American Economic Review 2013, 103(6): 2437–2465
http://dx.doi.org/10.1257/aer.103.6.2437

Incarceration and Incapacitation: Evidence from the 2006 Italian Collective Pardon[†]

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In August 2006, the Italian government released one-third of the nation's prison inmates via a national collective pardon. We test for a discontinuous break in national crime rates corresponding to the mass release. We also test for the effect of the return of the incarceration rate to its predicted steady state level on national crime rates. Finally, we exploit regional variation in prison releases based on the province of residence of pardoned inmates. All three sources of variation yield substantial incapacitation effect estimates and suggest that the crime-preventing effects of incarceration diminish with increases in the incarceration rate. (*JEL* K42)

A growing body of studies finds significant and, in some instances, quantitatively substantial causal impacts of incarceration on crime. While results are sensitive to estimation methodology and tend to be context specific, most careful research finds that exogenous increases in incarceration rates generally lead to decreases in crime. However, the exact mechanisms driving this relationship have proved difficult to pin down. Whether this relationship is driven primarily by deterrence or incapacitation is an open empirical question.

Our understanding of these mechanisms is of direct importance to crime control policy. To the extent that criminal activity is deterred by severe punishment, optimal sentencing should emphasize stiff penalties over apprehension since the latter policy tool is resource-intensive while the former may decrease crime at low cost (Becker 1968; Polinsky and Shavell 1984). On the other hand, if prison reduces crime primarily through incapacitation, greater resources should be devoted to identifying and incapacitating the most criminally active. Moreover, heterogeneity in the propensity to reoffend implies that the crime preventing benefits of additional prison years served will vary from inmate to inmate. Lengthy sentences that incarcerate people beyond the age of desistence as well as a liberal application of incarceration may incarcerate some offenders whose behavior may be effectively

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[†] Go to http://dx.doi.org/10.1257/aer.103.6.2437 to visit the article page for additional materials and author disclosure statement(s).

controlled through other means. Understanding the sources of such heterogeneity would facilitate efforts to selectively incapacitate those who pose the greatest risk to society while employing less drastic, and perhaps less costly sanctions for others.

The relative importance of deterrence and incapacitation also speaks to theoretical reasoning regarding criminal participation more generally. Economists postulate a rational offender who weighs the expected costs and benefits and makes decisions accordingly. Alternative theories emphasize socialization toward antisocial norms, peer influence, biology, and determinants of crime that do not fit neatly within the rational choice framework. An assessment of the relative importance of incentives as opposed to predetermined characteristics among those deterred or constrained by prison would help us discriminate between these alternative theories.

This paper presents lower-bound estimates of pure incapacitation effects based on an unusual policy event in the Italian corrections system. In August 2006, the Italian government released more than one-third of the nation's prison inmates in an attempt to relieve prison overcrowding.[1] The collective pardon did not change sentencing for future offenders while it enhanced sentences for pardoned offenders who reoffend. These changes likely induced a modest deterrent effect on criminal activity. Thus, any increase in crime associated with the pardon arguably reflects a lower-bound incapacitation effect estimate.

We exploit three sources of variation in incarceration rates created by the pardon. First, we test for a discontinuous break in national crime rate time series associated with the August 2006 mass release. Second, we use variation along the adjustment path of the national incarceration rate triggered by the collective pardon to provide a second estimate of the incapacitation effect. Finally, we exploit provincial variation in the impact of the pardon based on the province of residence of pardoned inmates. All three sources of variation yield evidence of sizable incapacitation effects mainly for the crimes of theft and robbery.

The estimates based on the break in the national crime and prison time series range from 14 to 18 crimes per prison year served. Adjusting these estimates for the magnitude of the deterrence effects presented in Drago, Galbiati, and Vertova (2009) yields pure incapacitation effects ranging from 17 to 21 crimes per prison year served. The estimates using variation in crime and incarceration along the dynamic adjustment path following the pardon are larger (ranging from 22 to 46) and statistically distinguishable from the estimates based on time-series discontinuities. This suggests that the offenders that replaced the pardoned are generally more criminally active. Our cross-province analysis finds average incapacitation effects that are similar in magnitude. Finally, we find that the reverse incapacitation effect of the pardon is considerably smaller among those provinces with higher pre-pardon incarceration rates, holding pre-pardon crime rates constant, suggesting that the crime-preventing effects of incarceration decline as incarceration rates rise.

[1] Italian prisons were chronically overcrowded prior to the pardon. The prison population-to-capacity on December 31, 2000 stood at 1.20 in 2000. In June 2006 the ratio was 1.38 (Dipartimento dell'Amministrazione Penitenziaria, Ministero della Giustizia 2009).

I. The Causal Pathway Linking Incarceration and Crime Rates

Incarceration may impact the overall level of crime through several channels. First, incarceration mechanically incapacitates the criminally active. Second, the risk of incarceration increases the expected costs of crime and may thus deter potential offenders (an effect referred to as general deterrence). Finally, the incarceration experience may alter future offending either positively or negatively. Prior prison experience may either reduce criminal activity among former inmates who do not wish to return to prison (referred to as specific deterrence) or enhance criminality if prior incarceration increases the relative returns to crime.

A large body of research by criminologists has focused on measuring pure incapacitation effects with nearly all of this research focused on the United States. Many such studies are based on inmate interviews regarding their criminal activity prior to their most recent arrest and then imputing the amount of crime that inmates would have committed from their retrospective responses. Results from this research vary considerably across studies (often by a factor of ten), a fact often attributable to a few respondents who report incredibly large amounts of criminal activity. The most careful reviews of this research suggest that on average each additional prison year served results in 10 to 20 fewer serious felony offenses (Marvell and Moody 1994; Spelman 1994, 2000). The usefulness of these studies have been questioned, however, based on the sensitivity of these estimates to outlier inmates as well as the possibility that those incapacitated are often replaced on the street by new offenders (Miles and Ludwig 2007).

Most of this research employs prisoner surveys fielded during periods when the US incarceration rate was much lower than it is currently. As the incarceration rate increases one might expect marginal and average incapacitation effects to decline, if more expansive use of incarceration nets consecutively less dangerous offenders. The more recent study by Owens (2009) suggests that this is the case. Owens (2009) analyzes the criminal activity of convicted felons who serve less time as the result of the discontinuance of the practice of considering juvenile records when sentencing adult offenders in the state of Maryland. The author finds that these former prison inmates indeed committed additional crimes during the time period when they would have otherwise been incarcerated. However, the implied incapacitation effects are quite small, on the order of one-fifth the size of the incapacitation effects from earlier research.

By construction, the incapacitation studies provide only a partial estimate of the effect of incarceration on crime. Several scholars have attempted to estimate the overall contemporary effect (incapacitation plus general deterrence) of incarceration using aggregate crime and prison data, usually state-level panel data for the United States. However, these studies must address an alternative methodological challenge; the fact that unobserved determinants of crime are likely to create a simultaneous relationship between incarceration and crime rates.

Marvell and Moody (1994) are perhaps the first to estimate the overall incarceration effect using state-level panel regressions. The authors use a series of granger causality tests and conclude that after first differencing the data, within state variation in incarceration is exogenous. They then estimate the effect of incarceration on crime using a first-difference model with an error correction component to account

for the cointegration of the crime and prison time series. The authors estimate an overall crime-prison elasticity of −0.16.

Levitt (1996) also estimates the effect of incarceration on crime using US state panel data, but explicitly corrects for potential endogeneity. Levitt exploits the fact that in years when states are under a court order to relieve prison overcrowding, state prison populations grow at relatively low rates. Using a series of variables measuring the status of prison overcrowding lawsuits as instruments for state level incarceration rates, Levitt finds 2SLS estimates of crime-prison elasticities that are considerably larger than comparable estimates from OLS with a corrected property crime-prison elasticity of −0.3 and a violent crime-prison elasticity of −0.4.

Johnson and Raphael (2012) use an instrument for incarceration based on the difference between a state's current incarceration rate and the state's steady-state incarceration rate implied by observable admissions and release rates. The authors derive an empirical prediction regarding the impact of this difference on next-year's change in incarceration and use this prediction as an instrumental variable. They find statistically significant impacts of incarceration on crime. However, the joint incapacitation/deterrence effect of incarceration declines considerably in the United States as the incarceration rate increases. In an analysis that parallels Marvell and Moody (1994), Liedka, Piehl, and Useem (2006) also find that the marginal impact of incarceration on crime declines as the US incarceration rate increases.

Vollaard (2013) analyzes the impact of a Dutch sentence enhancement targeted at repeat offenders. In 2001, the Netherlands enacted an enhanced sentence of two years for such offenders, first allowing a subset of municipalities to experiment with the enhancement before later nation-wide expansion. Vollaard finds very large deterrence/incapacitation effects, on the order of 50 to 60 reported thefts per year. However, those municipalities that dipped further into their repeat offender pool experienced significantly smaller crime reductions per additional prison-year served. This finding is particularly interesting since the Dutch incarceration rate as of 2004 (124 per 100,000) was less than one-fifth the comparable rate for the United States.[2]

A recent study of Italian crime rates by Barbarino and Mastrobuoni (2012) is perhaps most relevant to our current analysis. The authors construct a panel dataset of crime and incarceration rates that vary by year and by Italian region. To break the simultaneity between crime and incarceration the authors use the recurrent national-level collective pardons and the province-level pardon totals occurring between 1962 and 1995 as an instrument for regional incarceration rates. The authors find sizable impacts of prison on crime. In an accompanying cost-benefit analysis, the authors conclude that mass pardons in Italy over the period studied are particularly socially expensive ways of relieving prisoner overcrowding.

