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

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Job Market paper
Last version: November 2017
Please check for the last version:
https://sites.google.com/site/arnaudphilippe11/

Abstract: What is the effect of incarcerating one member of a group on her criminal partners? I answer this question using administrative data on all convictions in France between 2003 and 2012. I exploit past joint convictions to identify 34,000 groups. Using a 48-month individual panel that records later criminal activity and sentencing, I find that the incarceration of a peer is associated with a 5% decrease in the conviction rate in groups of two individuals. Exploiting within-group heterogeneity, I show that offenders who have the characteristics of leaders are not affected by their followers but exert influence on them. Lastly, I show that the effect derives from lower criminogenic behavior and not from a loss of criminal human capital or from better information on the risks associated with crime.

1. Introduction

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 euros per year in France,[2] and at least 80 billion dollars[3] per year in the United States – the cost–benefit analysis of this public policy is the subject of recurrent political debates, administrative evaluation and research papers. However, while the effect of incarceration on criminals' behavior is frequently compared to the cost of the infrastructure, its effect an inmate's social network – for example, their family, coworkers, friends, or partners in crime – has rarely been studied in economics. Yet these spillover effects could drastically change the results of a cost–benefit analysis.

[1] I would like to thank the French Ministry of Justice (Sous direction de la Statistique et des Etudes) and especially Benjamin Camus for their help in obtaining and interpreting the data. I am especially grateful to David
[2] http://www.justice.gouv.fr/prison-et-reinsertion-10036/les-chiffres-clefs-10041/
[3] https://www.bjs.gov/index.cfm?ty=pbdetail&iid=5239

This paper investigates the effect of incarceration on criminal partners who remain free. Crimes are often committed by more than one person. In addition to criminal organizations like mafias and gangs, a large share of everyday crimes is committed by small groups of people. Studies examining large official records suggest that 10–20% of crimes are committed in groups, and that 20–45% of offenders take part in co-offending (Grund and Morselli, 2017). In France, 15% of all convictions are for crimes committed in groups.[4] In those groups, when one offender is incarcerated his partners are likely to be affected. On the one hand, offenders may be less likely to offend if their peers are incarcerated because their criminal opportunities decrease or because the perceived cost of crime increases. On the other hand, they may be more likely to commit a crime because they have to do the "criminal work" of the incarcerated person, for example if they have to sell drug to their peers' clients.

The present study builds on a rich administrative dataset reporting detailed descriptions of all convictions and sentences imposed in France between 2003 and 2012. Criminal partners are defined as people who were convicted together. Using data from 2003–2006, I identify 24,735 groups of two offenders (49,470 offenders) and 9,276 groups of 3–7 offenders (31,098 offenders) who were convicted together. Starting from this initial joint conviction, I built an 48 months individual-level panel recording convictions, imprisonment status and criminal activity of individuals and their peers. In the analysis, the period during which one member of the group served a sentence decided at the initial joint trial is excluded.

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 variations in 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 who commit many crimes also tend to have high incarceration rates (what Manski (1993) calls the "correlated effect").

The first and most important finding is that people are less likely to have a new conviction if their peers are incarcerated. All the effect comes from duos (groups composed of two offenders); no effect is observed for larger groups (3–7 offenders). Among duos, a peer's

[4] Author's calculation using French criminal records. The 15% rate excludes road-related offenses.

incarceration reduce the probability to commit a crime during the month by around 8% (4–8% of the effect of an individual's own incarceration). This effect is robust to including a large set of controls, in particular those for other types of sentences, time-varying conditions or individual times year fixed effects. I find that criminal activity returns to the level observed before the incarceration of the peer after a peer's release, and there is no lasting decreasing effect.

It is theoretically possible that this correlation is not causal but derives from a common shock that results in both the incarceration of one member of a group and the decreasing criminal activity of the others ("exogenous effect" in Manski 1993). To test this hypothesis I run several exercises. I first control for county times 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, road-related crimes or crimes committed a long time ago. While those incarcerations have a higher chance of being exogenous to a peer's criminal activity, they have the same decreasing effect on the peer's criminal activity, which makes an explanation based on common shocks unlikely.

The effect of the incarceration of a peer could be due to either a decrease in people's criminal activity or a reduced 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 peer is in prison, and if those crimes have lower chances of leading to a conviction than in-group crimes. To test this hypothesis, I assess the effect of a peer's incarceration on different measures of in-group and lone crimes (based on how likely it is, for each crime identifier, to find criminals convicted together). The probability of committing an in-group crime clearly diminishes when a peer is in prison. The probability of committing a lone crime diminishes or remains constant depending on the definition of 'lone'. 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 a peer's incarceration on offenders' criminal activity.

Within duos, the influence is not symmetrical: some members exert more influence on their partners than others. Offenders who were identified by judges at the initial joint 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 more experience are not affected by the incarceration of their peer. However, *their* incarceration affects the criminal activity of their peer. These results are consistent with a leader–follower dynamic. Other mechanisms – e.g., the quality of the lawyer, path dependency – could hardly explain all the results. Additional results indicate that the incarceration of men and French citizens affects women and foreigners, respectively, more than the contrary.

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, vandalism 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 should be more affected than experienced offenders, as they have less knowledge of the judicial system. Third, crime could decrease because people tend to exhibit less criminogenic behavior – 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 criminogenic behavior 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 effect does not seem to be driven by changes in perceptions, as experienced offenders are more affected than people with a short criminal career.

This paper expands the existing literature in several ways. First, it documents an under-explored channel of peer effects on crime. While the general effect of the social environment (Glaeser et al., 1996; Ludwig et al., 2001; Zenou, 2003; Ludwig and Kling, 2007; Damm and Dustman, 2014), the effect of the network size (Corno, 2015), the quality of the peers (Calvó-Armengol et al., 2007; Corno, 2015; Billings et al, 2016), 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 effect of the incapacitation of a peer through imprisonment have rarely been explored empirically. 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 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 were sentenced together. This strategy has two primary 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).

Those first two extensions of the literature are partly shared with two recent working papers. Lindquist and Zenou (2014) take structural approach and use Swedish data to estimate peer effects in criminal networks. Criminal networks are defined based on police registers, which record who is suspected of committing a crime with whom. In a second part they measure the effect of removing some offenders (i.e., death, migration or incarceration) on others' criminal activity. They define who the key player should be according to their model and provide evidence that removing this key player results in the highest reduction in the overall crime rate.

The most closely related paper is a recent working paper by Billings and Schnepel (2017), which defines peers as people in the criminal's neighborhood of residence who share similar characteristics. They show that former offenders tend to recidivate less when more of their peers are in jail at the time of their release. In one exercise, conducted on a subsample of 5,400 persons, the authors use a definition of peers similar to the one used in this paper and

present a marginally significant 12% decrease in offenders' criminal activity after one year when a criminal's peer is in prison at the time of their release. My results are very much consistent with Billings and Schnepel (2017). One difference is that their main result could be interpreted as the importance of conditions at release, in line with previous work (Munyo, Rossi, 2013; Schnepel, 2016; Yang, 2016; Galbiati, Ouss, Philippe, 2017), rather than a general spillover effect of incapacitation.

In contrast to those two papers, my paper also expands the literature by providing the first empirical evidence of the mechanisms of the effect. It provides consistent 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) as well as evidence that suggests an effect based on the diminution of criminogenic behavior. I find that causal chains based on 'criminal capital' loss or deterrence are not supported.

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

2. Data and empirical setup

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 outcomes 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 and resulted in many criminal records being cleared, 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."[5] This does not necessarily mean that the rest of the group was convicted. A crime could be registered as a "group robbery" even if only one of three robbers was arrested and convicted.

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 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 subsets 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% of the cases. In comparison, the same strategy applied to offenders who did not commit a crime described as "in group"[6] led to the discovery of a "partner" in 17.13% 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% represents the proportion of false matches among 1,075,497 offenders, then this rate is 3.1% in the group of interest[7]. 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% 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[8].

