his lawyer with those for other members of the group, will easily observe it. The lawyer will not be hired for other trials. There is no reason why a lawyer's quality at the initial joint trial should affect people's behaviour during the entire Panel. In addition, it is hard to see why offenders with good lawyers should decrease their criminal activity when their peer with a bad lawyer is in jail. The same is true for offenders' intelligence: it is hard to see why clever offenders should decrease their criminal activity when the less clever ones are in jail. This is the case only if clever offenders commit crimes with peers to be able to make them responsible for everything in case of an arrest. In this situation, we return to the second explanation (about treason), and it could explain the result only if the peer is stupid enough to be made responsible for the crime several times consecutively.

Lastly, the results could be explained by the degree to which people are rooted in criminal behaviour. This explanation gives the following picture: offenders with the shortest sentence/smallest number of convictions/shortest criminal career of the group are affected by the incarceration of peers, as in the general case. Offenders with the longest sentence/highest number of convictions/longest criminal career are not affected by the incarceration of peers because they fail to modulate their behaviour, e.g., because they need to steal to survive no matter what their peers do. However, this explanation is not specific to intragroup variations. If this is true, I should observe that all offenders with a long criminal record are less affected than all offenders with a short criminal record. This not the case, as is shown in the next section (see table 8, Columns 7-8).

Even if a combination of those alternative mechanisms is possible, the most parsimonious explanation of the results presented in this section is that leaders of criminal groups are not affected by the imprisonment of their peers, while followers are.

[25] If offenders have a short criminal record because they betrayed others in the past, this should not affect the group considered. If they repeatedly betray others, the effect of the incarceration of their peers is even less likely.

7. Mechanism

7.1. Possible causal chains

The preceding two sections present consistent results showing that people's criminal activity is negatively affected by the incarceration of their peers. This general effect could be driven by very different mechanisms. At least three causal chains could lead to these results.

First, the incarceration of one member of the group could lead to a loss of "criminal human capital". This is especially important for crimes in which some criminal specialization could be suspected. Among burglars, some members of the group could specialize in locating good prospects, while others could specialize in opening doors or the resale of stolen goods. Among drug dealers, some offenders could be responsible for the drug supply, while others are in charge of the sale. Such specialization is a priori less likely for violence, drug consumption or property damages that do not require specific knowledge.

Second, having a peer in prison could increase people's perception of the cost of sanctions. It could make the risk of the sanction more salient. It could also increase the perceived cost of sanctions, for example, by providing new information about the harshness of prison.

Third, having a peer in prison could decrease "risky behaviour". If one person used to drink or take drugs or just felt particularly strong (and aggressive) in interactions with someone else, the incarceration of the peer could strongly decrease criminal activity.

These three mechanisms are not mutually exclusive. However, they lead to different predictions regarding the heterogeneity of the effect. If the incarceration of the peer decreases criminal activity because of some form of specialization, we could expect groups composed of thieves or drug dealers to be more affected than those composed of offenders convicted of violence, drug consumption or destruction. We would also expect crimes similar to the first one to be more affected than other types and in-group crimes to be more affected than lone crimes. This second result was partly addressed in section 4.3.

If peers' incarceration decreases criminal activity by changing people's perception of sanctions, offenders with longer criminal careers should be less affected than others. For those

criminals, the organization of the judicial system, the probability of being arrested and sanctioned and the personal cost of sanctions should be clearer, and peers' incarceration should provide less useful information.

Finally, if the effects are driven by the diminution of risky behaviours, crimes described as more "impulsive" and more related to alcohol and drug consumption—such as violence or property damage—should be more affected than "rational" crimes—such as robbery or drug dealing.

7.2. Heterogeneity of the effect

The three hypotheses presented in the preceding section are tested in tables 8 and 9. Table 8 presents the heterogeneity of the effect. All regressions include controls for other possible sentences (probation and suspended prison sentence). The sample size is restricted to groups composed of two persons. Similar results for all groups and for triplet to septuplets are presented in appendix E table E4 and appendix F table F4 respectively.

The first five Columns of table 8 distinguish the effect by type of crime judged during the initial trial. The categories used during this exercise are robbery, property damage, violence, drug consumption and drug dealing. Columns 6 and 7 distinguish offenders who experience their first conviction during the initial trial and those who have been convicted before. Lastly, columns 8 and 9 present the effects of peers' incarceration on two types of new crime: similar or different to the one for which offenders are convicted during the initial trial.

The effect of peers' incarceration is larger for groups jointly convicted of property damage (table 8, columns 2), violence (table 8, columns 3) and drug consumption (table 8, columns 4) than for those convicted of robbery (table 8, columns 1) or, drug dealing (table 9, columns 5). In the last two categories, the results are insignificant while they are in the first three. The effect of peers' incarceration in groups jointly convicted of property damage, violence or drug consumption represents approximately 10 per cent of the effect of one's own incarceration (9.9 per cent, 8.5 per cent and 12.9 per cent respectively). Coefficients represent less than 3 per cent in duos jointly convicted of theft or drug dealing (3 per cent and 2 per cent respectively). As mentioned earlier, drug consumption, violence and property damage are generally considered to be more impulsive than theft or drug dealing. Those results go against

the causal chains of crime specialization. They plead in favour of an explanation (at least partly) based on diminution of risky behaviour.

Among duos, offenders who experience their first conviction during the initial trial (table 8, columns 6) are less affected by the incarceration of their peers than offenders with longer criminal records (table 8, columns 7). Those results were already mentioned in section 6.2: they are not consistent with the explanation of the within-group differences, which states that offenders with long criminal careers do not adapt their behaviour to their peers' incarceration. Moreover, they also go against the explanation of the effect based on change in people's beliefs.

Lastly, the first two columns of table 9 show that crimes identical to (table 9, columns 1) and crimes different from (table 9, columns 2) the first one are affected by peers' incarceration. The effect is slightly greater for the former than for the latter, but both are significant and of the same order of magnitude (approximately 5 per cent of the effect of one's own incarceration). Those results are consistent with those observed in the other columns. They reinforce the explanation of an effect based on the diminution of risky behaviour. In contrast, they go against an explanation based on specialization and criminal capital loss. Indeed, criminal capital is specific, and its loss should mainly affect one type of criminal activity.

Taken together, table 8 and 9 draws a consistent picture of the mechanisms underlying the effect of peers' incarceration. Peers' incarceration decreases criminal activity among duos because of a decrease in risky behaviour. Explanations based on information or human capital are not supported by the data.