In an analysis of the most recent Italian pardon, Drago, Galbiati, and Vertova (2009) present evidence regarding the pure deterrent effect associated with the threat of a longer prison sentence. The Italian pardon released most inmates with

[2] International Centre for Prison Studies, http://www.prisonstudies.org/info/worldbrief/ (accessed June 15, 2012). The comparable incarceration rate for the United States (aggregating jail and prison inmates) in 2004 was 750 per 100,000. The prison incarceration rate in the United States in 2004 stood at 486 (Guerino, Harrison, and Sabol 2011).

three years or less remaining on their sentence. Those who reoffend face an enhanced sentence through the addition of their unserved time to whatever new sentence is meted out. The authors exploit the fact that among pardoned inmates with similar offenses and sentences, those who are admitted to prison closer to the date of the pardon faced a larger post-release sentence enhancement than those who are admitted to prison at earlier dates. The authors demonstrate statistically significant and substantially higher recidivism rates among those pardoned inmates facing lower effective sentence enhancement.

In what follows, we present estimates of the incapacitation effect caused by this pardon. Comparison of our findings to the existing body of research estimating joint incapacitation/deterrence effects will permit characterization of the relative importance of incapacitation in explaining the crime-preventing impacts of incarceration. Moreover, we provide several tests of whether incapacitation effects diminish as the incarceration rate increases.

II. Description of the 2006 Italian Pardon and our Estimation Strategy

On July 31, 2006 the Italian Parliament passed the Collective Clemency Bill. The pardon reduced the sentences of eligible inmates convicted of their offenses prior to May 2, 2006 by three years, effective August 1, 2006. As a result, most inmates with less than three years to serve as of August first were immediately released. Subsequent releases occurred as remaining sentences fell to 36 months, though roughly 83 percent of all those released through December 2007 were pardoned at some point in August 2006. Inmates convicted of offenses involving organized crime, felony sex offenders, and those convicted of terrorism, kidnapping, or exploitation of prostitution are ineligible for early release (Drago, Galbiati, and Vertova 2009). Pardoned inmates are not subject to any form of post-release supervision. However, those who are convicted for a crime receiving at least a two-year sentence during the five year period following release face a sentence enhancement equal to the unserved portion of their sentence from their pardoned offense.

According to Drago, Galbiati, and Vertova (2009), the passage of the clemency bill followed a six-year debate surrounding Italian prison conditions, spurred in large part by the activism of the Catholic Church and the personal involvement of Pope John Paul II. With Italian prisons filled to 130 percent of capacity, the pardon was principally motivated by the need to address overcrowding. While the 2006 Collective Clemency Bill was the only such collective pardon in recent times, Italy has a long history of such pardons dating back to the nineteenth century. According to Barbarino and Mastrobuoni (2012), collective pardons occurred with relative frequency during the post-World War II period. However, since the 1992 change to the Italian constitution requiring a two-thirds majority vote in the parliament, there were no subsequent pardons until the 2006 event.[3]

Figure 1 displays Italian monthly incarceration rates for 2004 through 2008. Months are measured relative to August 2006. The figure also plots quadratic regression functions fit to the pre-pardon period (January 2004 through August 2006) and

[3] Between the end of World War II and the early 1990s, an amnesty or pardon occurred on average every three years. As of this writing, there has not been another amnesty since the 2006 event.

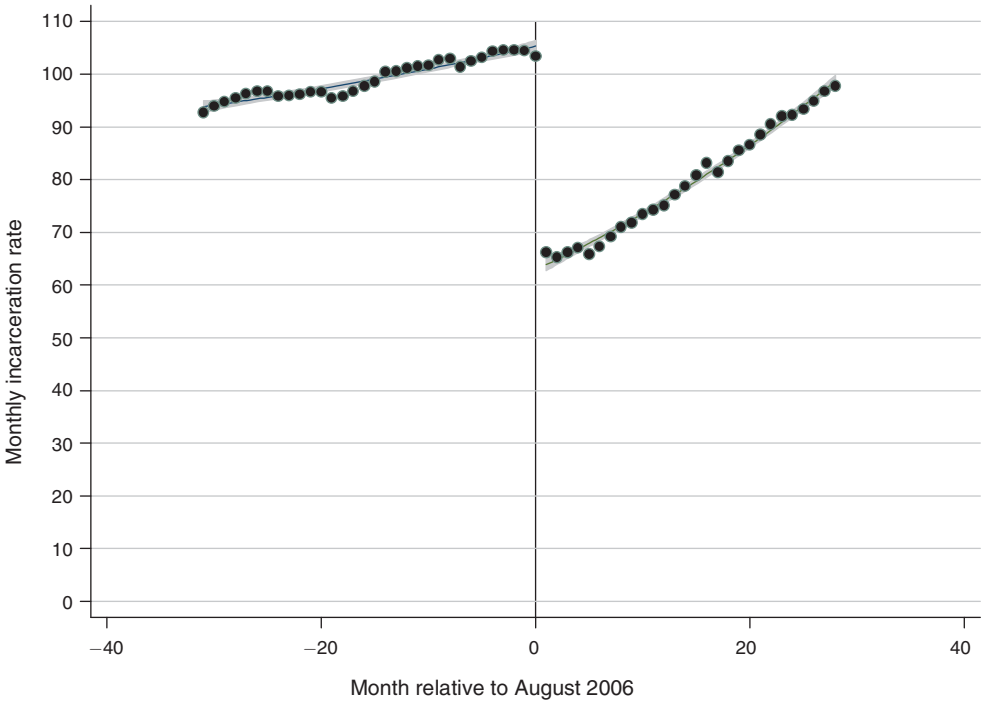

FIGURE 1. SCATTER PLOT OF MONTHLY INCARCERATION RATE AGAINST MONTH MEASURED RELATIVE TO AUGUST 2006

the post-pardon period (September 2006 through December 2008), along with 95 percent confidence intervals for the predicted values of the regression functions. The figure depicts a relatively stable pre-pardon incarceration rate. Between August and September 2006, however, the collective pardon induces a sharp decline in the national prison population (of 21,863 individuals, equivalent to a 36 percent decrease) with a corresponding decrease in the national incarceration rate from 103 to 66 inmates per 100,000. Between September 2006 and December 2008 the incarceration rate steadily increases to the point where by December 2008 the incarceration rate of 98 is only slightly less than the pre-pardon high in August 2006 (103).

Summary data published by the Italian Prison Statistical Office coupled with prison population totals suggest that most of the post-pardon growth in the Italian incarceration rate was not driven by returns to custody of those pardoned by the 2006 legislation. On August 1, 2006 the prison population stood at 60,710. Through December 2007, 27,010 inmates were released early as a result of the collective pardon. The December 2007 prison population stood at 49,193. Assuming there were no other releases aside from pardoned inmates between August 2006 and December 2007, 15,493 additional admissions are needed to increase the population to the actual December 2007 level. Of course, if there were additional releases of inmates ineligible for the pardon or of inmates admitted since August 2006, the total admissions needed to generate the December 2007 population total would be higher. However, by December 2007 only 5,529 of the 27,010 inmates pardoned through this period had been returned to custody. Since returns-to-custody of pardoned

inmates makes up at most 36 percent of subsequent prison growth, the majority of the new inmates driving up the Italian incarceration rate after the pardon are individuals who were not impacted by the 2006 Act. This fact will be important to keep in mind when we discuss our results below.

A. *Channels Linking the Pardon to Crime and Our Principal Methodological Strategy*

The collective pardon may have impacted national crime rates through several channels. First, consider offenders not incarcerated at the time of the pardon. For this population, the pardon does not alter the expected sentence associated with being caught, prosecuted, and convicted of a crime, since the clemency bill did not alter Italian sentencing policy. One might argue that the pardon may impact one's expectations regarding the likelihood of a future pardon. By extension, this would alter subjective assessments of the expected value of time served should one be caught and convicted. Barbarino and Mastrobuoni (2012) argue that the impact on expectations can go in either direction. The demonstrated ability to muster the two-thirds majority needed to pass the clemency bill may indicate to some that such actions in the future are possible. Alternatively, the size and scope of the 2006 pardon substantially relieved pressure to address overcrowding, bringing the nation's prison population below system capacity, reducing pressure for and the likelihood of subsequent pardons in the foreseeable future.

While one cannot assess the effect on expectations with any degree of certainty, we believe that the pardon likely had little effect on expectations regarding future pardons. Prior to the 2006 Collective Clemency Bill, several attempts to push such bills through the parliament failed (Drago, Galbiati, and Vertova 2009) and hence expectations regarding an early release prior to the 2006 legislation were likely to already be quite low.[4] If anything, the diminished pressure to relieve prison overcrowding should lead potential offenders to lower their expectations regarding the likelihood of future pardons. To the extent that this is true, the pardon would induce a negative deterrent effect on crime committed by those not incarcerated in August 2006, imparting a negative bias to our incapacitation effect estimates.

Next, consider the criminal behavior of those released as a result of the pardon. By virtue of their conviction, past behavior has revealed a relatively high propensity to commit crime. Releasing these inmates into noninstitutional society should mechanically lead to an increase in crime rates via reverse incapacitation. On the other hand, the looming sentence enhancement should a pardoned inmate reoffend would reduce criminal activity below what it otherwise would have been via general deterrence (precisely the finding in Drago, Galbiati, and Vertova 2009).

To illustrate the likely impacts of the pardon on crime operating through incapacitation as well as our identification strategy, here we present a simple mechanical model of incapacitation similar to that presented in Johnson and Raphael (2012). We interweave into the discussion the empirical equations that we estimate to

[4] Many believe that the 2006 collective pardon was one of the key factors behind the electoral defeat of the incumbent government (Ricolfi 2008). The 2006 collective pardon was very unpopular with Italian citizens. A survey conducted by Eurispes in 2007 found that only 14 percent of those interviewed favored the law.

measure incapacitation. Suppose that all members of the national population can be defined as either incarcerated or not incarcerated. The distribution across these two states at a given time t is given by the share vector, $\mathbf{S}_t' = [S_{1,t}\, S_{2,t}]$, where $S_{1,t}$ is the proportion not incarcerated at time t, $S_{2,t}$ is the proportion incarcerated at time t, and $S_{1,t} + S_{2,t} = 1$. Suppose that the likelihood of committing a crime when not incarcerated is c, that the likelihood of being caught and convicted conditional on committing a crime is given by p, and that the likelihood of being released from prison in any given period is given by the parameter θ. Hence, the incarceration hazard rate for the nonincarcerated is given by pc while the release hazard for the incarcerated is given by θ. The parameter c represents the incapacitation effect that we wish to uncover.