[5] People convicted of a crime "en réunion", "en association", as "complice" or in a "trafic".
[6] 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.
[7] If $1{,}075{,}497 * p = 0.1713$ then $p=1.59*10^{-7}$. $199{,}082*1.59*10^{-7}=0.031$.
[8] Another 16.5% is composed of drug use without the mention of trafficking. In France, the difference is driven mainly by the quantity seized by the police.

Juveniles (under 18) are dropped. Indeed, criminal records could be cleared at 18 and juvenile courts (that are specific and follow rules that are specific to juveniles) do not always send the decisions to the criminal record authorities.

Using this method, I identify 82,792 group members. 49,942 belong to groups of two (24,971 groups) and 32,850 belong to groups of 3 to 7 (9,037 groups).[9] According to the criminology literature, those small groups (two or three persons) are responsible of the majority of in-group crimes (Weerman, 2003).

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%), French (83%) and almost 50% 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% for groups with more than 3 persons compared to 13% for duos and 10% 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.

In the rest of the paper, the conviction used to identify the group members will be called the "initial joint trial" or simply the "initial trial".

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 within a group and how offenders may self-selected into groups. According to Weerman (2013) criminal groups are very much homogeneous and homophily has been documented in several articles (see Lindquist and Zenou, 2014; Young, 2011).

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

[9] 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. Larger groups exist, but they are extremely rare. They are not used in this paper.

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% are composed of two French offenders and 10% of one French and one non-French offender. As a comparison, among the random rearrangements, the duos are, on average, 69% French and 28% non-French.[10]

2.3. Panel data

The procedure described in section 2.1. allowed me to identify partners in crime. The main goal of this paper is to study the dynamics of those groups and the effect of a peer's 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, sentences and incarceration of the peers in the four years following the initial joint conviction day.

The presence of an individual ID allows me to reconstruct a person's criminal career. I use it to record the precise dates of all crimes that lead to conviction[11].

For each month of the Panel, I also measure if people are in jail[12] 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.[13] 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

[10] Comparisons with theoretical distribution (based on means in the sample) are presented in appendix A. The results are similar to those based on random rearrangements.
[11] 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. Note that, when a crime covers a period of time – for e.g. in case of a drug dealing –, I keep the last day of the period.
[12] Note that, in France, there is no distinction between jail and prison. Both terms will be used in the paper.
[13] 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.

service is left open – that is, the offender goes home and is summoned a few days later by another judge who might modify the sentence if it is shorter than 2 years (less than 5% of the sentence at the initial trial in the sample). In the second case, offenders have few chances of going to prison: even if they represent 38% of the prison sentences, the sum of pre-trial detention and prison sentences that could not be modified represents 85% of the total time spent in jail each year in France. For those reasons, I distinguish between the two sentences. [14] In addition to those two dimensions I record probation and suspended prison sentences.

Lastly, for each month of the panel, I measure if peers are incarcerated and the reason for the incarcerations.

A stylized form of the data is presented in Figure 1. The initial trial is used to identify criminal groups but 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 initial joint trial. The offenders are followed in the 48 months following the initial trial. The panel is, at maximum, 48 months long (48 months minus the time during which members of the group serve sentences following the joint trial).[15]

The final dataset contains 3,676,092 individual*month observations: 2,267,048 for duos (49,470 offenders x 48 months, minus prison term resulting from initial trial), and 1,373,284 for groups of three to seven offenders (31,098 offenders and 1,373,284 observations)[16]. The most important variables of this panel answer the following questions: did person *i* commit a crime during month *t*? Is person *i* in jail, or is she serving another sentence, during month *t*? Are person *i*'s peers in jail during month *t*?

Table 3 presents descriptive statistics of the Panel. The first two Columns present the statistics for all groups while Columns 3 and 4 describe duos and bigger groups separately. Offenders commit at least one crime in 2.1% of the months (2.2% among duos, 1.9% for bigger groups). Crimes explicitly labelled 'in-group crimes' are relatively rare (0.3% of the months/15% of the crimes). Some of those crimes are committed with the same peer (0.03% of the months/1.3% of the crimes and 8.8% of in-group crimes) and some with other offenders (0.16% of the months/7.6% of the crimes and 50% of in-group crimes). In the remaining

[14] Additional information on the construction of these variables is provided in Appendix B.
[15] Robustness checks with a fully balanced 36-month panel are also presented.
[16] The sample sizes are slightly smaller that those given in Section 2.1 because some groups are composed of offenders who spend all the month of the panel in jail. Those groups are dropped.

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 (in 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 definition of 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 which the average number of match per offender is above (resp. below) than 0.4[17]. '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. 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.[18]

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

[17] 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.
[18] Additional information on the construction of these variables is provided in Appendix C.

Imprisonment is slightly more frequent than crime: 2.5% of the months are spent in jail (for sure), and an additional 1.4% 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% of the months vs. 2.2% for groups of three to seven persons.

The per-month probability of having one peer incarcerated while being free is 2.4% among duos. This situation is more frequent in larger groups (4.8%). 0.4% of the incarcerations of the peer followed crimes classified as 'alone' and 0.11% 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% vs. 0.5% 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% of the offenders involved in a group committed a new crime during the panel (46.6% for duos, 42.2% for larger groups). Approximately 20% spent some, but not all, of the months in jail (21.6% for duos, 20.7% for larger groups), and between 16.4% (duos) and 30.1% (large groups) spent some months free while at least one of their peers was in jail.

3. Identification strategy

3.1. Framework

The main question addressed in this paper is the effect of a peer's 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, when *i* is in jail, person *j*'s situation is not important for his criminal activity. Whatever *j*'s incarceration status is, person *i* has a very limited capacity to commit a crime.[19] Thus, regarding person *i*'s propensity to offend, three situations are relevant:

1) *i* is in jail;

[19] Crimes are possible in jail. However they could hardly be related to former partners, as people convicted together are usually separated by penitentiary administrators.

2) *i* is free and can enjoy the company of peer *j*; and

3) *i* is free but cannot interact with *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 criminogenic 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.

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 with more than two members. However, as the group grows, the third hypothesis—no effect of *j*'s incarceration—may be more likely as one person's incarceration is more anecdotal.

3.2. Empirical strategy

In practice, measuring the effect of one individual on another poses several problems. Indeed, the behaviors within a group could be correlated for several reasons. Manski (1993) distinguishes between correlated effects ("individuals in the same group tend to behave similarly because they have similar individual characteristics"), exogenous effects ("the propensity of an individual to behave in some way varies with the exogenous characteristics of the group," for example when the group faces the same shock) and endogenous effects ("the propensity of an individual to behave in some way varies with the behavior of the group"). In practice, peer effects are usually understood as the endogenous effects and so researchers want to isolate it and rule out exogenous and correlated effects.

To isolate the endogenous effects, 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:

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

$Crime_{i,j,t}$ 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.[20] $\mathbb{1}_{i\ in\ prison}$ 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*.

Individual fixed effects allow me to exclude the "correlated effects" (Manski, 1993). In this context, those effects would emerge from the fact that individuals with high criminal activity – and then high incarceration rates – probably belong to groups with similar individuals. For this reason, high criminal activity will be correlated with the high incarceration rate of the peers. Using individual fixed effects helps overcome those correlated effects. Indeed, the effect is identified using within-offender variation. This strategy does not take into account the potential evolution of offenders' characteristics during the study period I (partly) address this question by using individual times year-of-the-spell fixed effects in a robustness check in Section 4.4.

The condition presented in Equation 2 could be violated (and the estimation based on Equation 1 may be 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 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

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

control for the two other possible sentences:[21] probation and suspended prison time. In robustness checks I also control for possible cyclical behavior with a variable that indicates the time since the last trial.

Second, both a person's incarceration and the criminal behavior of his peer(s) could be driven by a common shock – what Manski (1993) calls the "exogenous effect." It is important to note that exogenous effects are more likely when people's behaviors are similar. Here, β_2 is biased if there is a common shock that drives one offender to prison and the other members of the group to change their criminal activity.[22] 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 (calendar month times county fixed effects; police activity; judicial activity). 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 and incarceration for a crime committed several weeks before. Lastly, I present the heterogeneity of the result regarding the characteristics of the offenders compared to their peers (Section 6) or in general (Section 7). 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

A first 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. 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

[21] 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.
[22] Note that a common shock leading to very different behavior is, *a priori*, more difficult to imagine, than when behaviors are similar.