7.3. Duration of the effect

Up to this point, all incarceration periods and every month of the spell have been treated equally. However, it is possible that the effect of the incarceration of peers depends on the time. First, the longer the time the peer spends in prison, the higher the probability that an individual may find a new peer to replace the incarcerated one or start committing crime by his own. Then, the effect of the incarceration of the peer should be smaller when he has spent more time in prison.

Second, the probability that the members of the group will split up increases over the spell. Then, the effect of the incarceration of the peer should be higher in the first years of the Panel.

Those two hypotheses are tested in the last two columns of table 9. Regressions include controls for other possible sentences (probation and suspended prison sentence). The sample size is restricted to groups composed of two persons. Columns 3 presents the effect of the incarceration of the peer depending on the time he spends in prison. I distinguish between the first three months of the incarceration, months 4 to 9 and months after the 9th. While the coefficients of the first two periods are significant, the coefficient of the last one is not. Moreover, this last coefficient is significantly smaller than the others (see p-values in the last lines of table 9). This is consistent with the idea that offenders are affected by the incarceration of their peer mainly during the first months of the incarceration.

Column 4 presents the effect of the incarceration of the peer in the first two years and in the last two years of the spell. No clear pattern emerges from this test. Both coefficients are significant and of the same order of magnitude (the p-value of the difference is not significant).

8. Conclusion

This paper uses data for offenders convicted of the same crime to study the effect of peers' incarceration by creating a four-year Panel to document this question. It provides consistent and robust evidence that offenders react to the incarceration of their criminal peers by decreasing their criminal activity. This effect is sizable and represents approximately 5 per cent of the effect of one's own incarceration. However, this average effect masks large disparities, depending on offenders' positions within their group. Those who received more severe sentences or were found guilty of a larger set of crimes than the rest of the group during the initial joint trial are not affected by the incarceration of their peers. Neither are offenders who have longer criminal careers than their peers. Those results are consistent with a leader-follower dynamic in which followers need leaders to commit crimes, while leaders are not affected by the incarceration of their followers.

Turning to mechanisms, the effect seems to be driven by different mechanisms, depending on group size. Among duos, offenders seem to decrease their criminal activity when their peers are in jail because they refrain from risky behaviour such as drinking alcohol or taking drug. Larger groups seem to be more structured, with some form of specialization at work.

Regarding the policy implications, these results imply that with budget constraints and prison-capacity constraints, having more heterogeneous sanctions—long for leaders and short for followers—would be an effective way to reduce crime.

The preceding results are true at least for small criminal groups ranging in size from two to seven. Extrapolations to larger groups such as well-structured gangs remain an open question.

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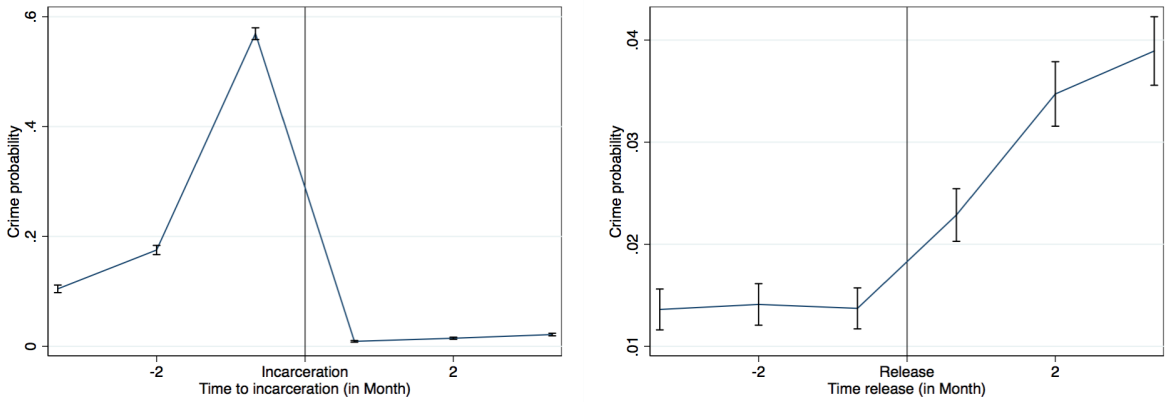
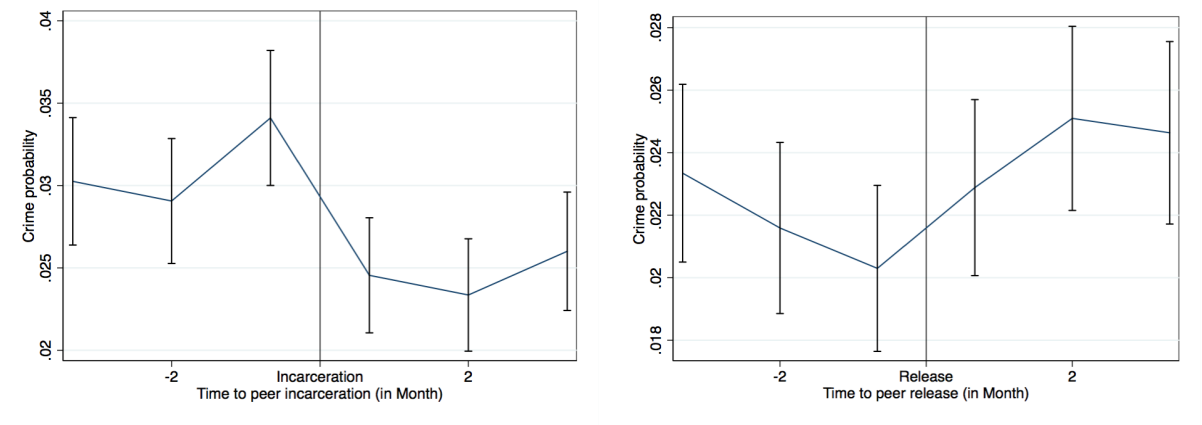
Figure 1: Structure of the data



(a) (b)

Figure 2: Effect of incarceration on the probability that an offender will commit a crime during the month. Vertical axis indicates entry into prison (a) or release (b).
Note: Bars present the confidence intervals at the 10 per cent level. Only the 3 months before and after incarceration have been used.



(a) (b)

Figure 3: Effect of the incarceration of a peer on the probability that an offender will commit a crime during the month. Vertical axis indicates peer entry into prison (a) or peer release from prison (b).

Note: Bars present the confidence intervals at the 10 per cent level. Only the 3 months before and after incarceration have been used. In order to avoid selection problems due to joint incarceration, the sample is restricted to offenders who remain free during the six-month period.