To analyze the short and long term effects of a collective pardon on crime and incarceration rates, we begin by assuming that the system is in steady state. We then shock the system with a one-time temporary increase in the prison release rate. Given the defined admissions and release hazard rates, the steady state population shares are

$$S_1 = \frac{\theta}{cp + \theta} \tag{1}$$

$$S_2 = \frac{cp}{cp + \theta}.$$

Assuming that the incarcerated do not commit crime, the nation's steady-state crime rate equals the proportion of the population not incarcerated multiplied by the criminality parameter, or

$$Crime = c S_1. \tag{2}$$

A one-time increase in the release rate will temporarily impact the proportion incarcerated and the crime rate by upsetting the balance between prison admissions and releases. The proportion of the population admitted to prison during any given period equals the admissions hazard times the proportion not incarcerated. In steady state, this admissions flow equals $cp\theta/(cp + \theta)$. The proportion of the population released from prison during any given period equals the release hazard times the proportion incarcerated. In steady state, the release flow also equals $\theta cp/(cp + \theta)$, and thus the proportion incarcerated is stable across periods.

The collective pardon is roughly equivalent to a one-time temporary increase in the release probability. Suppose the system is shocked by a change in the release parameter from θ to θ', where $\theta' > \theta$. Using the flow expressions above, the change in the incarceration rate between the two periods surrounding the collective pardon will be

$$\Delta S_2^{pardon} = [\theta - \theta'] \frac{cp}{cp + \theta} < 0. \tag{3}$$

Hence, the incarceration rate will decline discretely following the pardon (what we observe for Italy).

The temporary effect of this shock on the national crime rate is relatively straightforward. Differencing the crime equation (2) implies that the change in the crime rate between any two periods equals the criminality parameter times the change in the proportion not incarcerated. Since the two population shares must sum to one, $\Delta S_1^{pardon} = -\Delta S_2^{pardon}$. Hence, the change in crime rates between the two periods surrounding the pardon equals

$$\Delta Crime^{pardon} = -c\Delta S_2^{pardon} > 0. \tag{4}$$

Notably, the ratio of the reduced form change in crime rates given by equation (4) to the change in the incarceration rate in equation (3) identifies the criminality parameter c.

Our first empirical strategy for measuring the incapacitation effect uses monthly crime and incarceration data to estimate the changes in equations (3) and (4). We first define a monthly time variable, t, measuring month relative to August 2006 (with August 2006 taking on the value of 0). We then estimate the univariate time-series equations

$$\begin{aligned} Crime_t &= \alpha_0 + \alpha_1 t + \alpha_2 t^2 + \beta_0 Break_t \\ &\quad + \beta_1 Break_t \times t + \beta_2 Break_t \times t^2 + \varepsilon_t \\ Incarceration_t &= \delta_0 + \delta_1 t + \delta_2 t^2 + \phi_0 Break_t \\ &\quad + \phi_1 Break_t \times t + \phi_2 Break_t \times t^2 + \eta_t, \end{aligned} \tag{5}$$

where the indicator variable $Break_t$ is set equal to one for $t > 0$ (corresponding to all months from September 2006 and beyond) and set equal to zero otherwise, the terms α_o, α_1, α_2, β_0, β_1, β_2, δ_0, δ_1, δ_2, ϕ_0, ϕ_1, and ϕ_2 are parameters to be estimated, and ε_t and η_t are disturbance terms. The change in crime for the two months surrounding the collective pardon can be constructed by summing the coefficient estimates for α_1, α_2, β_o, β_1, and β_2 with the coefficient on the break dummy variable, β_0 roughly interpretable as the counterfactual treatment effect of the collective pardon at $t = 0$ (Angrist and Pischke 2009). We use the empirical estimate of β_0 to approximate the change in crime in equation (4). The corresponding approximation of equation (3) is given by the coefficient on the break variable in the incarceration equation, ϕ_0. Negative one times the ratio of these two parameters (i.e., $-\beta_0/\phi_0$) provides a structural estimate of the incapacitation effect as measured by the parameter c in the model above. Below we estimate the equations in (5) for crime overall, for crime rates pertaining to specific offenses and for the incarceration rate, and use the break coefficients to estimate the reverse incapacitation effect induced by the pardon.

The incapacitation parameter can also be identified using the variation along the dynamic adjustment path for incarceration and crime that is induced by the one-time shock. A temporary increase in the release rate does not alter the long-run steady-state incarceration rate and thus, cannot alter the long-run crime rate. However, crime and incarceration will respond to the shock caused by the pardon, and the

slow adjustment back to steady state provides an alternative source of variation that can be used to identify the effect of interest.

To see this, note that the temporary increase in the release hazard does not impact the periodic likelihood that a given noninstitutionalized person transitions into prison. The temporary increase in the release hazard is, by definition, temporary and thus the parameter θ returns to its previous value. With stable admission and release hazard rates and a smaller proportion incarcerated relative to the pre-pardon steady state, the monthly admissions flow will now exceed the monthly release flow. This is the source of the upward adjustment in the incarceration rate toward its pre-pardon value (and again, what we empirically observe).

As the incarceration rate grows along this dynamic adjustment path, the proportion of the population incapacitated increases and the national crime rate will fall. In the Appendix, we derive an explicit expression for the change in the incarceration rate and the crime rate for periods where $t > 0$. Defining $\Delta S_{2,t|t>0}$ as the change in the incarceration rate between periods t and $t+1$ for any period where $t > 0$, the explicit expression for this change is given by

$$\Delta S_{2,t|t>0} = -\Delta S_2^{pardon}[1 - cp - \theta]^{t-1}(cp + \theta). \tag{6}$$

The change equals negative one times the decline in the incarceration rate caused by the pardon multiplied further by the adjustment factor $[1 - cp - \theta]^{t-1}(cp + \theta)$ that vanishes, as t grows larger.[5] Thus, as t gets larger the change in incarceration between any two periods shrinks and eventually becomes zero when the incarceration rate reaches the previous steady-state value.

In conjunction with the expression in equation (6) and the constraint that the proportion incarcerated and not incarcerated must sum to one, the dynamic adjustment path for the crime rate can be expressed as

$$\Delta Crime_{t|t>0} = -c\Delta S_{2,t|t>0}. \tag{7}$$

Similar to identification using the structural breaks surrounding the pardon, taking the ratio of equation (7) to equation (6) identifies the incapacitation parameter c. Note, here we identify c only using variation in incarceration and crime reflecting the adjustment response to the shock caused by the pardon, not including the variation induced by the initial shock. This identification strategy is identical to that pursued in a US context by Johnson and Raphael (2012).

To operationalize this strategy in terms of the regression parameters in equation (5), one would simply first difference the crime equation and the incarceration equation for any two periods in the post-structural break time series. In terms of the parameters of these functions, we derive the empirical analogs for equations (6) and (7) given by

$$\Delta Incarceration_t = \delta_1 + \phi_1 + (\delta_2 + \phi_2)(2t + 1) \tag{8}$$

[5] The sum of the admission and release hazard rates for prison are generally much lower than one. This translates into a smooth adjustment process between steady states without oscillation.

and

$$\Delta Crime_t = \alpha_1 + \beta_1 + (\alpha_2 + \beta_2)(2t + 1). \quad (9)$$

With estimates of the two regression functions, both changes in equations (8) and (9) can be easily constructed from the parameter estimates. The ratio of the predicted crime change to the predicted incarceration change provides an alternative estimate of the incapacitation effect.

B. *Limits to this Mechanical Incapacitation Model and Implications for the Interpretation of Empirical Results*

Our model yields clear empirical predictions that can be easily evaluated with high-frequency national data. However, there are several limitations to this model that should be noted as they impact how one should interpret the empirical results we present below.

First, the model is nonbehavioral. To the extent that released inmates are partially deterred from committing crime by the looming sentence enhancement, the incapacitation effect that we can measure with national data will be downward biased. Indeed, Drago, Galbiati, and Vertova (2009) find a substantial and significant deterrent effect of this implicit sentence enhancement. This finding drives our interpretation of the estimates below as lower-bound incapacitation effects.

Second, our model assumes a constant propensity to commit crime among all members of society. In reality, the parameter, c, most certainly varies across the population at large as well as among the criminally active. Assuming that those with the highest values of c are the most likely to be apprehended and incarcerated, we must interpret our estimated incapacitation effects as local average treatment effects.

Finally, the discussion above documents that much of the post-pardon increase in the Italian prison population is driven by the admission of offenders who were not among the pardoned. Hence, incapacitation effects exploiting the national break in time series will be driven by the behavior of the pardoned while the effects measured along the dynamic adjustment path of the incarceration rate will be driven by the admissions to prison of new offenders, the majority of which were not impacted by the 2006 act. Many factors may contribute to larger prison-crime effects along the dynamic adjustment path, including perhaps age differentials, specific deterrence associated with a prior prison experience, or the general deterrence of the pardoned operating through the potential sentence enhancement for future offenses.

C. *Exploiting Cross-Province Variation in the Effects of the Pardon*

The strategy that we have outlined thus far relies on national level data to identify incapacitation. An alternative strategy would be to exploit geographic variation across Italy's 103 provinces in the province of residence of pardoned inmates and exploit heterogeneity in the effective treatment received by different provinces.[6]

[6] The 103 Italian provinces (i.e., administrative Italian counties) correspond to the NUTS 3 Eurostat classification areas and are comparable in size to US counties.

Since the pardon was instituted at the national level, geographic variation in the scale of prison releases should be independent of the underlying determinants of crime trends for each locality. Thus, the inflow of releases returning to any specific province represents an exogenous shock to the locality's crime fundamentals.