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 2. For every total number of crimes over the panel (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 effect of incarceration can also be documented by measuring the probability of committing a crime, while free, just before and just after a peer's imprisonment (Figure 3) or release (Figure 4). The two graphs present the effects of a peer's incarceration when entrance (respectively release) is not associated with the criminal's own incarceration (respectively release). In order to smooth the variations, the graphs only present the effect of an incarceration stay of at least 3 months and criminal activity is averaged by quarter.

Criminal activity decreases after a peer enters prison (Figure 3) and increases after his or her release (graph 4). Those results are consistent with the pattern observed in Figure 2. Even if Figures 3 and 4 could not account for the potential correlation between a peer's incarceration and one's own sentence other than prison (probation, suspended prison), they clearly support the idea that a peer's incarceration decreases 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 month. The decreasing effect of one's own incarceration is presented in the first two rows (coefficient and s.e.), while the effect of a peer's incarceration is presented in rows 3 and 4. The first three Columns present the results for the entire sample. Columns 4 to 6 present the effect of a peer's incarceration among duos, and the last three Columns present the effect of the incarceration of at least one peer within a group of 3–7 persons.

In all nine Columns, rows 1 and 2 indicate that an individual's own incarceration drives the probability that he will commit a crime to zero. This is consistent with a full incapacitation effect. Unsurprisingly, this result is significant at the 1% level. [23]

The most important result comes from the coefficients observed in rows 3 and 4. For the entire sample, the effect of a peer's incarceration is both negative and strongly significant. In Column 1, which contains only individual and month of the spell fixed effects, it represents 3.5% 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% of the effect of one's own incarceration.[24] In the third Column I also include leads and lags of the peer's incarceration. The null effect of the lead variable ("two months before a peer's incarceration") could be interpreted as a first robustness check. More interestingly, the lag variable is small and insignificant. The incarceration of the peer does not seem to have a lasting effect.

The other Columns of Table 4 measure the effect for different group sizes. The incarceration of a peer clearly decreases criminal activity for pairs of offenders. The effect of a peer's incarceration represents slightly more than 5% of the effect of one's own incarceration, and it only marginally changes with the introduction of control variables for other sentences (Column 5). These results are significant at the 1% level. In Column 6, both lead and lag variables are small and insignificant. Again, those results go against the hypothesis of a lasting effect of the incarceration of a peer.

By contrast, among groups of 3–7 offenders, the incarceration of one peer has no effect (Columns 7 to 9). Coefficients are small – they represent less than 1% of the effect of one's own incarceration when controls are added – and not significant. Note that this result means that the effect of a peer's incarceration presented in Columns 3 and 4 could be biased toward zero. Indeed, duos could be subgroups of larger groups.

The difference between duos and groups of 3–7 offenders could have several origins. First, it is possible that offenders only decrease their criminal activity when they are alone. While among duos the offender would be alone if the peer is incarcerated, it is rare among larger

[23] It is possible to distinguish between "being in prison with peer(s) free" and "being in prison with peer(s) in prison." Those two situations are associated with a similar decrease in criminal activity: point estimates are close, and they are not statistically different (see Appendix D, Table D1, Columns 1 to 6).

[24] 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.

groups for all peers to be in jail.[25] Second, the criminal activity of a group may rely predominantly on one offender. In this case, there are more chances to lock up the important person in a small group than in a larger one (this mechanism is discussed in Lindquist and Zenou, 2014). This hypothesis is consistent with the results for within-group heterogeneity presented in Section 6. Third, the types of crimes committed in groups of 3–7 offenders could differ from those committed by duos. They may be easier to carry out alone or with at least one other person.

Since 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 Appendices E and F, respectively.

4.3. Common shocks and exogenous incarcerations of a peer

The most straightforward interpretation 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.

In order to 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 times county 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,[26] number of crimes, number of property crimes, number of violent offences, number of drug-related crimes, number of vandalism) 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.

[25] In groups of 3–7 offenders it is possible to have more than one peer in prison. However, this situation is 15 times less likely than having exactly one peer in prison. Individuals' criminal activity seems unaffected even if more than one of their peers is in jail (see Appendix D, Table D1, Column 7).

[26] 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 and other types of incarceration. The former could reasonably be considered as exogenous 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 (0.12% of the months, see Table 1), 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 goes against the hypothesis that the effect of the incarceration of a peer is driven by a common shock. They also contradict an interpretation of the results based on an increase in police surveillance of peers when one member of a group has been arrested and convicted. Indeed, an increase in police surveillance of the peers is hard to imagine after a lone crime or a road related crime. This interpretation is also inconsistent with the heterogeneity of the results presented in section 5, 6 and 7.[27]

[27] This hypothesis is, in practice, very unlikely. 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 (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).

4.4. **Robustness checks**

Table 6 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.

In Column 2, panel regressions include individual times year-of-the-spell fixed effects (four fixed effects per individual) instead of fixed effects per individual. Indeed, panel regressions with individual fixed effects control for any constant characteristics of the individuals during the panel. However, this strategy does not take into account the potential evolution of individuals' characteristics. For example, it is well known that older offenders commit fewer crimes than younger ones (see, e.g., Ganong, 2011). Individual times years fixed effects partly address this problem: individuals' characteristics are only considered as constant during a given year. The inclusion of those fixed effects does not affect the main results.

Column 3 presents the results using logit regressions. Column 4 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). 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 500 times and measure the effect of one's own incarceration, peer's 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 a peer's 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 a peer's 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 to 6 is that a peer's incarceration decreases criminal activity. However, the observed effect could come from a decrease in the probability of *being convicted 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 conviction

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 or convicted 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:

$$P(\text{conviction}) = P(\text{conviction} \mid \text{committing crime}) * P(\text{committing crime}) \quad (3)$$

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 write:

$$P(conv) = P(conv\ crime\ with\ B) + P(conv\ crime\ with\ C) + P(conv\ crime\ alone) \quad (4)$$

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. Combining Equations 3 and 4 we obtain:

$$P(conv) = P(Conv_{with\ B}|C_{with\ B}) * P(C_{with\ B}) + P(Conv_{with\ C}|C_{with\ C}) * P(C_{with\ C})$$
$$+P(Conv_{lone}|C_{lone}) * P(C_{lone}) \quad (5)$$

Where $conv$ denotes 'conviction' and the index indicates the peer status of the crime. In Equation 5, the probabilities of being convicted associated with the different types of crime have no reason to be similar. Therefore, the overall decreasing effect of a peer's incarceration on $P(conv)$ could hide a constant (or even an increasing) criminal activity if:

$$P(Conv_{with\ B}|C_{with\ B}) > P(Conv_{with\ C}|C_{with\ C}) \quad (6)$$

$$\text{or } P(Conv_{with\ B}|C_{with\ B}) > P(Conv_{lone}|C_{lone}) \quad (7)$$

Then it is possible to have a decrease in $P(conv)$ hiding a decrease in $P(C_B)$ and an increase (potentially bigger) in $P(C_{with\ C})$ 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 $P(Conv_{with\ C}|C_{with\ C})$ 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 orthogonal to whether peers are incarcerated, measuring the effect of a peer's 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 $P(C_{with\ B})$, $P(C_{with\ C})$ 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 peer's incarceration on in-group or lone crimes 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 composed of two persons.[28] 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) where the effect is, mechanically, almost equal to own incarceration.[29] 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 a peer's incarceration on crimes that are not labelled in-group crimes is both negative and significant.

[28] Similar results for all groups and for triplet to septuplets are presented in appendix E Table E2 and appendix F Table F2 respectively

[29] 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.

Taken together, the results presented in the first four Columns of Table 7 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 7 present the effect of a peer's 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 a peer's incarceration presented in Columns 5 to 8 are negative. They range from approximately 7.5% of the effect of one's own incarceration for in-group crimes to less than 1% 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 a peer's incarceration strongly affects the probability of committing a crime in-group. Lone crimes marginally decrease or remain unaffected.

The results presented in Table 7 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 a peer's incarceration decreases offenders' criminal activity.