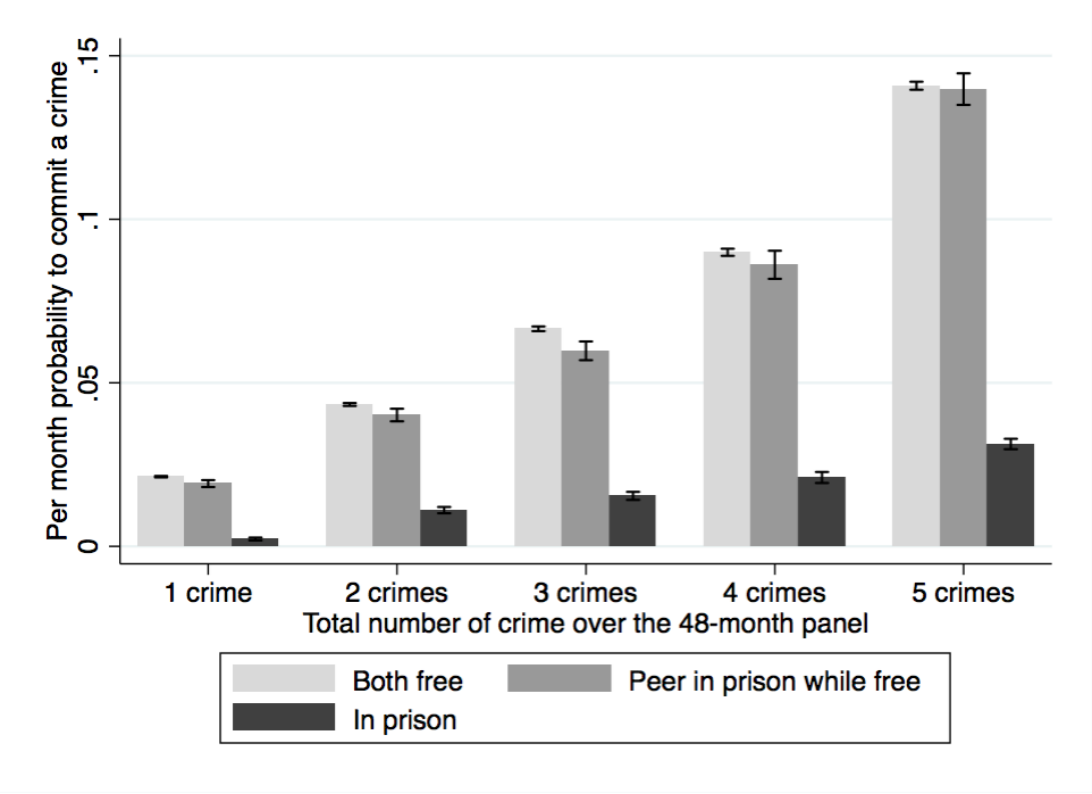


Figure 4: probability that an offender will commit a crime during the month depending on offenders' total number of crime over the panel and situation of the members of the group. *Note: Bars present the confidence intervals at the 10 per cent level.*

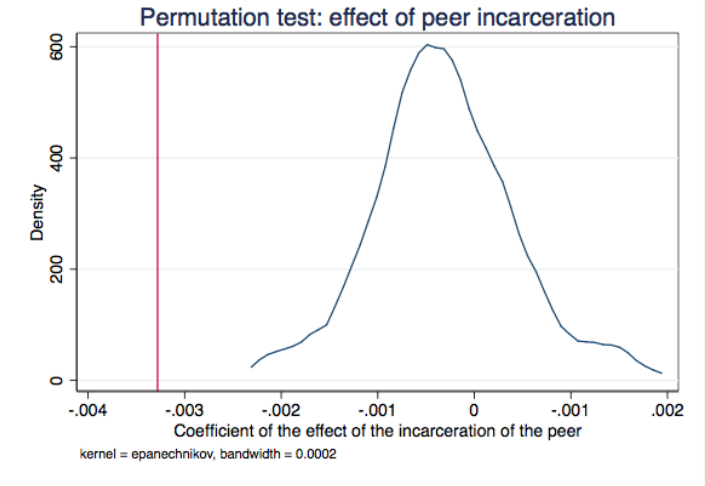


Figure 5: Density of the coefficient of the effect of peer incarceration obtains after 150 permutation tests. Random groups are composed of offenders that have been convicted the same month in the same county. The red bar represents the coefficient obtains with real groups.

	All group size		Duo	Triplet-7uplet	Offenders who do not belong to a group	
	Mean	Sd	Mean	Mean	Mean	Sd
Age	26.44	8.61	26.54	26.29	32.69	12.45
Sex	.88	.32	.88	.89	.88	.33
French	.83	.38	.83	.82	.84	.37
Past conviction	.47	.5	.48	.45	.41	.49
Theft	.57	.5	.59	.53	.36	.48
Violence	.23	.42	.24	.22	.3	.46
Drug	.15	.36	.13	.19	.1	.29
Prison (month)	3.72	10.88	3.04	4.76	1.79	6.18
Probation (month)	1.1	3.4	.94	1.34	1.18	3.52
Suspended prison (month)	1.65	3.41	1.44	1.97	1.33	3.01
N	82,792		49,942	32,850	733,667	

Table 1: Descriptive statistics.

	Mean	Real			Average random permutations		
		1-1	mixte	0-0	1-1	mixte	0-0
Sex	.88	.81	.13	.06	.77	.21	.02
Age>median	.56	.44	.24	.32	.33	.46	.21
French	.83	.78	.1	.12	.71	.25	.05
Past Conviction	.48	.3	.36	.34	.24	.48	.28
Past prison sentence	.21	.09	.25	.66	.05	.32	.63