To be specific, define the variable $Crime_i^{pre}$ as the average monthly crime rate (defined per 100,000 residents) for province i (where $i \in [1, \ldots, 103]$) for some defined pre-pardon period (for example, the four month period preceding the pardon). Define the comparable variable $Crime_i^{post}$ as the average monthly crime level for province i for a defined post-pardon period, and the variable $\Delta Crime_i^{2006}$ by the equation

$$\Delta Crime_i^{2006} = Crime_i^{post} - Crime_i^{pre}. \tag{10}$$

Finally, define the variable $releases_i$ as the number of those pardoned inmates whose last known residence prior to incarceration was in province i (measured as releases per 100,000 local residents). Our second strategy involves estimating the equation

$$\Delta Crime_i^{2006} = \alpha + \beta releases_i + \varepsilon_i, \tag{11}$$

where α, β, and δ are parameters to be estimates, and ε_i is a mean-zero random disturbance term. The coefficient β provides our alternative estimate of the impact of one additional released inmate per 100,000 local residents on the change in the number of crimes per 100,000 local residents.

We also use the cross-province variation to test for decreasing returns to scale of the incapacitation effect. Specifically, define Inc_i^{pre} as the province-level incarceration rate prior to the collective pardon. To the extent that provinces differ in their underlying propensity to punish local offenders with an incarceration spell, the effect of releases on crime will be larger in provinces that use incarceration relatively sparingly, holding constant all other determinants of criminal offending. To test for the specific form of heterogeneity, we estimate the model

$$\Delta Crime_i^{2006} = \alpha + \beta releases_i + \delta Inc_i^{pre} + \varkappa Crime_i^{pre} + \gamma releases_i x Inc_i^{pre} + \varepsilon_i. \tag{12}$$

The key test for an incapacitation effect that diminishes with higher incarceration rates is the test of the hypothesis that $\gamma < 0$. The specification of equation (12) is very similar to that employed by Vollaard (2013) for the Netherlands.

D. *Description of the Data*

We draw data from several sources. First we use data from the Italian Ministero dell'Interno on crimes reported to the police measured by month and province for the period from January 2004 through December 2008. Second, monthly national prison population data comes from the Ministero della Giustizia. Third, we use microdata on all pardoned inmates to tabulate the number of releases per 100,000 provincial residents. We assume that pardoned inmates return to their province of commitment.

Table 1—Italian Crime Rates (*Incidents per* 100,000) by Year and by Offense Type

Crime type	Crime rate 2004 through 2008 combined	Percent of total crime	Crime rates by year				
			2004	2005	2006	2007	2008
Total crime	378.41	100	344.08	365.37	393.07	412.56	376.98
Non-sexual violent crime	29.25	7.73	25.37	27.39	29.11	31.84	32.54
Sexual assault/corruption of minor	0.72	0.19	0.63	0.66	0.73	0.78	0.77
Thefts/receiving stolen property	218.51	57.74	213.38	217.5	229.21	234.74	197.71
Robbery	6.77	1.79	6.59	6.51	7.14	7.21	6.39
Extortion/usury/money laundering	1.05	0.28	0.97	1.01	0.98	1.14	1.15
Kidnapping	0.23	0.06	0.18	0.23	0.23	0.26	0.25
Arson	1.89	0.50	1.76	1.78	1.80	2.35	1.76
Vandalism	49.51	13.08	39.43	44.54	50.30	55.79	57.49
Drugs/contraband	4.72	1.25	4.35	4.68	4.73	4.99	4.88
Exploitation of prostitution	0.25	0.07	0.25	0.24	0.25	0.26	0.28
Other crime	65.51	17.31	51.17	60.83	68.61	73.18	73.77

Note: Crime data come from the Italian *Ministero dell'Interno* and refer to crimes reported to the police.

Finally, to measure province-level incarceration rates prior to the pardon, we use published statistics on prison totals per province as of June 2006.

In what follows, we test for effects on overall crime and on 12 mutually exclusive and exhaustive crime categories. Table 1 presents average monthly crime rates for the entire period and for each year in our analysis period. The majority of crimes occurring in Italy are non-violent property crimes (with theft accounting for nearly 60 percent of crime overall). The annual averages suggest higher crime in 2006 and the highest average monthly crime rates in 2007, a pattern consistent with an impact of the collective pardon.

III. Empirical Results Using National Data

Figure 2 presents a scatter plot of the total monthly crime rate against months measured relative to August 2006. In addition to the data points, the figure displays fitted quadratic time trends for the pre- and post-pardon periods as well as the 95 percent confidence intervals for each point on the fitted trend. Monthly total crime rates increase slightly during the pre-pardon period, increase discretely between August 2006 and September 2006, and then decline steadily back to pre-pardon levels. In conjunction with Figure 1, Figure 2 strongly suggests a substantial reverse-incapacitation effect corresponding in time with the pardon and subsequent incapacitation associated with the return of the incarceration rate to its pre-pardon level.

Table 2 presents estimates for various specifications of the regression function underlying the total crime trends in Figure 2 and the total incarceration trends in Figure 1. Note these regression functions correspond to the models outlined in equation (5) and provide key parameters for our two estimates of the incapacitation effects using national level data. We estimate four model specifications. The first includes a quadratic time trend, a dummy indicating post-August 2006, and interaction terms between the quadratic trend variables and the post-pardon dummy. The second specification adds twelve calendar month fixed effects. The third specification adds year fixed effects. The final model includes month and year fixed effects and specifies the error term in each equation as following an AR1 process.

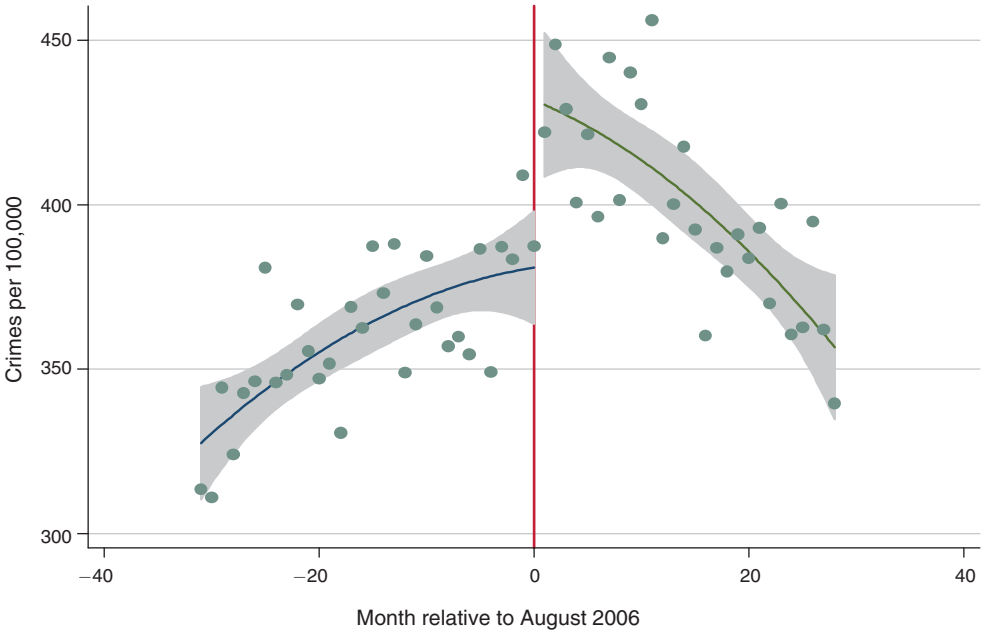

FIGURE 2. SCATTER PLOT OF TOTAL MONTHLY CRIMES PER 100,000 ITALIAN RESIDENTS AGAINST MONTH MEASURED RELATIVE TO AUGUST 2006

Panel A presents results for total crime. The coefficient on the post-pardon dummy is significant at the one percent level of confidence in all model specifications. In the base specification (model 1) there is a pre-post pardon increase in total crimes of approximately 51 per 100,000. Adding month effects increases the estimate to roughly 59, while adding year effects and correcting for serial correlation leads to slightly lower estimates of the break.

Turning to the incarceration rate models in panel B, the estimates of the pre-post pardon declines in incarceration are large and statistically significant at the one percent level of confidence in all model specifications. In the three models assuming an i.i.d. error term, the decline in the incarceration rate is roughly 43 inmates per 100,000. Adjusting for serial correlation yields a slightly smaller decrease of 38 inmates per 100,000. In all four models, incarceration rates trend upward at a differentially faster pace following the August 2006 pardon.

The coefficient estimates from the models presented in Table 2 provide the key parameters for tabulating incapacitation effects. Specifically, taking the ratio of the coefficient on post-pardon from the crime equation to the comparable coefficient from the incarceration equation and multiplying by negative one gives our first estimate of the amount of crime prevented per prison-month served. Additionally, the coefficient estimates can be used to tabulate the changes in crime and incarceration along the post-pardon adjustment path as measured by the predicted time trend during the post-August 2006 period (corresponding to equations (8) and (9) above). The ratio of the implied one period change in crime to the corresponding one period change in incarceration multiplied by negative one provides an estimate of the incapacitation effect of a prison month using only variation in the incarceration rate associated with the dynamic reaction to the pardon.