6. Peers' incarceration and position within groups

Up to this point, all offenders have been considered to play an equal role in the group. However, their importance within their groups is probably not homogeneous. As noted by Warr (1996), "it is difficult to believe that all members of offending groups are equally motivated or inclined to break the law on any given occasion. It is equally difficult to believe that members of offending groups are prepared to follow any and all other members of the group into illicit activities." According to Weerman (2003), there is one instigator in 80% of in-group crimes.

If groups are heterogeneous, the incarceration of one member of a group could have different effects on the group's dynamic. The incarceration of a "key player" could have a greater effect on others' criminal behavior than the incarceration of less central members of the group. The goal of this section is to test this hypothesis. As in the preceding section, the work presented below focuses on groups of two persons.

6.1. Within-group heterogeneity

I measure within-group heterogeneity of the effect along two main dimensions: heterogeneity in judicial characteristics at the initial 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: the sentence handed down at the initial trial, the number of charges at the initial trial,[30] and a measure of the individual's criminal career. When those variables are not equal within a group, they may signal some form of heterogeneity in members' influence.

Offenders usually receive a longer sentence at a joint trial because the judge identified them as having more responsibility for the crime. Indeed, the general criminal rule of "sentence individualization" mandates that sentences should depend on the gravity of the offense, the offender's responsibility and the offender's personality.[31][32] This difference in responsibility is even clearer for offenders who are convicted 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.

People with a longer criminal career could be viewed as having more criminal experience. This dimension has been identified as a good proxy for leadership. Indeed, past research in criminology (McGloin and Nguyen, 2012) indicates that criminal experience is the best indicator of instigating a crime. In the following I will use the sum of prison convictions before the initial joint trial. This measure aggregates different dimensions of experience (experience of the sanction, proxy for the number and the severity of previous crimes).

[30] All members of the group are, by definition, convicted of the same "main" crime. Some could also be convicted of other (related) offenses (e.g., theft in addition to violence).
[31] 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 (…)."
[32] 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.

The second dimension, based on state variables, is also composed of three sources of heterogeneity: age, gender 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 gender, previous research based on interviews indicates that women frequently acknowledge that a man was the instigator of the crime (Alrid et al., 1996). 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 from committing crimes (since they face no risk of expulsion).

As discussed in Section 2.2, groups present a strong homophily. Only some of them present within-group heterogeneity. Of the pairs, 84% are composed of people convicted of the same number of charges at the initial trial, and in 58% of the cases the two members received the same sentence, 69% are comprised of criminals with the same criminal experience (as measured by the sum of past prison sentences), 87% of criminals of the same gender, and 90% of offenders who are both French or both non-French.

The effects of a peer's incarceration on group members depending on their characteristics are presented in Table 8. All regressions include controls for other possible sentences (probation and suspended prison sentence). The sample size is restricted to groups of two.[33]

The first two Columns present the effect of a peer's 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. The difference between the two coefficients is large: one is ten times bigger than the other.

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 peer is in jail (Column 4). The coefficient is twice as large for offenders who receive the shortest sentence.

[33] Similar results for all groups and for groups of 3–7 are presented in Appendix Tables E3 and F3, respectively.

The last source of heterogeneity based on judicial characteristics, the criminal experience, is explored in Columns 5 and 6. Offenders who have the shortest prison conviction time in the past are significantly affected by the incarceration of a peer, while those with the longest are not.[34]

The last six Columns of Table 8 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.[35]

The differences based on gender 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.[36] 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.

Even if the differences in the coefficients are sometimes very important, they are not significant at the standard level because the sample sizes are small (three to ten times smaller than in the general case).

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 peer while followers are. Indeed, the results using the two proxies for instigating the crime convicted during the initial joint trial and the proxy for experience indicate that people who are more responsible or more experienced are not *affected by* their peer, but instead *exert influence* over them. In addition, women are affected by a male partner's incarceration while the opposite is not true, and foreigners are affected by a French citizen partner's incarceration while the opposite is not true. The interpretation of those results in terms of leadership is consistent with previous literature in criminology (Alrid et al., 1996; McGloin and Nguyen, 2012).

[34] Measures based on the number of past convictions or the number of past prison convictions give the same pattern even if the differences are smaller (not shown).
[35] This absence of difference is also observed if I restrict the sample to groups composed of offenders who have a difference in age of at least 2 years, 3 years, or 5 years (not shown).
[36] This difference in crime instigation could partly explain why women get smaller sentences than men (Starr, 2015; Philippe, 2017).

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 criminal behaviour should not be correlated. In addition, this explanation is hardly convincing for differences based on criminal experience.[37]

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. It is reasonable to think that he 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

[37] 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.

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 9, 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.

7. Mechanism

7.1. Possible causal chains

The preceding three sections present consistent results showing that people's criminal activity is negatively affected by the incarceration of their peer. 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 vandalism 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 "criminogenic 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 would 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 a peer's 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 a peer's incarceration should provide less useful information.

Finally, if the effects are driven by the diminution of criminogenic behaviours, crimes described as more "impulsive" and more related to alcohol and drug consumption—such as violence or vandalism —should be more affected than "planned" 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 9 and 10. Table 9 presents the heterogeneity of the effect based on the characteristics of the initial joint trial. All regressions include controls for other possible sentences (probation and suspended prison sentence). The sample size is restricted to groups composed of two persons.[38]

The first five Columns of Table 9 distinguish the effect by type of crime judged during the initial trial. The categories used during this exercise are robbery, vandalism, 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 1 and 2 of Table 10 present the effects of a peer's incarceration on two types of new crime: similar or different to the one for which offenders are convicted during the initial joint trial.

[38] Similar results for all groups and for triplet to septuplets are presented in appendix E Table E4 and appendix F Table F4 respectively.

The effect of a peer's incarceration is larger for groups jointly convicted of vandalism (Table 9, Columns 2), violence (Table 9, Columns 3) or drug consumption (Table 9, Columns 4) than for those convicted of robbery (Table 9, Columns 1) or, drug dealing (Table 9, Columns 5). In the last two categories, the results are not significant while they are in the first three. The effect of a peer's incarceration in groups jointly convicted of vandalism, violence or drug consumption represents approximately 10% of the effect of one's own incarceration (9.9%, 8.5% and 12.9% respectively). Coefficients represent less than 3% in duos jointly convicted of theft or drug dealing (3% and 2% respectively). As mentioned earlier, drug consumption, violence and vandalism 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 criminogenic behaviour.

Among duos, offenders who experience their first conviction during the initial trial (Table 9, Columns 6) are less affected by the incarceration of their peer than offenders with longer criminal records (Table 9, 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 peer's 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 10 show that crimes identical to (Table 10, Columns 1) and crimes different from (Table 10, Columns 2) the first one are affected by peer's 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% 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 criminogenic 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 9 and 10 draws a consistent picture of the mechanisms underlying the effect of a peer's incarceration. Peer's incarceration decreases criminal activity among duos because of a decrease in criminogenic behaviour. Explanations based on information or human capital are not supported by the data. This is consistent with studies in criminology that found a limited degree of specialization in group crimes (Weerman, 2003).

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 a peer 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 could 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 could be higher in the first years of the Panel.

Those two hypotheses are tested in the last two Columns of Table 10. 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 10). 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 documents the effect of former criminal partners' incarceration on criminal activity. Using a 48-month individual panel on more than 80,000 individuals, it provides consistent and robust evidence that offenders who belong to a group of two persons react to the incarceration of their criminal partner by decreasing their criminal activity. No effect is observed among groups of 3–7 persons.

Among duos, the effect is sizable and represents a decrease of approximately 5% per month during which the peer is incarcerated. It does not hide a shift from in-group crimes to other crimes: lonely crimes or crimes committed with another peer also decrease or remain constant.

This main effect masks some disparities, depending on an offender's position within the duo. The heterogeneity of the results is 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.

Additional results indicate that the effect observed among duos comes from the diminution of criminogenic behavior – drinking alcohol, consuming drug, looking for fights – and not from a lack of "criminal human capital" or from some form of deterrence effect due to new information on risk or the harshness of sanctions.