Table 2: Homophily among duos

		All		Duo	Triplet-7uplet
		Mean	Sd	Mean	Mean
Per offender * Month	Crime	2.09%	.14	2.22%	1.89%
	Crime labeled as in-group crime - all	.32%	.06	.34%	.31%
	Crime labeled as in-group crime - same peer	.03%	.02	.03%	.04%
	Crime labeled as in-group crime - other peer	.16%	.04	.17%	.14%
	Crime NOT labeled as in-group crime	1.77%	.13	1.89%	1.58%
	Crime "in group"	.45%	.07	.47%	.42%
	Crime "probably in group"	.81%	.09	.84%	.75%
	Crime "probably alone"	1.33%	.11	1.43%	1.17%
	Crime "alone"	.72%	.08	.78%	.63%
	Prison	2.52%	.16	2.7%	2.23%
	Prison/probation	1.36%	.12	1.47%	1.19%
	One peer prison while outside	3.25%	.18	2.39%	4.63%
	One peer prison for crime "alone" while outside	.43%	.07	.49%	.33%
	One peer prison for road related crime while outside	.11%	.03	.12%	.09%
	N	3,676,092		2,267,048	1,373,316
Per offender	At least 1 crime	44.85%	.5	46.58%	42.15%
	At least 1 month in prison, not 48	21.21%	.41	21.57%	20.65%
	At least 1 month peer in prison while free, not 48	21.77%	.41	16.43%	30.07%
	At least 1 month peer in prison for crime "alone" while free, not 48	4.51%	.21	3.56%	5.99%
	At least 1 month peer in prison for road related crime while free, not 48	1.79%	.13	1.32%	2.52%
	N	81350		49,470	31,098

Table 3: Descriptive statistics of the Panel.

	(1)	(2)	(3)	(4)	(5)	(6)
	All groups		Duos		Triplets to septuplets	
Incarcerated	-0.075***	-0.062***	-0.078***	-0.064***	-0.070***	-0.058***
	(0.00094)	(0.00096)	(0.0012)	(0.0012)	(0.0016)	(0.0016)
Peer incarcerated	-0.0026***	-0.0017**	-0.0044***	-0.0033***	-0.00098	-0.00026
	(0.00069)	(0.00068)	(0.00103)	(0.0010)	(0.00093)	(0.00092)
Prison or probation		-0.0091***		-0.0090***		-0.0093***
		(0.0012)		(0.0015)		(0.0020)
Cumul. Time prison		-0.0051***		-0.0051***		-0.0049***
		(0.00010)		(0.00013)		(0.00017)
Cumul. Probation		-7.7e-06***		-1.0e-05***		-3.2e-06
		(3.0e-06)		(3.7e-06)		(5.04e-06)
Cumul. Suspended prison		-0.00013***		-0.00014***		-0.00013***
		(1.2e-05)		(1.6e-05)		(1.4e-05)
Constant	0.032***	0.039***	0.034***	0.041***	0.030***	0.036***
Observation	3,676,092	3,676,092	2,267,048	2,267,048	1,409,044	1,409,044
Nb individual	81,350	81,350	49,470	49,470	31,880	31,880

Table 4: Effect of peers' incarceration on criminal activity by group size.
Note: The dependent variable is a dummy equal to one if offender i *commits at least one crime that leads to a conviction during month* t. *All regressions include both individual and month of the spell fixed effects. Standard errors are clustered at the group level.*

	(1) Control cal month	(2) Control crime police	(3) Control nb conviction	(4)	(6)	(5)
				Nb crime in the month		
Incarcerated	-0.064***	-0.064***	-0.064***	-0.064***	-0.064***	-0.064***
	(0.0012)	(0.0012)	(0.0012)	(0.0012)	(0.0012)	(0.0012)
Peer incarcerated	-0.0033***	-0.0033***	-0.0033***			
	(0.0010)	(0.0010)	(0.0010)			
Peer inc., crime not "alone"				-0.0032***		
				(0.0011)		
Peer inc., crime "alone"				-0.0036*		
				(0.0022)		
Peer inc., non road crime					-0.0033***	
					(0.0010)	
Peer inc., road crime					-0.0032	
					(0.0039)	
Peer inc., crime committed more than one month before inc.						-0.0025*
						(0.0014)
Peer inc., crime committed the month of inc. or the month before						-0.0042***
						(0.0014)
Control	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.048**	0.039***	0.041***	0.041***	0.041***	0.041***
Observations	2,267,048	2,223,164	2,266,986	2,267,048	2,267,048	2,267,048
Number of individual	49,470	48,480	49,470	49,470	49,470	49,470
P-value of the difference				0.855	0.978	0.367

Table 5: Effect of peers' incarceration on criminal activity among duos, evidences on the absence of a common shock.
Note: The dependent variable is a dummy equal to one if offender i *commits at least one crime during month* t*. All regressions include both individual and month of the spell fixed effects. Controls are for other types of sentences. Standard errors are clustered at the group level.*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Crime labeled as in-group crime			Not labeled as in-group crime	Crime "in group"	Crime "probably in group"	Crime "probably alone"	Crime "alone"
	All	Same peer	Other peer					
Incarcerated	-0.011***	-0.00056***	-0.011***	-0.053***	-0.020***	-0.029***	-0.038***	-0.020***
	(0.00040)	(9.4e-05)	(0.00039)	(0.0011)	(0.00053)	(0.00066)	(0.00095)	(0.00062)
Peer incarcerated	-0.0011***	-0.00050***	-0.00058	-0.0022**	-0.0015***	-0.0020***	-0.0015*	-0.00012
	(0.00040)	(8.0e-05)	(0.00039)	(0.00093)	(0.00050)	(0.00064)	(0.00081)	(0.00059)
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.0087***	0.00094***	0.0078***	0.032***	0.013***	0.018***	0.024***	0.01 »***
Observations	2,267,048	2,267,048	2,267,048	2,267,048	2,267,048	2,267,048	2,267,048	2,267,048
Nb of individual	49,470	49,470	49,470	49,470	49,470	49,470	49,470	49,470

Table 6: Effect of the incarceration of one peer on different types of crime among duos.
Note: The dependent variable is a dummy equal to one if offender i commits at least one crime of the type during month t. All regressions include individual and month of the spell fixed effects. Controls are for other types of sentences. Standard errors are clustered at the group level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Nb of convictions at joint trial		Sentence at joint trial		Criminal record		Age		Sex		Nationality	
	Highest of the group	Lowest of the group	Longest of the group	Shortest of the group	Longest of the group	Shortest of the group	Oldest of the group	Youngest of the group	Male	Female	French	Non-french
Inc.	-0.069***	-0.068***	-0.067***	-0.062***	-0.070***	-0.059***	-0.061***	-0.066***	-0.063***	-0.056***	-0.075***	-0.063***
	(0.0024)	(0.0024)	(0.0014)	(0.0020)	(0.0016)	(0.0022)	(0.0012)	(0.0011)	(0.0024)	(0.0051)	(0.0031)	(0.0032)
Peer inc.	-0.00060	-0.0066***	-0.0014	-0.0030**	-0.0035	-0.0028**	-0.0027**	-0.0026**	0.0041	-0.0069***	0.00056	-0.0068**
	(0.0029)	(0.0024)	(0.0020)	(0.0014)	(0.0025)	(0.0012)	(0.0012)	(0.0012)	(0.0062)	(0.0024)	(0.0033)	(0.0031)
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cst	0.054***	0.039***	0.063***	0.038***	0.069***	0.040***	0.039***	0.041***	0.040***	0.023***	0.042***	0.051***
Obs	176,212	176,212	457,999	457,999	663,402	663,402	968,014	968,014	145,867	145,867	107,409	107,409
Nb indiv	3,949	3,949	10,330	10,330	14,563	14,563	21,175	21,175	3,188	3,188	2,385	2,385
diff own	0.784		0.0352		1.29e-07		0.00278		0.232		0.00596	
diff pair	0.110		0.516		0.753		0.929		0.0935		0.105	