Table 2—Regressions of Crime and Incarceration Rates

	(1)	(2)	(3)	(4)
Panel A. Dependent variable = total monthly crimes per 100,000 residents				
Time	0.500	0.196	0.986	1.107
	(1.365)	(0.690)	(1.078)	(1.439)
Time^2	−0.039	−0.045	−0.44	−0.041
	(0.042)	(0.022)	(0.031)	(0.043)
Post-pardon	50.861	59.247	58.085	57.016
	(14.451)	(7.710)	(7.646)	(11.571)
Time × post-pardon	−1.842	−2.290	−4.891	−4.967
	(2.242)	(1.104)	(1.825)	(2.433)
Time^2 × post-pardon	−0.008	0.019	0.060	0.055
	(0.073)	(0.039)	(0.051)	(0.067)
Month effects	No	Yes	Yes	Yes
Year effects	No	No	Yes	Yes
AR1 correction	No	No	No	Yes
R^2	0.711	0.945	0.951	—
Observations	60	60	60	60
Panel B. Dependent variable = monthly incarceration rate				
Time	0.465	0.504	0.499	0.224
	(0.078)	(0.070)	(0.109)	(0.221)
Time^2	0.003	0.005	0.005	−0.001
	(0.002)	(0.002)	(0.003)	(0.009)
Post-pardon	−42.405	−42.782	−42.699	−38.116
	(0.824)	(0.785)	(0.769)	(3.502)
Time × post-pardon	0.474	0.489	0.680	0.501
	(0.127)	(0.112)	(0.184)	(0.411)
Time^2 × post-pardon	0.009	0.005	−0.002	0.018
	(0.004)	(0.004)	(0.005)	(0.012)
Month effects	No	Yes	Yes	Yes
Year effects	No	No	Yes	Yes
AR1 correction	No	No	No	Yes
R^2	0.993	0.994	0.997	—
Observations	60	60	60	60

Notes: Table shows regressions of total monthly crime rates (panel A) and incarceration rates (panel B) on a quadratic trend with post-pardon breaks in intercept and trend coefficients. Standard errors are in parentheses. Each regression model uses five years of monthly crime and incarceration data that begins in January 2004 and ends in December 2008. We normalize time such that August 2006 is set to zero.

Table 3 presents these incapacitation effect estimates. For the sake of comparison to previous empirical research, we have annualized the incapacitation effect estimates and have adjusted the standard errors accordingly. The first column of figures gives annual incapacitation effect estimates based on the structural breaks in trend. The second through fifth columns present incapacitation effect estimates based on variation in the incarceration rate along the adjustment path measured at 6, 12, 18, and 24 months following the pardon. Below each estimate in the second through fifth columns we present in brackets the *p*-value from a test of the null hypothesis that the given incapacitation effect estimate equals the corresponding estimate based on the break in crime and prison trends at August 2006.

The incapacitation effects identified by the structural breaks in crime and incarceration suggest that each prison year served prevents 14 to 18 crimes, with the estimate

TABLE 3—ESTIMATES OF ANNUALIZED INCAPACITATION EFFECTS

		Identification using variation along the dynamic adjustment path measured at:			
	Identification using break in time series	$T = 6$	$T = 12$	$T = 18$	$T = 24$
Model (1)	14.392***	21.503*	24.550***	26.962***	28.919***
	(4.104)	(11.495)	(4.780)	(5.600)	(10.023)
	—	[0.564]	[0.115]	[0.078]	[0.188]
Model (2)	16.618***	25.938***	26.419***	26.816***	27.151***
	(2.010)	(5.925)	(2.437)	(2.964)	(5.489)
	—	[0.145]	[0.004]	[0.007]	[0.079]
Model (3)	16.324***	36.354***	33.432***	30.681***	28.085***
	(2.001)	(8.023)	(4.389)	(4.787)	(8.122)
	—	[0.020]	[0.001]	[0.009]	[0.168]
Model (4)	17.950***	46.783***	36.808***	29.819***	24.650**
	(3.999)	(16.202)	(7.537)	(7.381)	(10.544)
	—	[0.092]	[0.033]	[0.166]	[0.556]

Notes: Standard errors are in parentheses. Model specifications correspond to the model specification used in Table 2. All figures are annualized to approximate the incapacitation effect of a person-year of prison time. The standard error estimates for models (1) through (3) identifying with the break in the time series are calculated by taking the standard error from a two-stage least squares regression of total crime rates on incarceration rates with the first-stage specifications corresponding to panel B in Table 2 and the second stage specification including all variables in the models in panel A of Table 2 with the exception of the post variable and the addition of the incarceration rate (i.e., the post variable serves as the instrument). For all estimates using Model (4) and all estimates identifying the incapacitation effect off the dynamic adjustment of crime and incarceration to the collective pardon, we first estimate the linear combination of parameters and the accompanying standard errors given in equations (18) and (19) in the text. We then estimate the standard error of the ratio giving the incapacitation effect by the delta method. We assume that the covariance between the two components of each ratio equals zero.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

from model (4) being the largest. All estimates are statistically significant at the one percent level of confidence. The annual incapacitation effects based on the dynamic reactions of crime and incarceration to the pardon are uniformly larger than the estimates based on the discrete breaks in the time series. All of these estimates are also statistically significant at the one percent level of confidence. In several instances, the incapacitation effects based on the post-pardon dynamic variation are statistically distinguishable from the corresponding estimate identified by the break in the time series. For example, for model (1) the p-value from a test of equality between the estimate in column 1 and the estimate using post-pardon variation in the incarceration rate is 0.078 when evaluated at 18 months after the pardon and 0.115 when evaluated one year after the pardon. In the models where we control for year effects and year and month effects, there is much stronger evidence that the estimates based on the post-pardon reaction of the incarceration rate and statistically distinguishable from the estimate based on the break in trend at August 2006. For several specifications, the incapacitation estimates are larger earlier in the adjustment process than later. However, in each instance one cannot reject the hypothesis that the six-month estimate is equal to the estimate evaluated at 24 months following the pardon.

Why would we expect a relatively higher incapacitation effect for the inmates that eventually took the places of the pardoned? First, the pardoned inmates on average served two years in prison prior to their release and are nearly 39 years old (Drago, Galbiati, and Vertova 2009). One would expect prison releases to be older on

average than new admits and, as criminal offending tends to decline with age, to be less criminally active. Second, the return to custody of pardoned offenders explains up to one-third of the increase in the Italian incarceration rate between August 2006 and December 2007. To the extent that the most active offenders are the first to fail and be returned to custody, we would expect both higher incapacitation effect estimates along the adjustment path as well as incapacitation effects that decline as the incarceration rate increases. In some sense, one could interpret the generally lower estimates based on the structural break as evidence of great heterogeneity in criminal propensities among those sent to prison, and by extension evidence of potential diminishing returns to scale. Finally, pardoned inmates are all subject to a sentence enhancement equal to the part of their sentence that was eliminated by the pardon should they reoffend and be convicted. Most of the offenders generating the post-pardon increase in incarceration are not. Hence, the difference may reflect in part the general deterrence of pardoned inmates relative to other offenders.

The estimates presented in Drago, Galbiatai, and Vertova (2009) can be employed here to assess the plausibility of some of these explanations. The authors estimate that each additional month of residual sentence reduces the likelihood of recidivism among pardoned offenders by 0.0016, relative to an overall recidivism rate of 0.123 percent. The average residual sentence among pardoned inmates is 14.511 months. Hence, their estimate implies that the threatened sentence enhancement reduced the recidivism rate among the pardoned by 0.023 (0.0016×14.511). This suggests a counterfactual recidivism rate in the absence of the sentence enhancement provision of 0.146. Hence, the sentence enhancement reduces offending among the pardoned to 84 percent of what it otherwise would have been $[(0.123/0.146) \times 100]$.

Inflating the estimates in the first column to eliminate the general deterrence effect of the sentence enhancement threat yields pure incapacitation effects of 17.133, 19.783, 19.433, and 21.369 for models (1), (2), (3), and (4), respectively. These figures are still notably smaller than the estimates based on variation in incarceration along the dynamic adjustment path. Hence, enhanced general deterrence does not explain these disparities, leaving selective returns to custody of the pardoned and replacement of the pardoned by more criminally active individuals as key explanations. We will revisit this issue in more detail in our cross-province analysis.

Table 4 presents a limited set of regression results for specific offenses. For each offense the table presents the coefficient on the post-pardon dummy variable for each of the four model specifications used in Table 2. Here we suppress the remaining coefficients to conserve space. The table reveals relatively large and statistically significant (at the one percent level) increases in crime corresponding to the month of the pardon for thefts and robbery. The increase in theft accounts for 70 to 90 percent of the overall increase in crime, while the increase in robbery accounts for a relatively smaller share.

We find some limited evidence of effects of the pardon on crimes other than theft and robbery. In particular, adjusting for month effects yields a positive effect for nonsexual violent crime that is marginally significant in specifications (2) and (3). A similar pattern is observed for other crime, where models (2) and (3) yield increases in crime that are statistically significant at the one percent level of confidence. There is also some evidence of a slight increase in vandalism and drugs/contraband offenses.

TABLE 4—REGRESSION ESTIMATES OF DISCONTINUITY IN CRIME RATES FOR INDIVIDUAL OFFENSES

Offense	Base specification	Base specification plus month effects	Base specification plus month and year effects	Base specification plus month and year effects with AR1 correction
Total crime	50.86***	59.24***	58.09***	57.02***
	(14.45)	(7.71)	(7.65)	(11.57)
Non-sexual violent crime	−3.168	1.446*	1.498**	1.510
	(2.851)	(0.751)	(0.734)	(1.370)
Sexual assault/corruption of minor	–0.141*	0.010	–0.001	0.000
	(0.079)	(0.040)	(0.038)	(0.053)
Thefts/receiving stolen property	46.564***	45.957***	45.246***	41.503***
	(8.771)	(5.547)	(5.569)	(6.893)
Robbery	2.551***	2.019***	2.0669***	2.002***
	(0.392)	(0.249)	(0.238)	(0.281)
Extortion/usury/money laundering	0.002	0.046	0.035	0.035
	(0.081)	(0.053)	(0.054)	(0.053)
Kidnapping	0.026	0.027	0.020	0.018
	(0.021)	(0.022)	(0.023)	(0.019)
Arson	–0.667	0.412	0.538	0.767
	(0.861)	(0.487)	(0.483)	(0.952)
Vandalism	3.311	2.308*	2.459**	2.575
	(2.437)	(1.281)	(1.209)	(3.183)
Drugs/contraband	0.305	0.390*	0.327	0.338
	(0.397)	(0.219)	(0.220)	(0.270)
Exploitation of prostitution	–0.044	–0.071***	–0.072***	–0.076***
	(0.035)	(0.025)	(0.024)	(0.020)
Other crime	2.123	6.703***	5.967***	5.243
	(3.731)	(2.301)	(2.310)	(3.613)

Notes: Standard errors are in parentheses. The base specification includes a time trend, a time trend squared, a dummy for the post-pardon period, and interaction terms between the post-pardon dummy and the time and time-squared terms. The coefficients in the tables are the coefficients on the post-pardon dummy.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

Table 5 presents corresponding incapacitation effect estimates for specific offenses. Here we present estimates based both on the break in crime trend as well as the coefficients capturing post-pardon trends. To conserve space, we only present estimates from the model inclusive of month and year effects and that corrects for serial correlation. Using the break in crime and incarceration rates, we find an annualized incapacitation effect of 13 crimes per 100,000 for theft/receiving stolen property and 0.63 crimes per 100,000 for robbery. All other estimates are insignificant, although we observe a slight and statistically significant decrease in incidents involving solicitation of a prostitute.