The results presented in this paper could be viewed as the upper bound of the effect of prison on peers. They are based on a very restrictive definition of peers – people who have been convicted together – and the effect is probably smaller for other peers. However, and for the same reason, those results could also be viewed as a lower bound of the social effect. Many other types of criminal peers could be affected by the incarceration of one person, and the aggregate result is probably bigger than what is measured here: a 5% decrease in the criminal activity of members of pairs (60% of the 15% crimes committed in group).

Regarding the policy implications, the results indicate that, among duos, making sentences more heterogeneous – long for leaders and short for followers – would be an effective way to reduce crime with no change in jailing rates or to reduce incarceration with no increase in crime rates.

The scope of this study is limited to the effect of prison on former criminal partners. It underlines the importance of understanding the effect of incarceration on the people around the convicted persons in order to fully address the cost–benefit analysis of prison. The effect of prison on other types of peers – family, children, friends etc. – seems of primary importance and remains to be explored.

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Figure 1: Structure of the data

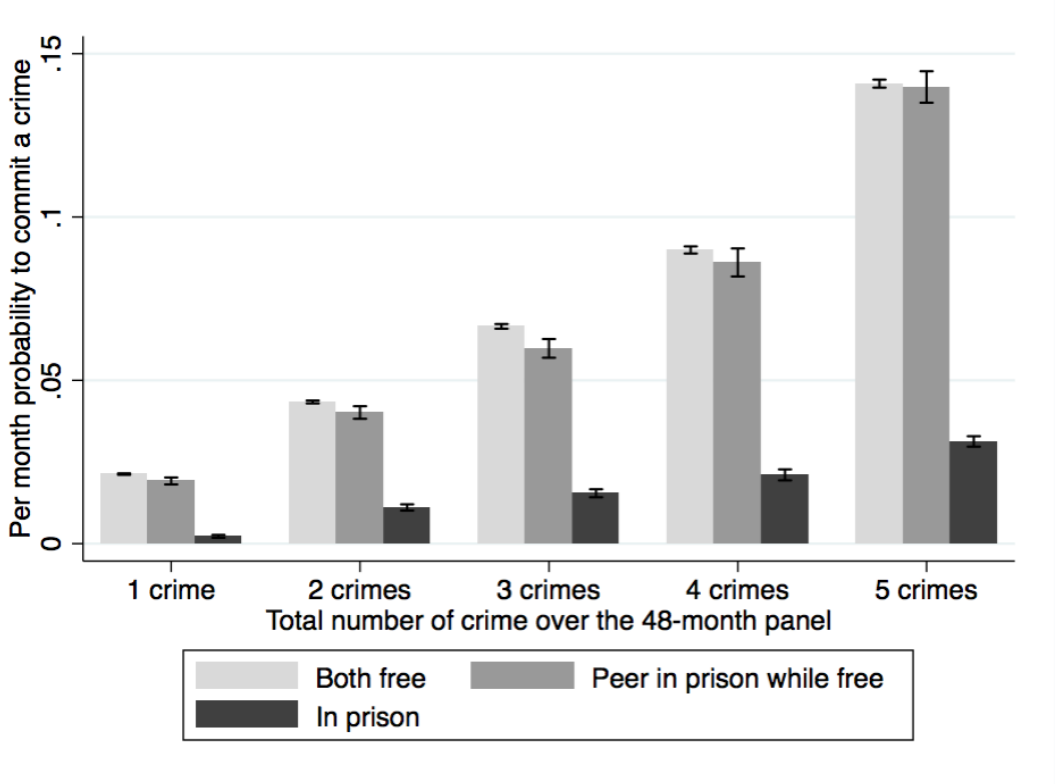

Figure 2: probability that an offender will commit a crime during the month depending on offenders' total number of crime over the panel and situation of the members of the group.
Note: Bars present the confidence intervals at the 10% level.

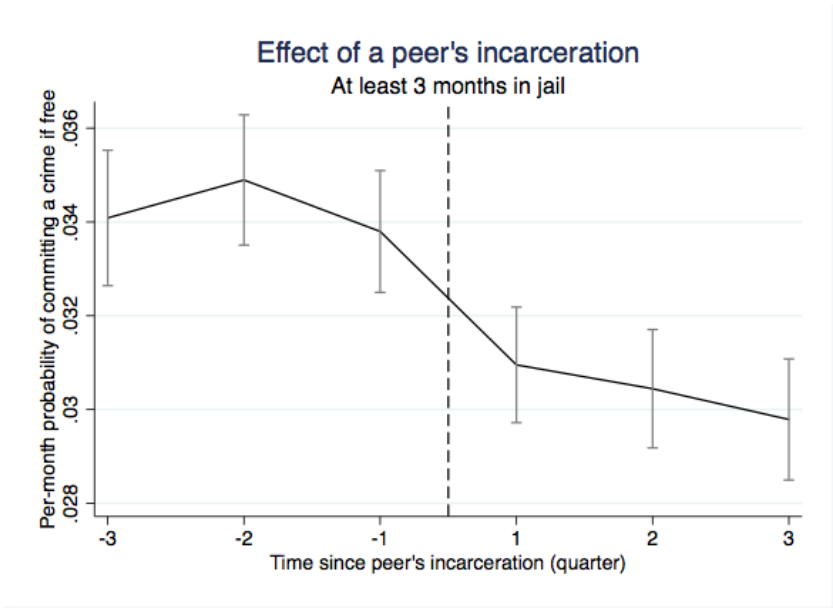

Figure 3: per-month probability that an offender will commit a crime before and after a peer's incarceration for at least 3 months. *Note: probabilities are averaged per quarter. Peers' incarcerations concomitant to self-incarcerations are excluded. The graph aggregate 32,438 events. Bars represent the confidence intervals at the 5% level.*

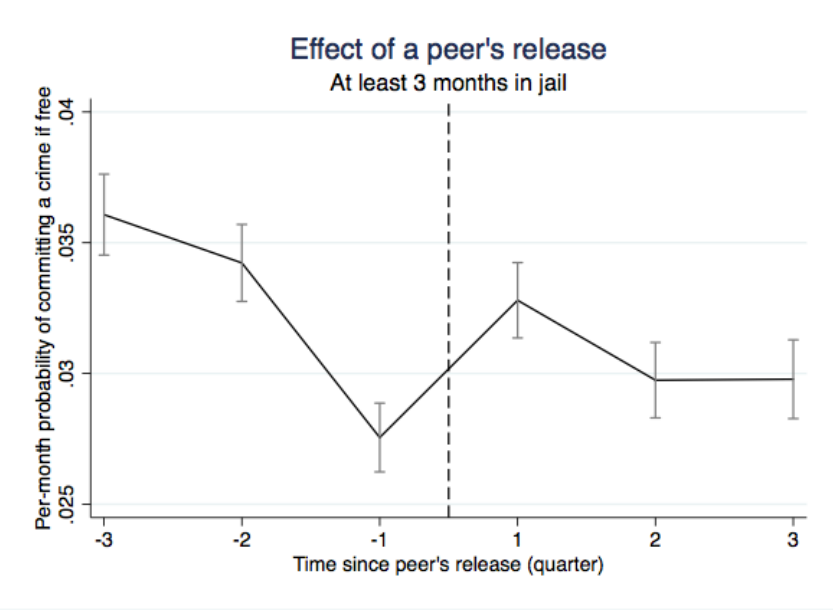

Figure 4: per-month probability that an offender will commit a crime before and after a peer's release from prison when the peer spent at least 3 months in prison. *Note: probabilities are averaged per quarter. Peers' incarcerations concomitant to self-incarcerations are excluded. The graph aggregate 25,093 events. Bars represent the confidence intervals at the 5% level.*

	(1)	(2)	(3)	(4)	(5)	
	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
Male	.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: Summary statistics for offenders included in the dataset and offenders convicted during the same period for crimes that were not flagged as in-group crimes. The first two Columns present the characteristics of all offenders in the sample (i.e., offenders who committed a crime flagged as "in-group" in 2003–2006 and for whom at least one peer was found). Column 3 presents the same characteristics for groups of two offenders, while Column 4 presents the characteristics for groups of 3–7. The last two Columns present the characteristics of offenders convicted in 2003–2006 for a crime that was not targeted as "in group." Road-related crimes are excluded.