Table 7: Effect of the incarceration of peers depending on offenders' position within group among duos.
Note: The dependent variable is a dummy equal to one if offender i commits at least one crime during month t. All regressions include both individual and month of the spell fixed effects. Controls are for other types of sentences. Standard errors are clustered at the group level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Robbery	Property damages	Violence	Drug consumption	Drug dealing	First offender	Recidivist
Incarcerated	-0.071***	-0.073***	-0.056***	-0.046***	-0.067***	-0.044***	-0.068***
	(0.0016)	(0.0049)	(0.0025)	(0.0033)	(0.0052)	(0.0025)	(0.0013)
Peer inc.	-0.0022	-0.0073*	-0.0048**	-0.0059**	-0.0013	-0.00042	-0.0048***
	(0.0014)	(0.0039)	(0.0022)	(0.0028)	(0.0046)	(0.0013)	(0.0014)
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cst	0.048***	0.036***	0.027***	0.032***	0.054***	0.020***	0.065***
Obs	1,172,860	178,540	557,370	162,240	92,014	1,193,431	1,073,617
Nb indiv	25,156	3,768	12,016	3,848	2,338	25,798	23,672

Table 8: Heterogeneity of the effect by crime at the initial trial and criminal record among duos.
Note: The dependent variable is a dummy equal to one if offender i commits at least one crime of the type during month t. All regressions include both individual and month of the spell fixed effects. Standard errors are clustered at the group level.

	(1)	(2)	(3)	(4)
	Type of new crime			
	Identical to the first one	Different from the first one	Difference in peer incarceration length	Difference in the spell
Incarcerated	-0.032***	-0.034***	-0.064***	-0.064***
	(0.00086)	(0.00086)	(0.0012)	(0.0012)
Peer incarcerated	-0.0019***	-0.0015*		
	(0.00068)	(0.00080)		
Peer incarcerated, first 3 month			-0.0034**	
			(0.0014)	
Peer incarcerated, 4th to 9th month			-0.0045***	
			(0.0015)	
Peer incarcerated, 10th month and after			-0.0010	
			(0.0019)	
Peer incarcerated, first 2 years of the spell				-0.0030*
				(0.0016)
Peer incarcerated, last 2 years of the spell				-0.0035***
				(0.0012)
Control	Yes	Yes	Yes	Yes
Constant	0.020***	0.021***	0.041***	0.041***
Observations	2,267,048	2,267,048	2,267,048	2,267,048
Nb of individual	49,470	49,470	49,470	49,470
pval diff 1-3 vs 4-9			0.473	
pval diff 4-9 vs 10 and after			0.0425	
pval diff first 2 y-last 2 y				0.698

Table 9: Effect of the incarceration of the peer on different types of crime and at different moments among duos.

Note: The dependent variable is a dummy equal to one if offender i commits at least one crime of the type during month t. All regressions include both individual and month of the spell fixed effects. Controls are for other types of sentences.. Standard errors are clustered at the group level.

Appendix

Appendix A: Homophily

Another way to document homophily among duos is to measure the differences between theoretical and real repartitions of the characteristics. For example, 88 per cent of the offenders who belong to a duo are men. If they were randomly distributed among groups, this would lead to 77 per cent man-man duos (0.88*0.88), 22 per cent man-woman duos (0.88*0.12*2) and 2 per cent woman-woman duos (0.12*0.12). However, this is not the ratio observed in real groups. Mixed duos are under-represented (13 per cent, i.e., 9 per cent less than theoretically expected), while homogeneous duos (two men or two women) are over-represented.

This is also the case for age, nationality and criminal career. Real and theoretical characteristics are presented in Table A1 below.

	Mean	Real			Theory		
		1-1	mixte	0-0	1-1	mixte	0-0
Sex	.88	.81	.13	.06	.77	.22	.01
Age>median	.56	.44	.24	.32	.32	.49	.19
French	.83	.78	.1	.12	.69	.28	.03
Past Conviction	.48	.3	.36	.34	.23	.5	.27
Past prison sentence	.21	.09	.25	.66	.05	.33	.62

Table A1: real and theoretical repartition of characteristics among duos.

Appendix B: Construction of the imprisonment variable

As mentioned in Section 2.3. the database does not contain the exact incarceration period but only precise preventive detention dates, sentences and procedural variables. Four different cases are treated.

1) Preventive detention: prison entrance and prison release dates are precisely indicated.

2) Prison sentence with "mandat de dépot": this term refers to a procedural decision that leads to immediate incarceration. In this situation, I know the prison entrance date (the day of the trial). The date of release could be calculated because it is equal to the trial date plus the prison sentence minus the automatic time reductions.

3) Prison sentence longer than 2 years (or one year for a recidivist): the sanction could not be fully converted into probation. I consider that the entrance date is the trial date and that the date of release is the entrance date plus the prison sentence minus the automatic time reductions.

4) Prison sentence shorter than 2 years (or one year for a recidivist) without mandat de dépot: the offender is not incarcerated after the trial but should be summoned later on to see if his sentence could be converted to probation. In this case, I do not consider that the offender is "definitely" in jail. This situation is taken into account with the variable "prison or probation" added to the control variables in almost all regressions (except in Columns 1 and 5 of Tables 3 and 4).

In practice, there are very limited chances of going to prison in that case. For example, in 2006 in France, there were, according to the penitentiary administration, 86,500 entrances into prison. This number is divided into entrance for pretrial detention (eventually followed by the sentence time) or entrance as a convicted offender. The latter category represents 29,800 entrances. In the same period, 86,300 people were sentenced to prison without spending time in pretrial detention. Among them, 16,500 got mandat de dépot". Then, around 70,000 people were sentenced to prison without mandate de dépot and without pretrial detention. Those people are responsible for approximately 13,000 entrances into prison. This means that of the 70,000 persons sentenced to prison without pre-trial detention or mandat de dépot, less than one-fifth went to prison. This proportion is probably even smaller, as some people enter prison because of past suspended sentences or probation violations.