The estimates based on the post-pardon adjustment of crime and incarceration, when significant, are generally larger than the estimates from the time series discontinuities. For theft, the estimated effect is largest six months following the pardon (44 incidents per 100,000) and then decreases as time passes (to 22 incidents 24 months following the pardon). Tests of whether the theft estimates, in the second

Table 5—Estimates of Annualized Incapacitation Effects for All Crimes and for Individual Offenses

Offense	Identification using break in time series	Identification using variation along the dynamic adjustment path measured at: $T = 6$	$T = 12$	$T = 18$	$T = 24$
Total crime	17.950***	46.783***	36.808***	29.819***	24.650**
	(3.999)	(16.202)	(7.537)	(7.381)	(10.544)
Nonsexual violent crime	0.475	–0.789	–0.383	–0.099	0.111
	(0.789)	(1.669)	(0.764)	(0.499)	(0.795)
Sexual assault/corruption of minor	0.000	0.073	0.068**	0.064**	0.062
	(0.017)	(0.058)	(0.027)	(0.024)	(0.037)
Thefts/receiving stolen property	13.066***	43.586***	33.719***	26.806***	21.693***
	(2.480)	(13.207)	(6.744)	(5.963)	(7.455)
Robbery	0.630***	1.258**	1.093***	0.978***	0.892***
	(0.106)	(0.497)	(0.224)	(0.200)	(0.304)
Extortion/usury/money laundering	0.011	–0.104	–0.016	0.046	0.091
	(0.017)	(0.088)	(0.036)	(0.053)	(0.083)
Kidnapping	0.006	–0.022	0.002	0.018	0.031
	(0.006)	(0.031)	(0.014)	(0.014)	(0.021)
Arson	0.241	–0.672	–0.246	0.052	0.273
	(0.301)	(1.495)	(0.600)	(0.816)	(1.321)
Vandalism	0.811	–3.306	–0.747	1.046	2.372*
	(1.005)	(2.122)	(0.980)	(0.854)	(1.257)
Drugs/contraband	0.106	0.332	0.281*	0.246*	0.219
	(0.086)	(0.325)	(0.155)	(0.144)	(0.214)
Exploitation of prostitution	–0.024***	–0.052	0.003	0.042***	0.071***
	(0.007)	(0.036)	(0.016)	(0.014)	(0.022)
Other crime	1.651	5.297	2.894	1.211	–0.034
	(1.148)	(4.118)	(1.816)	(1.862)	(2.894)

Notes: Standard errors are in parentheses. All estimates are based on specification in model (4) of Table 2. All figures are annualized to approximate the incapacitation effect of a person-year of prison time. To estimate standard errors for the annualized incapacitation effects, we first estimate the linear combination of parameters and the accompanying standard errors given in equations (18) and (19) in the text. We then estimate the standard error of the ratio giving the incapacitation effect by the delta method. We assume that the covariance between the two components of each ratio equals zero.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

through fifth columns, differ from the estimate based on the breaks in the time series yields p-values of 0.029, 0.007, 0.040, and 0.279 respectively.

We observe a similar time pattern in the estimates for robbery, where the point estimate evaluated six months following the pardon are 140 percent of the point estimate evaluated two years following the pardon. However, these point estimates are not statistically distinguishable from one another and only the estimate evaluated 12 months following the pardon is significantly different from the point estimate based on the time series breaks (at the seven percent level of confidence). There are several crimes that register significant incapacitation effects along the dynamics adjustment path but no effect when identified by the measured discrete change in crime. In particular, we find significant effects for sexual assault at 12 and 18 months following the pardon, significant effects for drugs/contraband

offenses at 12 and 18 months, and significant effects for exploitation of prostitution at 18 and 24 months.[7]

IV. Incapacitation-Effects Based on Cross-Provincial Analysis

Thus far our estimates of the reverse incapacitation effect induced by the 2006 Collective Clemency Act have relied entirely on national level time series variation in crime and incarceration. The data reveal sharp breaks in overall crime with most of this attributable to increases in property crime associated with the mass pardon. The post-pardon adjustment paths in crime and incarceration rates yield larger incapacitation effects. In addition to this national level variation, the pardon induced considerable subnational variation in the number of returned inmates per 100,000. On average, each of Italy's 103 provinces received approximately 33 pardoned inmates per 100,000 residents. However, there was considerable variance in this variable across provinces with a cross-province standard deviation of 17, and values at the 10th, 25th, 75th, and 90th percentile of 16.46, 20.24, 44.04, and 52.67, respectively.

Moreover, there is a fair degree of heterogeneity across Italian provinces in the pre-pardon incarceration rate. For example, the province at the 25th percentile of this distribution has a June 2006 incarceration rate of 59 inmates per 100,000 residents, while the province at the 75th percentile had an incarceration rate of 160 per 100,000. While underlying differences in determinants of crime likely contribute to these disparities, inter-province differences in sentencing practices likely also contribute to variation in the intensiveness and extensiveness of the use of prison sentences in punishing convicted offenders.

Here we assess whether provinces receiving more released inmates per resident experience larger increases in crime. This cross-provincial variation can be used to generate alternative estimates of the reverse incapacitation effect that can be compared to the results from our national level time series analysis. Moreover, we exploit variation in pre-pardon incarceration rates to assess whether the reverse incapacitation effect interacts with the pre-pardon incarceration level. If pardoned inmates are homogenous in their propensity to commit crime when on the street, there should be no interaction effect of releases and pre-pardon incarceration rates. On the other hand, heterogeneity in the propensity to offend coupled with a criminal justice system that tends to send the worst offender to prison first (either through the offenders revealing themselves or policing strategies targeted toward the usual suspects) is likely to generate incapacitation effects that decline as the incarceration rate increases, holding all other determinants of crime constant.

Table 6 reports the results from a series of bivariate regressions. For each crime rate (the total crime rate and the twelve individual crime rates) we regress several alternative measures of the pre-post change in crime rates against the number of pardoned inmates per 100,000 returned to each of the 103 provinces.

[7] We also conduct more general tests for an impact of the collective pardon on national level time series that does not presuppose the timing of the intervention. The results from this analysis confirm our findings of structural breaks in total crime, theft, and robbery that correspond in timing to the August 2006 prisoner release. These additional results are available from the authors upon request.

Table 6—Estimates of Annualized Incapacitation Effects

Offense	Change, July to September	Change, June–July to September–October	Change, May–July, to September–November	Change, April–July to September–December
Total crime	13.548***	13.653***	10.933***	9.463***
	(3.404)	(2.810)	(2.324)	(2.042)
Nonsexual violent crime	0.488	0.622**	0.512**	0.395**
	(0.375)	(0.278)	(0.216)	(0.190)
Sexual assault/corruption of minor	−0.066**	0.002	0.009	0.010
	(0.028)	(0.018)	(0.017)	(0.014)
Thefts/receiving stolen property	7.381***	7.973***	6.449***	5.916***
	(2.479)	(2.061)	(1.748)	(1.563)
Robbery	0.814***	0.995***	0.855***	0.806***
	(0.086)	(0.088)	(0.075)	(0.069)
Extortion/usury/money laundering	0.179***	0.123***	0.084***	0.071***
	(0.037)	(0.025)	(0.020)	(0.016)
Kidnapping	−0.004	0.001	0.005	0.008
	(0.016)	(0.011)	(0.009)	(0.008)
Arson	0.069	0.096	0.090	0.117**
	(0.140)	(0.092)	(0.064)	(0.046)
Vandalism	1.064**	0.773**	0.651**	0.504**
	(0.495)	(0.365)	(0.281)	(0.237)
Drugs/contraband	0.435***	0.302***	0.209***	0.121***
	(0.106)	(0.073)	(0.063)	(0.053)
Exploitation of prostitution	−0.011	0.000	0.000	0.007
	(0.015)	(0.013)	(0.012)	(0.010)
Other crime	3.198***	2.765***	2.069***	1.507***
	(0.738)	(0.644)	(0.514)	(0.450)

Notes: Figures in the table come from bivariate regressions of the province-level change in crime rates on the number of pardoned inmates from the province expressed per 100,000 province residents. All regressions are weighted by province population. The figures in the table are annualized by multiplying the monthly effect by 12. Standard errors (in parentheses) are adjusted accordingly. The dependent variable in the first column is the change in the crime rate between July and September 2006. The second column calculated the change in the average monthly crime rate for June through July to September through October. The third column averages the three months prior and three months following the pardon while the fourth column calculates the change in crime rates using four-month averages.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

We employ pardon totals by province of residence for the period August 2006 through December 2006. For inmates pardoned over this time period, 89 percent are pardoned in August 2006. The first column of results uses the crime rate change between July 2006 and September 2006 as the dependent variable. The next column uses the change in the average crime rate from June/July (the pre-period) to September/October (the post-period). The third column adds May to the average for the pre-period and November to the average for the post-period while the final column uses the change in average crime rates from April through July to September through December. Since each regression includes a constant term, the incapacitation effect is identified by cross-provincial variation in the number of pardoned inmates per 100,000 above and beyond the overall national change. To facilitate comparison with our national estimates, we annualize the incapacitation effect by multiplying by 12. Of course, the standard errors are adjusted accordingly.