	(1) Mean	(2)	(3) Observed duos	(4)	(5)	(6) Random permutations	(7)
		1-1	mixed	0-0	1-1	mixed	0-0
Male	.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. The first Column presents the mean of each characteristic in the sample. Columns 2 to 4 present, respectively, the proportion of groups composed of two offenders with the characteristic in that row, one offender with the characteristics and one offender without them, and two offenders without the characteristics. Columns 5 to 7 present those proportions in 100 random groups. Random groups are random matches of two offenders of the dataset whose initial trial occurred in the same county during the same quarter but were not committed in group.

		(1) All Mean	(2) Sd	(3) Duo Mean	(4) Triplet-7uplet Mean
Panel A: Per offender * Month	Crime	2.09%	.14	2.22%	1.89%
	Crime labelled as in-group crime - all	.32%	.06	.34%	.31%
	Crime labelled as in-group crime - same peer	.03%	.02	.03%	.04%
	Crime labelled as in-group crime - other peer	.16%	.04	.17%	.14%
	Crime NOT labelled 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
Panel B: Per offender	At least 1 crime	44.85%	.5	46.58%	42.15%
	At least 1 month in prison	21.21%	.41	21.57%	20.65%
	At least 1 month peer in prison while free	21.77%	.41	16.43%	30.07%
	At least 1 month peer in prison for crime "alone" while free	4.51%	.21	3.56%	5.99%
	At least 1 month peer in prison for road related crime while free	1.79%	.13	1.32%	2.52%
	N	81350		49,470	31,098

Table 3: Descriptive statistics of the panel. Columns 1 and 2 present the statistics for all groups included in the dataset, while Column 3 presents the same statistics for duos and Column 4 presents the statistics for groups of 3–7. Panel A presents the descriptive statistics of the monthly panel. For all groups, the sample is composed of about 3.7 million monthly observations for 81,350 individuals. The months during which at least one offender in the group served a sentence decided at the initial trial (used to identify the group) are excluded. Panel B presents the descriptive statistics at the individual level. Again, the months during which at least one offender in the group served a sentence decided at the initial trial (used to identify the group) are excluded, which explains why the sample sizes are slightly smaller than in Table 1. “Alone”, "probably alone", "probably in group", “in group” refers to a categorization based on how likely it is, for each crime identifier, to find criminals convicted together (see section 2.3).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		All groups			Duos			Triplets to septuplets	
Incarcerated	-0.075***	-0.062***	-0.062***	-0.078***	-0.064***	-0.064***	-0.070***	-0.058***	-0.058***
	(0.00094)	(0.00096)	(0.00096)	(0.0012)	(0.0012)	(0.0012)	(0.0016)	(0.0016)	(0.0016)
Peer incarcerated while free	-0.0026***	-0.0017**	-0.0019***	-0.0044***	-0.0033***	-0.0034***	-0.00098	-0.00026	-0.00039
	(0.00069)	(0.00068)	(0.00071)	(0.0011)	(0.0010)	(0.0011)	(0.00093)	(0.00092)	(0.00094)
2 month before peer incarceration			6.1e-05			-0.00011			0.00026
			(0.00089)			(0.0014)			(0.0012)
2 month after peer incarceration			-0.0011			-0.00062			-0.0015
			(0.00087)			(0.0014)			(0.0011)
Prison or probation		-0.0091***	-0.0091***		-0.00904***	-0.0090***		-0.0093***	-0.0093***
		(0.0012)	(0.0012)		(0.00146)	(0.0015)		(0.0020)	(0.0020)
Cumul. Time prison		-0.0051***	-0.0051***		-0.00513***	-0.0051***		-0.0049***	-0.0049***
		(0.00010)	(0.00010)		(0.000127)	(0.00013)		(0.00017)	(0.00017)
Cumul. Probation		-7.7e-06***	-7.7e-06***		-1.02e-05***	-1.0e-05***		-3.1e-06	-3.1e-06
		(3.0e-06)	(3.0e-06)		(3.65e-06)	(3.7e-06)		(5.0e-06)	(5.0e-06)
Cumul. Suspended prison		-0.00013***	-0.00013***		-0.000138***	-0.00014***		-0.00013***	-0.00013***
		(1.2e-05)	(1.2e-05)		(1.60e-05)	(1.6e-05)		(1.4e-05)	(1.4e-05)
Cst	0.033***	0.039***	0.039***	0.030***	0.041***	0.041***	0.030***	0.036***	0.037***
Obs	3,676,092	3,676,092	3,676,092	2,267,048	2,267,048	2,267,048	1,409,044	1,409,044	1,409,044
N indiv	81,350	81,350	81,350	49,470	49,470	49,470	31,880	31,880	31,880

Table 4: Effect of a peer's incarceration on criminal activity by group size. 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 individual and month of the spell fixed effects. Standard errors are clustered at the group level. The variable "Peer incarcerated while free" is a dummy equal to one if the offender is free and if at least one of his peer(s) is in prison. The variable "prison or probation" is a dummy equal to one if the incarceration could have been converted into probation. The variables "Cumul. Time prison," "Cumul. Probation" and "Cumul. Suspended prison" are the sum of prison, probation and suspended prison quanta since the beginning of the panel, respectively. *Note: *** p<0.01, ** p<0.05, * p<0.10.*

	(1)	(2)	(3)	(4)	(6)	(5)
	Control calendar month*county	Control crime police in county	Control nb conviction in county	Nb crime in the month		
Incarcerated	-0.065***	-0.064***	-0.064***	-0.064***	-0.064***	-0.064***
	(0.0012)	(0.0012)	(0.0012)	(0.0012)	(0.0012)	(0.0012)
Peer incarcerated while free	-0.0035***	-0.0033***	-0.0033***			
	(0.0010)	(0.0010)	(0.0010)			
Peer inc., crime "alone"				-0.0036*		
				(0.0022)		
Peer inc., crime not "alone"				-0.0032***		
				(0.0011)		
Peer inc., road crime					-0.0032	
					(0.0039)	
Peer inc., non road crime					-0.0033***	
					(0.0010)	
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		0.039***	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 a peer's incarceration on criminal activity among duos, evidence of the absence of a common shock. 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 controls for other sentences as well as individual and month of the spell fixed effects. Standard errors are clustered at the group level. In addition, Column 1 includes county times month fixed effects, Column 2 includes controls for the number of arrests by the police in the county during the month (number of felonies, number of misdemeanors, number of property crimes, number of violent crimes, number of drug crimes, number of vandalism crimes, categories are not mutually exclusives), Column 3 includes controls for the number of criminal convictions in the county during the month (in general as well as for 19 sub-categories). The variable "Peer incarcerated while free" is a dummy equal to one if the offender is free and if at least one of his peer(s) is in prison. The variables "Peer inc., crime 'alone,'" "Peer inc., crime not 'alone,'" "Peer inc., road crime," "Peer inc., non road crime" are dummies equal to one if the offender is free and if at least one of his peer(s) is in prison for a crime categorized as "alone," a crime not categorized as "alone," a road-related crime, and a crime that is not related to road offenses (respectively). The variables "Peer inc. crime committed the month of inc. or the month before" and "Peer inc. crime committed more than one month before inc." are dummies equal to one if the offender is free and if at least one of his peer(s) is in prison for a crime that was/was not (respectively) committed during the month of the incarceration or the month before. The last row presents the P-values of the differences between the two variables on peer incarceration while free (alone vs. not alone; road vs. non road; month or month before vs. not). *Note: *** p<0.01, ** p<0.05, * p<0.10.*