Considering "definitely in prison" and "prison or probation" as different is reasonable. As we can see in Tables 3 and 4, the effect of being in "prison or probation" on crime is approximately 6 times smaller than the effect of being "definitely in prison".

Appendix C: Categorize crime during the Panel: in-group, probably in-group, alone, probably alone

Only a small part of in-group crimes is labelled as such in the database. I use this label in the group constitution procedure because it is a restrictive one that helps to avoid false matches. However, the problem is different when the goal is to qualify the type of new crime committed during the Panel, as I am now more interested in a restrictive definition of "lone crimes" (because I want to test the hypothesis of a shift from one type of crime to another).

I construct the definitions based on the average number of "matches" per crime. The idea is to measure, for every type of crime, the proportion of offenders who commit this crime on the same day and in the same county and are judged on the same day as someone else. If a very small proportion of offenders who commit one type of crime are convicted on the same day in the same county for a crime committed on the same day, then I can reasonably consider that this crime is usually committed alone. In contrast, if this proportion is extremely high, I can consider that this type of crime is usually committed in group.

I define four different measures based on the average group size (equal to one if offenders never have a match, two if they are all in duos, etc.):

- Crimes are considered "probably in group" when the average group size is larger than 1.4
- Crimes are considered "probably alone" when the average group size is smaller than 1.4
- Crimes are considered "in group" when the average group size is larger than 1.8
- Crimes are considered "alone" when the average group size is smaller than 1.1

Reassuringly, crimes labelled "in group" are mainly in the last group (they are not all in the last group because some are rare and lead to a small number of matches).

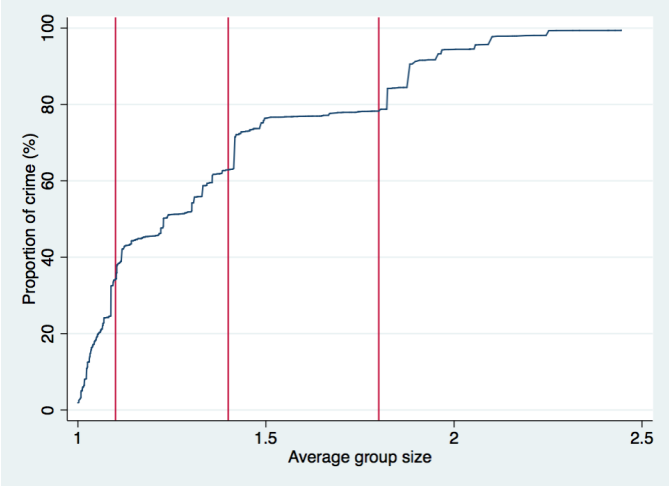


Figure C1: proportion of crime per category.

Appendix D: additional robustness checks

Table D1 presents additional robustness checks to the specifications presented in table 4. The upper part (panel A) of the table presents robustness checks for all groups, the middle part (panel B) presents robustness checks for pairs and the lower part (panel C) for groups of 3–7. All regressions include the control variables used in columns 2 and 6 of tables 4 and 5, i.e., controls for other possible sentences.

In the first two columns of table D1, I present the main effect while using different estimation methods. In column 1, I use a half-panel jacknife estimation method following Chudik et al. 2016. This method deals with the risk of downward bias in the estimation of weakly exogenous regressors. The results presented in column 2 use logit regressions with individual fixed effects. All the results are very close to those presented in table 4.

In column 3, the dependent variable used is the number of crimes committed during the month, rather than a dummy equal to one if there is at least one crime. In the panel composed of the pairs, the number of crimes committed per month (where at least one crime was committed) is equal to one in 92.8 per cent of cases and more than one in 7.2 per cent of cases. The results using a continuous variable are very similar to those presented in table 4.

In column 4, I present the main results when groups coming from the biggest counties (Paris and the counties in Île de France, Marseille, Lyon) are excluded. Indeed, the risk of a false match is greater in those counties. The results are similar to those presented in table 4.

In column 5, the first sentences – following the trial used for group identification – are included in the sample. As previously mentioned, the month when one member of the group is incarcerated following the first trial were dropped in the previous models. Including those periods does not affect the results.

In column 6, I control for the time since the last trial to control for some form of monotonicity in criminal activity. The results remain similar even if the effect of the incarceration of a peer turns out to be insignificant in panel A. It remains significant at the 1 per cent level among pairs.

In the last column, I transformed the panel in order to be fully balanced. I exclude groups in which one offender receives a sentence longer than a year at the initial trial. For the other groups, I keep the first 36 months of the panel. Once again, the results are very similar to those presented in table 4.

	(1) Half panel jacknife estimate	(2) Logit	(3) Crime continuous	(4) Excluding biggest cities	(5) With first sentence	(6) Control time since last trial	(7) Panel balanced 36 months
Panel A: all groups							
Inc.	-0.0417***	-1.649***	-0.0690***	-0.0586***	-0.0535***	-0.0582***	-0.0701***
	(0.00111)	(0.0299)	(0.00110)	(0.00117)	(0.000673)	(0.000989)	(0.00119)
Peer inc.	-0.00135**	-0.0369*	-0.00185**	-0.00191**	-0.00326***	-0.00112	-0.00182**
	(0.00135)	(0.0217)	(0.000784)	(0.000807)	(0.000515)	(0.000683)	(0.000856)
Obs	3,676,092	1,615,284	3,676,092	2,642,084	3,974,016	3,676,092	2,708,244
Panel B: duos							
Inc.	-0.0425***	-1.674***	-0.0710***	-0.0607***	-0.0570***	-0.0603***	-0.0725***
	(0.00149)	(0.0365)	(0.00136)	(0.00144)	(0.000857)	(0.00122)	(0.00145)
Peer inc.	-0.00264***	-0.0852***	-0.00368***	-0.00387***	-0.00322***	-0.00265***	-0.00348***
	(0.000938)	(0.0304)	(0.00117)	(0.00121)	(0.000820)	(0.00102)	(0.00126)
Obs	2,267,048	1,039,161	2,267,048	1,636,722	2,397,216	2,267,048	1,684,296
Panel C: triplets to septuplets							
Inc.	-0.0378***	-1.599***	-0.0651***	-0.0546***	-0.0472***	-0.0540***	-0.0651***
	(0.00203)	(0.0522)	(0.00188)	(0.00197)	(0.00107)	(0.00168)	(0.00208)
Peer inc.	-0.000419	0.0172	-0.000132	-4.72e-05	-0.00295***	0.000389	-0.000134
	(0.00103)	(0.0310)	(0.00105)	(0.00107)	(0.000659)	(0.000919)	(0.00116)
Obs	1,409,044	576,123	1,409,044	1,005,362	1,576,800	1,409,044	1,023,948

Table D1: Robustness checks.