The bivariate regression results for total crime yield estimates of annual incapacitation effects that are generally consistent with the results from the time series analysis. The models based on the change in crime between July and September and the change in crime for the average of the two months prior and the two months following the pardon yield the largest estimates of roughly 13.6 crimes per inmate per year. Our national level estimates based on the discontinuous break in crime yielded annual incapacitation effects of 14.4 to 17.9 crimes per year. Given the size of the standard errors reported in Tables 3 and 6, these two sets of estimates generally lie within each other's confidence intervals. The cross-provincial estimates based on the change in three and four-month averages are somewhat smaller (10.9 and 9.5 respectively). This is not surprising however, since the incarceration rate begins to climb fairly quickly and hence part of the prisoner release has been undone in these later months. All four of the cross-provincial reverse incapacitation effect estimates for total crimes are statistically significant at the one percent level of confidence.

Regarding the results for the individual offenses there are some similarities to the national level analysis, yet some notable differences. We find consistently significant (all at the 1 percent level) positive effects of receiving pardoned inmates on theft, robbery, and the "other crime" category. The theft effects account for 55 to 62 percent of the total effect. The robbery effects account for 6 to 8.5 percent of the total, while other crimes account for 16 to 24 percent. Interestingly, the proportional importance using the cross-provincial variation is quite similar to that using the national-level time series. To be specific, in Table 5 the incapacitation effects for robbery, theft, and other crimes account for 86 percent of the total incapacitation effect using the break in crime and prison time series. In the first two columns of results in Table 6, these three categories account for 85 and 86 percent of the total crime effect, respectively.

A key difference relative to the national level results is the relatively consistent evidence on crimes other than robbery, theft, and other crimes. In three of the four specifications, we find positive effects of pardoned inmates per 100,000 residents on the nonsexual violent crime rate that are significant at the five percent level of confidence. All estimates of the effect on drugs/contraband offenses are positive and significant at the one percent level of confidence, while all of the estimates for vandalism are positive and significant at the 5 percent level.

Table 7 presents our tests for diminishing crime prevention returns to scale. Here we focus on the overall change in the province crime rate using the change from June/July 2006 to September/October 2006 as the dependent variable. In these results, we report coefficients without annualizing them as we use these coefficients subsequently to tabulate annual incapacitation effects at various points in the pre-pardon incarceration rate distributions. Regression (1) presents a base model where the change in crime rates is regressed on the number of pardoned inmates per 100,000, the pre-pardon incarceration rate (measured as of June 2006), and the pre-pardon crime rate (the average monthly crime rate for June and July 2006). The coefficient on the number of pardons per 100,000 is positive and significant at the one percent level and implies an incapacitation effect per prison year served of 15.04, somewhat larger than the estimate of 13.653 in Table 6 based on a bivariate model with no control variables.

Model (2) adds an interaction term between the pardon rate and the pre-pardon incarceration rate to the specification of model (1). The coefficient on the interaction

Table 7—Regression Models Using Cross-Provincial Variation in Pardon Rates that Test for Heterogeneity in the Reverse Incapacitation Effect

	Models using all provinces		Provinces stratified by pre-pardon incarceration rates	
			Below median	Above median
	(1)	(2)	(3)	(4)
Pardon rate	1.253***	3.223***	3.007***	0.334
	(0.290)	(0.856)	(0.668)	(0.255)
Pre-pardon incarceration rate	0.060	0.610**	0.169	−0.109
	(0.111)	(0.251)	(0.341)	(0.153)
Pre-pardon crime rate	−0.050	−0.078	−0.349***	0.173***
	(0.049)	(0.049)	(0.065)	(0.054)
Pardon rate × pre-pardon incarceration rate	—	−0.016**	—	—
		(0.006)		
R^2	0.190	0.248	0.461	0.389
Observations	103	103	51	52

Notes: Standard errors are in parentheses. The dependent variable in all models is the change in average monthly crime rates between the two-month period immediately preceding the pardon (June and July 2006) and the two-month period following the pardon (September and October 2006). Pre-pardon crime rates are measured as the average crime rate for the province for the two pre-pardon months. The pre-pardon incarceration rate is based on the number of prisoners housed within each province as of June 2006. All rates are calculated per 100,000 province residents.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

term is negative and statistically significant, with a p-value of 0.017. In other words, provinces with higher pre-pardon incarceration rates experienced smaller crime increases per pardoned inmate. Interestingly, this result is not sensitive to controlling for pre-pardon province crime rates.

Models (3) and (4) present an alternative test for diminishing crime-prevention returns to incarceration. In model (3) we re-estimate the specification in column 1 with the sample of provinces restricted to those with pre-pardon incarceration rates below the median. Column 4 presents the comparable regression for provinces above the median. A larger effect of pardoned inmates for below-median provinces would confirm the evidence of diminishing returns to scale from the specification presented in column 2. There is very strong evidence that the reverse incapacitation effect is higher in provinces with lower incarceration rates, with the point estimate for below-median provinces (3.007) greater than the corresponding estimate for above-median provinces (0.334) by a factor of nine. A hypothesis test of the equality of these two coefficients easily rejects the null at the 1 percent level of confidence.

To facilitate comparison with our earlier estimates, Table 8 calculates the implied incapacitation effect per prison year served based on model (2) in Table 7 that includes the interaction term between the pre-pardon incarceration rate and the pardon rate. The table presents key percentiles of the pre-pardon incarceration rate as well as the implied annual incapacitation effect implied by model (2). Model (2) implies incapacitation effects that drop quite rapidly with higher incarceration rates. Moving from the 25th percentile with an incarceration of 59 per 100,000 to the median incarceration rate of 100 yields a decline in the implied annual incapacitation effect of 28 percent (from 27.615 to 19.867). Moving to the incarceration rate

Table 8—Implied Annual Incapacitation Effects at Various Percentiles of the Pre-Pardon, Province-Level Incarceration Rate Distribution

Percentile of the pre-pardon province incarceration rate	Pre-pardon incarceration rate	Implied annual incapacitation effect
10th	32.460	32.574***
		(7.962)
25th	58.861	27.615***
		(6.183)
50th	100.102	19.867***
		(3.936)
75th	160.062	8.603**
		(4.303)
90th	191.926	2.616
		(6.126)

Notes: Standard errors are in parentheses. Estimates in the third column are based on the results of a linear regression of the pre-post pardon change in crime on the pardon rate, the pre-pardon crime rate, the pre-pardon province level incarceration rate and an interaction term. The results from this regression are reported in column 2 of Table 7. The estimates here are multiplied by 12 (along with the standard errors) to approximate the incapacitation effect of one prison year at different points of the province incarceration rate distribution.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

at the 75th percentile (160.062) further halves the annual incapacitation effect to 8.603. Below, we will return to these point estimates to characterize the findings for Italy relative to those from other countries.

V. Comparison of Our Estimates to Those from Previous Research

The range of our estimation results suggests a great deal of heterogeneity in the crime prevention benefits from incarceration. Our lower bound incapacitation effects for those pardoned range from 14 to 18 crimes per year. Adjusting for the general deterrence created by the threat of sentence enhancement faced by pardoned inmates who reoffend suggest a range of 17 to 21 crimes per year. On the other hand, the average incapacitation effects for those who subsequently replaced the pardoned range from 22 to 47. Moreover, the cross-provincial analysis revealed strong evidence of incapacitation effects that quickly diminish as the incarceration rate increases. This is a particularly striking finding given the generally low level of incarceration in Italian provinces relative to incarceration rates in the United States.

How do these results compare to prior incapacitation effect estimates? The criminological literature attempting to measure pure incapacitation through inmate surveys find pure incapacitation effect estimates ranging between 10 and 20 offenses per prison year. The range of our results for those released due to the pardon clearly overlaps with this range. As much of this survey research was conducted in the United States at a time when the incarceration rate was considerably lower than it is today and much closer to that of Italy on the eve of the pardon, the findings from this body of research present a particularly appropriate benchmark. Interestingly, despite commonly voiced skepticism regarding the value of these estimates based on inmate self-reports, our results appear to validate this body of research.

The larger estimates exploiting variation in incarceration along the dynamic adjustment path as well as larger estimates for provinces with relatively low pre-pardon incarceration rates are suggestive of great heterogeneity in criminal offending among those sentenced to prison, even in Italy where the propensity to punish with a prison spell is relatively infrequent. These results are consistent with Vollaard's (2013) recent study of the targeted use of incarceration in the Netherlands. Vollaard finds an average annual incapacitation effect of roughly 50 offenses per year from incarcerating identified repeat offenders. Moreover, Vollaard finds very strong evidence that as Dutch municipalities dip further into their pool of repeat offenders in the application of a repeat offender sentence enhancement, the marginal incapacitation effect decreases significantly. Our evidence pertaining to cross-province heterogeneity accords with this finding.

Regarding evidence from panel data studies, Johnson and Raphael (2012) estimate that for the period between 1978 and 1990 each additional prison year served in the United States prevented on average 14 reported serious crimes (11.4 property crimes and 2.5 violent crimes). This corresponds to a period when the average state incarceration rate was 186 per 100,000, roughly double the Italian incarceration rate over the period we are studying. Since these US panel data estimates represent the joint effect of incapacitation and general deterrence, our Italian results suggest that the average incapacitation effect in Italy at this point in time are somewhat larger than the measurable incapacitation effect in the United States during the 1980s. One interpretation of these relative magnitudes is that, relative to Italy, the United States during the 1980s had already begun to experience diminishing marginal returns to incarceration due to the relatively high and rising US incarceration rate.

This inference is buttressed by the findings in Johnson and Raphael (2012) for a later time period. Specifically, they find considerably smaller joint incapacitation/deterrence effects in the United States for the period 1991 through 2004 when the average state incarceration rate was 396 inmates per 100,000 (total reported crimes prevented per prison year during this latter period of approximately 3, with 2.6 of the incidents property crimes).