	(1) Half panel jacknife estimate	(2) Fixed effect individual * year	(3) Logit	(4) Number of crimes	(5) With first sentence	(6) Control time since last trial	(7) Panel balanced 36 months
Panel A: all groups							
Inc.	-0.042***	-0.075***	-1.649***	-0.069***	-0.054***	-0.058***	-0.070***
	(0.0011)	(0.0011)	(0.0299)	(0.0011)	(0.00067)	(0.00099)	(0.0012)
Peer inc.	-0.0014**	-0.0018**	-0.0369*	-0.0019**	-0.0033***	-0.0011	-0.0018**
while free	(0.0014)	(0.00072)	(0.0217)	(0.00078)	(0.00052)	(0.00068)	(0.00086)
Obs	3,676,092	3,676,092	1,615,284	3,676,092	3,974,016	3,676,092	2,708,244
Panel B: duos							
Inc.	-0.043***	-0.086***	-1.67***	-0.071***	-0.0570***	-0.060***	-0.073***
	(0.0015)	(0.0015)	(0.037)	(0.0014)	(0.000857)	(0.0012)	(0.0015)
Peer inc.	-0.0026***	-0.0034***	-0.085***	-0.0037***	-0.00322***	-0.0027***	-0.0035***
while free	(0.00094)	(0.0012)	(0.030)	(0.0012)	(0.000820)	(0.0010)	(0.0013)
Obs	2,267,048	2,267,048	1,039,161	2,267,048	2,397,216	2,267,048	1,684,296
Panel C: triplets to septuplets							
Inc.	-0.038***	-0.058***	-1.60***	-0.065***	-0.047***	-0.054***	-0.065***
	(0.0020)	(0.0016)	(0.052)	(0.0019)	(0.0011)	(0.0017)	(0.0021)
Peer inc.	-0.00042	-0.00026	0.017	-0.00013	-0.0030***	0.00039	-0.00013
while free	(0.0010)	(0.00092)	(0.031)	(0.0011)	(0.00066)	(0.00092)	(0.0012)
Obs	1,409,044	1,409,044	576,123	1,409,044	1,576,800	1,409,044	1,023,948

Table 6: Effect of a peer's incarceration: robustness checks. Panel A presents the effect of the incarceration of a peer in the entire sample, Panel B presents the same results when the sample is restricted to duos and Panel C presents the results when the sample is restricted to groups of 3–7. These estimates include fixed effects for individual (except in Column 2) and month of the spell as well as controls for other types of sentences. In all Columns except for Column 3, standard errors are clustered by group. In all Columns except for Column 4, the outcome variable is a dummy equal to one if the individual commits a crime during the month. In Column 1 the results are estimated following Chudik et al. 2016. In Column 2, fixed effects for individual time year of the spell are added. In Column 3, the results are estimated using logistic regressions. In Column 4, the outcome variable is the number of crimes committed by the individual during the month. In Column 5, the period following the initial trial (used to identify the peers) is included. In Column 6, regressions include a variable controlling for the number of months since the last trial. Lastly, in Column 7, the sample is restricted to a fully balanced 36-month panel. *Note: *** $p<0.01$, ** $p<0.05$, * $p<0.10$.*

	(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
while free	(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 7: Effect of the incarceration of one peer on different types of crime among duos. The dependent variables are dummies equal to one if at least one of the following crimes is committed during month *t*: crime labeled as in-group crime (Column 1); crime labeled as in-group crime and committed with the same peer (Column 2); crime labeled as in-group crime and committed with another identified peer (Column 3); crime not labeled as in-group (Column 4); crime *categorized* as 'in group' (Column 5); crime *categorized* as 'probably in group' (Column 6); crime *categorized* as 'probably alone' (Column 7); crime *categorized* as 'alone' (Column 8). Categorization is based on the average number of groups found for the crime type. All regressions include controls for other sentences as well as individual and month of the spell fixed effects. Standard errors are clustered at the group level. *Note: *** p<0.01, ** p<0.05, * p<0.10.*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Nb of convictions at initial joint trial		Sentence at initial joint trial		Sum past prison sentences		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***	-0.072***	-0.064***	-0.061***	-0.066***	-0.063***	-0.056***	-0.075***	-0.063***
	(0.0024)	(0.0024)	(0.0014)	(0.0020)	(0.0020)	(0.0025)	(0.0012)	(0.0011)	(0.0024)	(0.0051)	(0.0031)	(0.0032)
Peer inc.	-0.00060	-0.0066***	-0.0014	-0.0030**	-0.0014	-0.0030**	-0.0027**	-0.0026**	0.0041	-0.0069***	0.00056	-0.0068**
while free	(0.0029)	(0.0024)	(0.0020)	(0.0014)	(0.0029)	(0.0015)	(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***	0.063***	0.038***	0.039***	0.041***	0.040***	0.023***	0.042***	0.051***
Obs	176,212	176,212	457,999	457,999	359,363	359,363	968,014	968,014	145,867	145,867	107,409	107,409
Nb indiv	3,949	3,949	10,330	10,330	8,119	8,119	21,175	21,175	3,188	3,188	2,385	2,385
Diff own	0.84		0.12		0.005		0.042		0.41		0.061	
Diff pair	0.22		0.63		0.64		0.947		0.36		0.24	

Table 8: Effect of the incarceration of a peer depending on the offender's position within the group among duos. Sample sizes are restricted to duos with different numbers of convictions during the joint trial (Columns 1 and 2); duos with different sentences at the joint trial (Columns 3 and 4); duos with different criminal record lengths (Columns 5 and 6); duos with different ages (Columns 7 and 8); duos with different genders (Columns 9 and 10); duos with different nationalities (Columns 9 and 10). 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 controls for other sentences as well as individual and month of the spell fixed effects. Standard errors are clustered at the group level. The last two rows give the P-values of the differences between subgroups for the effect of incarceration (next to last row) and the effect of a peer's incarceration while free (last row). *Note: *** p<0.01, ** p<0.05, * p<0.10.*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Crime type at the initial joint trial						
	Robbery	Vandalism	Violence	Drug consumption	Drug dealing	First-time 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***
while free	(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 9: Heterogeneity of the effect by crime at the initial trial and criminal record among duos. Sample sizes are restricted to robbery (Column 1), vandalism (Column 2), violence (Column 3), drug consumption (Column 4), drug dealing (Column 5), offenders who were convicted for the first time at the joint trial (Column 6), and offenders who were not convicted for the first time at the joint trial (Column 7). 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 controls for other sentences as well as individual and month of the spell fixed effects. Standard errors are clustered at the group level. *Note: *** p<0.01, ** p<0.05, * p<0.10.*

	(1)	(2)	(3)	(4)
	Type of new crime			
	Identical to the one at initial joint trial	Different from the one at initial joint trial	Difference in peer incarceration length	Difference in the spell
Incarcerated	-0.0318***	-0.0344***	-0.0643***	-0.0643***
	(0.000858)	(0.000862)	(0.00118)	(0.00118)
Peer inc. while free	-0.00190***	-0.00147*		
	(0.000676)	(0.000797)		
Peer inc. while free, first 3 month			-0.00338**	
			(0.00138)	
Peer inc. while free, 4th to 9th month			-0.00445***	
			(0.00145)	
Peer inc. while free, 10th month and after			-0.00100	
			(0.00185)	
Peer inc. while free, first 2 years of the spell				-0.00296*
				(0.00159)
Peer inc. while free, last 2 years of the spell				-0.00350***
				(0.00119)
Control	Yes	Yes	Yes	Yes
Constant	0.0201***	0.0214***	0.0407***	0.0407***
Observations	2,267,048	2,267,048	2,267,048	2,267,048
Number of indiv	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 10: Effect of the incarceration of a peer on different types of crimes and at different moments among duos. The dependent variable is a dummy equal to one if, during month *t*, offender *i* commits at least one crime identical to the one sentenced at the initial joint trial (Column 1), at least one crime different from the one sentenced at the initial joint trial (Column 2) or at least one crime of any type (Columns 3 and 4). In Column 3 the effect of the incarceration of the peer while free is divided into three dummies equal to one if the peer is in the first 3 months of his incarceration, is in month 4–9, or in month 10 and after (respectively). All regressions include controls for other sentences as well as individual and month of the spell fixed effects. Standard errors are clustered at the group level. *Note: *** p<0.01, ** p<0.05, * p<0.10.*

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% of the offenders who belong to a duo are men. If they were randomly distributed among groups, this would lead to 77% man-man duos (0.88*0.88), 22% man-woman duos (0.88*0.12*2) and 2% woman-woman duos (0.12*0.12). However, this is not the ratio observed in real groups. Mixed duos are under-represented (13%, i.e., 9% 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	mixed	0-0	1-1	mixed	0-0
Male	.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 pre-trial 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 pre-trial detention. Among them, 16,500 got mandat de dépot". Then, around 70,000 people were sentenced to prison without mandate de dépot and without pre-trial 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).