Note: The dependent variable is a dummy equal to one if offender i *commits at least one crime of during month* t *except in column 3, where the dependent variable is the number of crimes committed during the month. All regressions include individual and month of the spell fixed effects. Controls are for other types of sentences. Standard errors are clustered at the group level. Coefficients presented in panels A, B and C come from separate estimations. Column 2 includes a smaller number of observations, as offenders who do not commit crimes during the panel do not contribute to the logit estimation.*

Appendix E: additional results when all groups are used

	(1) Control crime police	(2) Control nb conviction	(3)	(4)	(5)
			Nb crime in the month		
Incarcerated	-0.062***	-0.062***	-0.062***	-0.062***	-0.062***
	(0.00098)	(0.00096)	(0.00096)	(0.00096)	(0.00096)
Peer incarcerated	-0.0017**	-0.0018**			
	(0.00069)	(0.00068)			
Peer inc. for crime not "alone"			-0.0017**		
			(0.00076)		
Peer inc. for crime "alone"			-0.0018		
			(0.0015)		
Peer inc. non road crime				-0.0017**	
				(0.00071)	
Peer inc. road crime				-0.0025	
				(0.0025)	
Peer inc. for crime committed more than one month before inc.					-0.0011
					(0.00091)
Peer inc. for crime committed the month of inc. or the month before					-0.0028***
					(0.00095)
Constant	0.038***	0.039***	0.039***	0.039***	0.039***
Observations	3,601,351	3,675,981	3,676,092	3,676,092	3,676,092
Number of individual	79,644	81,350	81,350	81,350	81,350
P-value of the difference			0.99	0.75	0.18

Table E1: Effect of peers' incarceration on criminal activity among all groups, evidences on the absence of common shock.
Note: The dependent variable is a dummy equal to one if offender i commit at least one crime during month t. All regressions include both individual and month of the spell fixed effects. Controls are for other types of sentences. Standard errors are clustered at the group level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Crime labeled as in-group crime			Not labeled as in-group crime	Crime "in group"	Crime "probably in group"	Crime "probably alone"	Crime "alone"
	All	Same peer	Other peer					
Inc.	-0.012***	-0.00082***	-0.011***	-0.050***	-0.020***	-0.029***	-0.035***	-0.019***
	(0.00032)	(9.9e-05)	(0.00032)	(0.00089)	(0.00043)	(0.00054)	(0.00077)	(0.00049)
Peer inc	-0.00098***	-0.00053***	-0.00045*	-0.00076	-0.0012***	-0.0016***	-0.00026	0.00011
	(0.00026)	(7.3e-05)	(0.00025)	(0.00062)	(0.00033)	(0.00042)	(0.00055)	(0.00039)
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cst	0.0082***	0.0010***	0.0072***	0.031***	0.012***	0.017***	0.023***	0.012***
Obs	3,676,092	3,676,092	3,676,092	3,676,092	3,676,092	3,676,092	3,676,092	3,676,092
Nb indiv	81,350	81,350	81,350	81,350	81,350	81,350	81,350	81,350

Table E2: Effect of the incarceration of one peer on different types of crime among all groups.
Note: The dependent variable is a dummy equal to one if offender i commit at least one crime of the type during month t. All regressions include individual and month of the spell fixed effects. Controls are for other types of sentences. Standard errors are clustered at the group level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Nb of convictions at joint trial		Sentence at joint trial		Criminal record		Nationality		Sex		Age	
	Highest of the group	Lowest of the group	Longest of the group	Shortest of the group	Longest of the group	Shortest of the group	French	Non-french	Male	Female	Oldest of the group	Youngest of the group
Inc.	-0.064***	-0.063***	-0.065***	-0.059***	-0.069***	-0.055***	-0.067***	-0.063***	-0.063***	-0.051***	-0.059***	-0.065***
	(0.0017)	(0.0020)	(0.0011)	(0.0015)	(0.00090)	(0.0014)	(0.0021)	(0.0024)	(0.0017)	(0.0040)	(0.00098)	(0.00095)
Peer inc.	-0.0020	-0.0049***	0.00037	-0.0021**	-0.0019	-0.0017**	0.0011	-0.0041**	-0.0021	-0.0054***	-0.0016*	-0.00095
	(0.0015)	(0.0015)	(0.0012)	(0.00089)	(0.0012)	(0.00079)	(0.0017)	(0.0020)	(0.0019)	(0.0016)	(0.00084)	(0.00087)
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs	438,000	389,328	894,48	967,440	1,112,640	1,291,920	282,480	230,928	346,848	278,688	1,543,776	1,541,136
N indiv	9,125	8,111	18,635	20,155	23,18	26,915	5,885	4,811	7,226	5,806	32,136	32,107
diff pair	0.18		0.10		0.93		0.046		0.20		0.61	

Table E3: Effect of the incarceration of peers depending on offenders' position within group among all groups.
Note: The dependent variable is a dummy equal to one if offender i commit at least one crime during month t. All regressions include both individual and month of the spell fixed effects. Controls are for other types of sentences. Standard errors are clustered at the group level.

	(1) Robbery	(2) Deterioration	(3) Violence	(4) Drug consumption	(5) Drug dealing	(6) First offender	(7) Recidivist
Incarcerated	-0.068***	-0.072***	-0.057***	-0.045***	-0.058***	-0.041***	-0.067***
	(0.0013)	(0.0041)	(0.0020)	(0.0026)	(0.0044)	(0.0019)	(0.0011)
Peer incarcerated	-0.0012	-0.0047*	-0.0016	-0.0032**	-0.0017	0.00041	-0.0030***
	(0.0010)	(0.0026)	(0.0015)	(0.0016)	(0.0027)	(0.00079)	(0.00098)
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cst	0.046***	0.035***	0.027***	0.030***	0.044***	0.019***	0.064***
Obs	1,823,187	307,396	882,490	327,432	146,022	1,981,378	1,694,714
Nb indiv	39,278	6,502	19,158	8,225	3,805	43,317	38,033

Table E4: Heterogeneity of the effect by crime at the initial trial and criminal record among all groups.
Note: The dependent variable is a dummy equal to one if offender i commit at least one crime of the type during month t. All regressions include both individual and month of the spell fixed effects. Standard errors are clustered at the group level.