An alternative manner of characterizing the results here for the purposes of comparison to previous research would be to express the impacts as crime-prison elasticities. Using crime and incarceration rates in August 2006 as base values, the discrete increase in crime and decrease in incarceration from our most complete model specification yields a total crime-prison elasticity of -0.4. Measuring crime and incarceration changes along the dynamic adjustment path yields total crime prison elasticities as high as -0.66. For the earlier period studied in Johnson and Raphael (2010) they find crime-prison elasticities of -0.43 for property crime and -0.79 for violent crime (with the overall average closer to property crime given its much greater relative frequency). Levitt's 1996 study, using prison-overcrowding litigation as an instrument, reports crime-prison elasticities of between -0.38 and -0.42 for violent crime and -0.26 and -0.32 for property crime. Note, Levitt's study uses data from the late 1970s through the early 1990s, and thus corresponds to a relatively low incarceration epic in the United States. Perhaps the most relevant comparison is the study by Barbarino and Mastrobuoni (2012) analyzing the impact of earlier collective pardons in Italy using region-level annual data. The authors report total crime-prison elasticities of between -0.25 and -0.30. In a recent analysis of crime differentials between Europe and the United States, Buonanno et al. (2011), find a crime-prison elasticity about -0.4.

In general, our results are comparable in magnitude to those from prior research for the United States during periods when the US incarceration rate was considerably lower. Interestingly, these research studies focusing on relatively low-incarceration rate periods in the United States are generally consistent with one another despite very large qualitative differences in methodological approach. Given the clear exogenous shock in Italy and the consistency with these alternative research studies, we believe that our findings here validate these earlier research efforts.

VI. Conclusion

We document sizable increases in crime associated with the August 2006 Italian collective pardon. Relative to the number of inmates released, our various estimation strategies suggest that each prison-year served at current Italian incarceration rates prevents between 14 and 46 crimes reported to the police. Most of this impact is attributable to thefts of various sorts, and to a lesser degree, robbery. However, we find some evidence that the pardon may have led to a slight increase in violent crime as well. Our empirical estimates, based on three separate sources of variation created by the pardon, are generally consistent with one another.

We find strong evidence of cross-inmate heterogeneity in incapacitation effects and, in particular, evidence that incapacitation effects decline quite quickly as incarceration rates increase. This finding accords with recent empirical evidence for the Netherlands (Vollaard 2013) and the United States (Johnson and Raphael 2012). The cumulative evidence of diminishing crime-preventing returns to scale are particularly relevant to the United States, where current incarceration rates are the highest in the world and nearly five times the average rate that existed prior to 1980.

Our incapacitation estimates for Italy lie within the range of estimates from older survey-based estimates of pure incapacitation conducted during a time period when the US incarceration rate was much closer to Italy's current rate (and much lower than the current US rate). Our estimates are also similar in magnitude to the findings from joint incapacitation/deterrence effect estimates based on US state panel data for relatively earlier time periods. Together these findings suggest that most of the crime-preventing effects of incarceration operate through incapacitation rather than deterrence.

To be sure, there are several qualifications that should be kept in mind when comparing our estimates to those for the United States. First, crime characterization and the propensity to report to the police may differ between the two countries. Second, while we make comparisons against estimates for the United States based on relatively early time periods (the 1980s and early 1990s), the incarceration rate in the United States during these periods is still roughly double that of Italy's current rate. Given the extant evidence of decreasing returns to scale in crime-incarceration effect (Johnson and Raphael 2010, Liedka, Piehl, and Useem 2006), these comparisons may overstate the relative importance of incapacitation.

A final caveat that should be kept in mind when interpreting these results concerns the fact that we are clearly estimating a local average treatment effect. The ultimate impact of releasing inmates on crime most certainly depends on which inmates are released, the degree of post-release supervision via community corrections, the degree to which police in receiving communities are able to handle the inflow, programming that released inmates undergo while incarcerated, as well as a number

of other factors. In addition, as we have mentioned several times throughout the paper incapacitation effects most certainly depend on the scale of incarceration, with great expansions in the use of incarceration along the extensive margin of the criminally active population most certainly netting less serious criminals. The results here suggest that an Italian incarceration rate of 60 per 100,000 in Italy is likely to be too low and that the bang-per-buck for corrections expenditure (crimes prevented per euro spent on corrections) was quite high in the aftermath of the 2006 pardon. In fact, that cost-benefit analysis presented in Barbarino and Mastrobuoni (2012) suggest that this was the case after most pardons in Italy occurring during the post-war period. Similar arguments were probably applicable to the United States during the 1970s, when the incarceration rate stood at 110 per 100,000. However, extrapolating our results from Italy to the current situation in the United States is unwise. With a 2009 US incarceration rate of 502 per 100,000, underlying correctional conditions are too different to make such comparisons.

A crucial question to ask is whether the expected benefits deriving from the collective pardon exceed the expected costs of crime committed by released inmates. We perform a cost-benefit analysis to draw some policy implications on the economic and social relevance of this unusual policy. The expected benefits of the collective pardon correspond to the budgetary savings associated with a lower incarceration rate. According to the official statistics by *Ministero di Giustizia*,[8] the total daily cost per prisoner is around 130 euros, but this figure includes both fixed and variable costs. Fixed costs refer to personnel and infrastructure and accounts for more of 80 percent of this daily cost, while variable costs refer to direct cost of support (i.e., food) and is equal to 22 euros per day (equivalent to roughly US$28). Given the temporary nature of the policy, only variable costs were affected. Since the average residual sentence among pardoned inmates was 14.5 months the implied saving of the collective pardon is 245 million euros.[9] We compute the costs of crime in the following manner. We employ our annualized estimates reported in Table 5 and in Table 6 respectively as a lower and upper bound of the increase in crime rate. Moreover, we use the cost of crime estimates presented in Cohen (1988), Miller, Cohen, and Wiersema (1996), and McCollister, French, and Fang (2010).[10] We only consider theft and robbery in our calculations since these crimes account for most of the incapacitation effects that we estimate. We calculate that the cost of crime attributable to the collective pardon range between 466 million euros and 2.2 billion euros depending on the source used and on the prison-crime elasticity considered.[11] Overall, the pardon falls far short of passing a cost-benefit analysis determining a "social" cost between 10 and 60 thousand euros per prisoner per year.

[8] http://www.giustizia.it/giustizia/it/mg_1_14_1.wp;jsessionid=9222995265E4B25C3286438420982CCB.ajpAL01?previsiousPage=mg_1_14_1&contentId=SST171342.

[9] 245 million euros is obtained by multiplying the number of released inmates at the end of 2006 (25,515) times the daily variable cost times the residual sentence expressed in days.

[10] The sources used differ in their estimates of the cost of crime. The cost of a theft is equal to US$ 344 for Cohen (1988), 529 for Miller, Cohen, and Wiersema (1996) and 3,532 for McCollister, French, and Fang (2010). While the cost of a robbery is respectively 24,168, 18,591, and 42,310 in US dollars. Cost of crime is expressed in 2008 US dollars.

[11] The cost of crime has been computed by multiplying coefficients in Table 5 (lower bound) and Table 6 (upper bound) by the residual sentence in years times 25,515 (number of released inmates) times the cost of crime.

Appendix: Deriving the Dynamic Adjustment Path of Crime and Incarceration

With the defined transition probabilities, the population shares evolve over time according to the equations

$$(A1) \quad S_{1,t} = S_{1,t-1}(1 - cp) + S_{2,t-1}\theta, \quad S_{2,t} = S_{1,t-1}cp + S_{2,t-1}(1 - \theta).$$

The corresponding national crime rate is given by

$$(A2) \qquad Crime_t = cS_{1,t}.$$

Combining the constraint $S_{1,t} + S_{2,t} = 1$ with (A1) and simplifying yields the following first-order difference equation relating incarceration in time t to incarceration in time $t - 1$:

$$(A3) \qquad S_{2,t} + (cp + \theta - 1)S_{2,t-1} = cp.$$

This equation has the corresponding general solution

$$(A4) \qquad S_{2,t} = A(1 - cp - \theta)^t + \frac{cp}{cp + \theta},$$

where A is definitized by an explicit value for the incarceration rate at the start of the adjustment process. We know that the pardon-induced change in incarceration is $[\theta - \theta']cp/(cp + \theta)$. Hence, incarceration at $t = 1$ is given by the sum of the previous steady-state value and this change, or

$$(A5) \qquad S_{2,1} = \frac{cp}{cp + \theta} + \frac{[\theta - \theta']cp}{cp + \theta} = \frac{[1 + \theta - \theta']cp}{cp + \theta}.$$

Evaluating equation (A4) at $t = 1$ and setting this equal to the expression in (A5) permits solving for A. Plugging this solution back into equation (A4) and substituting defined terms from the main text gives

$$(A6) \qquad S_{2,t} = \Delta S_2^{pardon}(1 - cp - \theta)^{t-1} + \frac{cp}{cp + \theta}.$$

The solution in equation (A6) shows the incarceration rate for $t > 0$ equal to the old steady state value (the second term) plus the remaining effect of the pardon on the incarceration rate. Equations (6) and (7) in the main text follow directly from (A6). Defining $\Delta S_{2,t|t>0}$ as the change in the incarceration rate for periods t and $t + 1$ where $t > 0$, differencing equation (A6) gives

$$(A7) \qquad \Delta S_{2,t|t>0} = -\Delta S_2^{pardon}[1 - cp - \theta]^{t-1}(cp + \theta),$$

which is the expression for equation (6) in the main text. It then follows that the corresponding change in the national crime rate is given by $\Delta Crime_{t|t>0} = -c\Delta S_{2,t|t>0}$, which is the expression in equation (7).

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1. Alessandro Barbarino, Giovanni Mastrobuoni. 2014. The Incapacitation Effect of Incarceration: Evidence from Several Italian Collective Pardons†. *American Economic Journal: Economic Policy* **6**:1, 1-37. [Abstract] [View PDF article] [PDF with links]