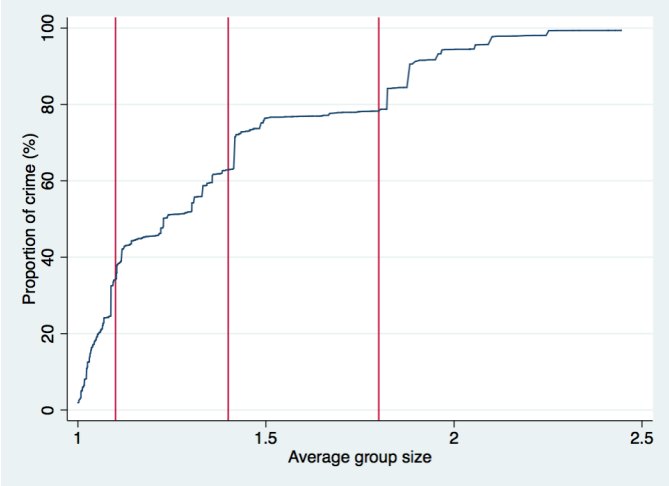

Figure C1: proportion of crime per category.

Appendix D: additional results

In all the Tables I consider only three situations: being free with all peers free, being free with at least one peer in prison and being in jail. These three situations contain all the possibilities. However, some of them could be split into subcategories.

First, it is possible to distinguish between being in prison with peer(s) free or being in prison with peer(s) in prison. In both cases, the person is in jail and his or her criminal activity should be equal to zero. This is the reason why I merge the two cases in the main analysis. However, it is possible that criminal activity while in jail or the probability of obtaining an unescorted temporary absence depend on the incarceration of a peer.

The distinction between being in jail with peer(s) free or with peer(s) in prison in presented in Columns 1 to 6 of Table D1. The first two Columns present the results for all groups, Columns 3 and 4 for duos and Columns 5 and 6 for groups of 3–7 offenders. Controls for other sentences are added in Columns 2, 4 and 6. In the last raw of the Table I present the p-value of the differences between the point estimates "incarcerated and at least one peer too" and "incarcerated and all peer free." The point estimates of these two variables are always very close and their difference is never statistically significant. These results validate the assumption that the incarceration status of a peer is not important when the person is in prison. The two subcases do not need to be differentiated.

Second, among groups of 3–7 offenders, it is possible to study the effect of the number of peers in prison. While the regressions presented in Tables 4 and 6 only measure the effect of "having at least one peer in prison," is possible to differentiate between "having one peer in prison" and "having more than one peer in prison." It is important to notice that the later is 15 times less likely than the former. This exercise is presented in Column 7. The two coefficients are insignificant. The incarceration status of a peer does not seem to have an effect in groups of 3–7 offenders.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	All		Duos		Triplets to septuplets		
Incarcerated							-0.058***
							(0.0016)
Incarcerated and at least	-0.074***	-0.058***	-0.074***	-0.059***	-0.073***	-0.056***	
one peer too	(0.0023)	(0.0025)	(0.0031)	(0.0034)	(0.0034)	(0.0038)	
Incarcerated and all peers	-0.075***	-0.063***	-0.078***	-0.065***	-0.070***	-0.058***	
are free	(0.00095)	(0.00097)	(0.0012)	(0.0012)	(0.0016)	(0.0016)	
Free and at least one peer	-0.0026***	-0.0017**	-0.0043***	-0.0032***	-0.0010	-0.00023	
incarcerated	(0.00069)	(0.00068)	(0.0010)	(0.0010)	(0.00093)	(0.00092)	
Free and one peer							-0.00045
incarcerated							(0.00092)
Free and two or more peers							0.0035
incarcerated							(0.0034)
Prison or probation		-0.0091***		-0.0090***		-0.0093***	-0.0093***
		(0.0012)		(0.0015)		(0.0020)	(0.0020)
Cumul. Time prison		-0.0051***		-0.0051***		-0.0049***	-0.0049***
		(0.00010)		(0.00013)		(0.00017)	(0.00017)
Cumul. Probation		-7.7e-06***		-1.0e-05***		-3.1e-06	-3.2e-06
		(3.0e-06)		(3.6e-06)		(5.0e-06)	(5.0e-06)
Cumul. Suspended prison		-0.0001***		-0.0001***		-0.0001***	-0.0001***
		(1.15e-05)		(1.6e-05)		(1.4e-05)	(1.4e-05)
Cst	0.032***	0.039***	0.034***	0.041***	0.030***	0.036***	0.036***
Obs	3,676,092	3,676,092	2,267,048	2,267,048	1,409,044	1,409,044	1,409,044
N indiv	81,350	81,350	49,470	49,470	31,880	31,880	31,880
Pval	0.497	0.0539	0.255	0.108	0.361	0.575	

Table D1

Appendix E: additional results when all groups are used

	(1) Control cal month*county	(2) Control crime police	(3) Control nb conviction	(4) Nb crime in the month	(5) Nb crime in the month	(6) Nb crime in the month
Incarcerated	-0.062***	-0.062***	-0.062***	-0.062***	-0.062***	-0.062***
	(0.00098)	(0.00098)	(0.00096)	(0.00096)	(0.00096)	(0.00096)
Peer incarcerated	-0.0019**	-0.0017**	-0.0018**			
	(0.00069)	(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)
Observations	3,601,351	3,601,351	3,675,981	3,676,092	3,676,092	3,676,092
Number of individual	79,644	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		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.	-0.064***	-0.063***	-0.065***	-0.059***	-0.069***	-0.055***	-0.059***	-0.065***	-0.063***	-0.051***	-0.067***	-0.063***
	(0.0017)	(0.0020)	(0.0011)	(0.0015)	(0.00090)	(0.0014)	(0.00098)	(0.00095)	(0.0017)	(0.0040)	(0.0021)	(0.0024)
Peer inc.	-0.0020	-0.0049***	0.00037	-0.0021**	-0.0019	-0.0017**	-0.0016*	-0.00095	-0.0021	-0.0054***	0.0011	-0.0041**
	(0.0015)	(0.0015)	(0.0012)	(0.00089)	(0.0012)	(0.00079)	(0.00084)	(0.00087)	(0.0019)	(0.0016)	(0.0017)	(0.0020)
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs	438	389,328	894,48	967,44	1,112,640	1,291,920	1,543,776	1,541,136	346,848	278,688	282,48	230,928
N indiv	9,125	8,111	18,635	20,155	23,18	26,915	32,136	32,107	7,226	5,806	5,885	4,811
diff pair	0.18		0.10		0.93		0.61		0.20		0.046	

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*county	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	-0.00033	-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
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		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.	-0.061***	-0.053***	-0.058***	-0.058***	-0.070***	-0.057***	-0.055***	-0.061***	-0.063***	-0.045***	-0.058***	-0.063***
	(0.0025)	(0.0031)	(0.0036)	(0.0043)	(0.013)	(0.0022`)	(0.0027)	(0.0027)	(0.0048)	(0.0078)	(0.0049)	(0.0057)
Peer inc.	0.0017	-0.0013	-0.0024	-0.0036*	-0.0025	-0.00011	-3.9e-05	0.0010	-0.0028	-0.0040**	0.0015	-0.0020
	(0.0021)	(0.0013)	(0.0022)	(0.0020)	(0.0062)	(0.0010)	(0.0016)	(0.0016)	(0.0031)	(0.0020)	(0.0028)	(0.0030)
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***	0.036***	0.039***	0.045***	0.026***	0.040***	0.044***
Obs	338,324	405,134	205,514	165,44	11,419	990,93	468,66	466,961	163,996	110,747	137,87	95,39
Nb indiv	7,845	9,374	4,883	3,928	328	22,259	10,509	10,468	3,844	2,515	3,25	2,243
Diff pair	0.11		0.65		0.19		0.53		0.70		0.271	

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.