Appendix F: Additional results for groups composed of three to seven persons.

	(1)	(2)	(3)	(4)	(5)	(6)
	Control cal month	Control crime police	Control nb conviction	Nb crime in the month		
Incarcerated	-0.058***	-0.058***	-0.058***	-0.058***	-0.058***	-0.058***
	(0.0016)	(0.0017)	(0.0016)	(0.0016)	(0.0016)	(0.0016)
Peer incarcerated	-0.00029	-0.00026	-0.00028			
	(0.00092)	(0.00093)	(0.00092)			
Peer inc. for crime not "alone"				-0.00036		
				(0.0010)		
Peer inc. for crime "alone"				0.00020		
				(0.0019)		
Peer inc. non road crime					0.00022	
					(0.0012)	
Peer inc. road crime					-0.0014	
					(0.0013)	
Peer inc. for crime committed more than one month before inc.						-0.00018
						(0.00095)
Peer inc. for crime committed the month of inc. or the month before						-0.0017
						(0.0031)
Control	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.048***	0.036***	0.036***	0.036***	0.036***	0.036***
Observations	1,409,044	1,378,187	1,408,995	1,409,044	1,409,044	1,409,044
Number of individual	31,880	31,164	31,880	31,880	31,880	31,880
P-value of the difference				0.795	0.354	0.630

Table F1: : Effect of peers' incarceration on criminal activity among groups composed of three to seven persons, evidences on the absence of common shock.
Note: The dependent variable is a dummy equal to one if offender i commit at least one crime during month t. All regressions include both individual and month of the spell fixed effects. Controls are for other types of sentences. Standard errors are clustered at the group level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Crime labeled as in-group crime			Not labeled as in-group crime	Crime "in group"	Crime "probably in group"	Crime "probably alone"	Crime "alone"
	All	Same peer	Other peer					
Inc.	-0.013***	-0.0013***	-0.011***	-0.045***	-0.020***	-0.030***	-0.031***	-0.016***
	(0.00062)	(0.00023)	(0.00056)	(0.0015)	(0.00076)	(0.00093)	(0.0013)	(0.00080)
Peer inc.	-0.00093***	-0.00057***	-0.00035	0.00067	-0.00098**	-0.0012**	0.00094	0.00038
	(0.00035)	(0.00012)	(0.00033)	(0.00084)	(0.00042)	(0.00055)	(0.00075)	(0.00051)
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cst	0.0075***	0.0011***	0.0063***	0.029***	0.011***	0.016***	0.022***	0.012***
Obs	1,409,044	1,409,044	1,409,044	1,409,044	1,409,044	1,409,044	1,409,044	1,409,044
Nb indiv	31,880	31,880	31,880	31,880	31,880	31,880	31,880	31,880

Table F2: Effect of the incarceration of one peer on different types of crime among groups composed of three to seven persons.
Note: The dependent variable is a dummy equal to one if offender i commit at least one crime of the type during month t. All regressions include individual and month of the spell fixed effects. Controls are for other types of sentences. Standard errors are clustered at the group level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Nb of convictions at joint trial		Sentence at joint trial		Criminal record		Nationality		Sex		Age	
	Highest of the group	Lowest of the group	Longest of the group	Shortest of the group	Longest of the group	Shortest of the group	French	Non-french	Male	Female	Oldest of the group	Youngest of the group
inc.	-0.061***	-0.053***	-0.058***	-0.058***	-0.070***	-0.057***	-0.058***	-0.063***	-0.063***	-0.045***	-0.055***	-0.061***
	(0.0025)	(0.0031)	(0.0036)	(0.0043)	(0.013)	(0.0022`)	(0.0049)	(0.0057)	(0.0048)	(0.0078)	(0.0027)	(0.0027)
Peer inc.	0.0017	-0.0013	-0.0024	-0.0036*	-0.0025	-0.00011	0.0015	-0.0020	-0.0028	-0.0040**	-3.9e-05	0.0010
	(0.0021)	(0.0013)	(0.0022)	(0.0020)	(0.0062)	(0.0010)	(0.0028)	(0.0030)	(0.0031)	(0.0020)	(0.0016)	(0.0016)
Control	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Cst	0.053***	0.031***	0.045***	0.035***	0.034*	0.028***	0.040***	0.044***	0.045***	0.026***	0.036***	0.039***
Obs	338,324	405,134	205,514	165,440	11,419	990,930	137,870	95,390	163,996	110,747	468,660	466,961
Nb indiv	7,845	9,374	4,883	3,928	328	22,259	3,250	2,243	3,844	2,515	10,509	10,468
Diff pair	0.11		0.65		0.19		0.271		0.70		0.53	

Table F3: Effect of the incarceration of peers depending on offenders' position within group among groups composed of three to seven offenders. *Note: The dependent variable is a dummy equal to one if offender i commit at least one crime during month t. All regressions include both individual and month of the spell fixed effects. Controls are for other types of sentences. Standard errors are clustered at the group level.*

	(1) Robbery	(2) Deterioration	(3) Violence	(4) Drug consumption	(5) Drug dealing	(6) First offender	(7) Recidivist
Incarcerated	-0.063***	-0.070***	-0.058***	-0.044***	-0.042***	-0.035***	-0.063***
	(0.0024)	(0.0072)	(0.0033)	(0.0042)	(0.0054)	(0.0028)	(0.0019)
Peer incarcerated	-3.3e-05	-0.0023	0.0013	-0.0018	-0.0019	0.0011	-0.0011
	(0.0014)	(0.0035)	(0.0020)	(0.0020)	(0.0031)	(0.00098)	(0.0014)
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cst	0.042***	0.033***	0.028***	0.029***	0.027***	0.017***	0.063***
Obs	650,327	128,856	325,120	165,192	54,008	787,947	621,097
Nb indiv	14,122	2,734	7,142	4,377	1,467	17,519	14,361

Table F4: Heterogeneity of the effect by crime at the initial trial and criminal record among groups composed of three to seven offenders.
Note: The dependent variable is a dummy equal to one if offender i commit at least one crime of the type during month t. All regressions include both individual and month of the spell fixed effects. Standard errors are clustered at the group level.