Reducing Crime through Expungements*

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October 8, 2016

Abstract

Expungement refers to the legal practice of having one's criminal record sealed. These legal devices lower the visibility of a person's criminal record, and thereby reduce the informal sanctions that may be imposed on him. This reduction is enjoyed by the ex-convict only if he does not become a repeat offender, because otherwise he re-obtains a criminal record. Thus, the value a person attaches to having his record expunged is inversely related to his criminal tendency. Therefore, by making expungements costly, the criminal justice system can sort out low criminal tendency individuals –who are unlikely to recidivate– from people who have high criminal tendencies. Moreover, the availability of expungements does not substantially affect a first time offender's incentive to commit crime, because one incurs a cost close to the reduction in informal sanctions that he enjoys by sealing his criminal record. On the other hand, expungements increase specific deterrence, because a person who has no visible record suffers informal sanctions if he is convicted a second time. Thus, perhaps counter-intuitively, allowing ex-convicts to seal their records at substantial costs reduces crime.

1. Introduction

Expungement refers to the legal practice of having one's criminal record sealed such that it is inaccessible to the public. Although there are many variations of this practice, the commonality among them is that they make the person's criminal records less visible, and they thereby mitigate the informal costs associated with being an ex-convict. This article demonstrates that allowing expungements at a cost can counter-intuitively reduce crime.

Expungements and similar practices[1] are becoming more popular, and their functions are being debated among academics,[2] perhaps because they are seen

*For insightful comments and suggestions I thank three anonymous referees and participants at the following events: the UCLA law and economics workshop; the European Association of Law and Economics 2016 Annual Meeting; the Canadian Law and Economics Association 2016 Annual Meeting; and the George Mason University School of Law faculty workshop. I also thank Andrew Butler and Kristen Harris for excellent research assistance.

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[1] *See* Schlosberg et al. (2014) for a list and brief review of "mechanism[s] through which an individual may expunge or limit disclosure of a criminal record" (Schlosberg et al. (2014 p. 355)).

[2] *See, e.g.,* Jacobs (2015), Roberts (2015), Litwok (2014), and Schlosberg et al. (2014).

as a potential remedy to the 'Mass Incarceration' problem, which is a popular term that refers to the high incarceration rates in the United States. Legal reforms and attempts at reforms parallel these debates. In 2011, two bills were proposed to enable federal expungement authority, although they did not pass.[3] In Delaware, Governor Jack Markell has signed around 1600 pardons in his six years of service to reduce the stigmatization of many ex-offenders.[4] Most recently, and within the last year, a federal judge in the Eastern District of New York expunged a person's criminal record claiming that his court has ancillary jurisdiction to expunge records,[5] whereas the New Jersey Supreme Court made it harder to obtain expungements by limiting their availability to cases where the offense occurred during a "single, uninterrupted" event.[6] Given these recent developments, it is likely that there will be new legislation and rulings related to expungements in the near future, and it is therefore important to explore the various costs and benefits of expungements.

The existing debates among legal scholars do not directly address whether expungements are likely to increase or reduce crime. Proponents of expanding the availability of expungements often claim that a criminal record presents a barrier to re-entering society, which is a significant cost that can be mitigated (or eliminated) through the use of expungements.[7] On the other hand, some academics note that allowing expungements violate 'the people's right to know'.[8] Moreover, expungements reduce the expected costs associated with committing crime, and may increase first-time-offenders' incentives to commit crime.[9] Thus, the relevant trade-off identified so far appears to be between reducing costs imposed on convicts (and their dependents) on the one hand, and costs associated with greater criminal incentives for first-time-offenders and depriving society of information regarding offenders on the other hand.

In this article, I highlight a feature of expungements that is ignored by many legal scholars, and has not yet been formalized in the economics literature. Ex-convicts who truly wish to refrain from committing crime in the future value expungements more than career criminals, because the latter type is more likely to be re-stigmatized as a result of his future misconduct. In more technical

[3] *See* The Second Chance for Ex-Offenders Act of 2011, H.R. 2449, 112th Cong. (summary available at https://www.govtrack.us/congress/bills/112/hr2065/summary) , and The Fresh Start Act of 2011, H.R. 2065, 112th Cong. (summary available at https://www.congress.gov/bill/112th-congress/house-bill/2449).

[4] These pardons are not as effective as expungements, but are still meant to reduce stigma. As Barrish and Starkey (2015) explain, "Pardons add a disclaimer to a criminal record saying someone is officially forgiven by the state but do not erase convictions. Rather, they restore civil liberties ... [and] can be used to show prospective employers a person is reformed — a kind of seal of approval from the governor."

[5] *Doe v. U.S.*, No. 14-MC1412, 2015 WL 2452613 (D.N.Y. May 21, 2015)

[6] *In re J.S.*, 121 A.3d 322 (N.J. 2015).

[7] *See, e.g.,* Roberts (2015).

[8] *See, e.g.,* Kilcommins and O'Donnel (2003) and Dunn (1987).

[9] That expungements may reduce general deterrence by reducing the negative consequences associated with being an offender seems to be stated rather infrequently (*see, e.g.,* Czajkoski (1982) and Easton (1981)), although this is presumably the first effect that comes to mind in the economics of law enforcement context.

terms, a person's reservation price for expungements is decreasing in his criminal propensity. Thus, if the government could price expungements, it could separate generally-law-abiding-citizens, who under exceptional circumstances have failed to act in accordance with the law, from career criminals. Moreover, the possibility of purchasing expungements at a price close to one's reservation price has little effect on a person's ex-ante incentives to commit crime, because it leaves the expected costs associated with criminal actions almost unchanged. However, an ex-convict who has expunged his record is less likely to commit crime in the future compared to a similar person with an unexpunged record, because he faces greater expected informal sanctions from recidivating. Thus, expungements can be used to reduce crime by lowering recidivism rates without much affecting first-time-offenders' incentives.

Explaining the dynamics associated with pricing expungements in further detail requires a brief digression into the stigmatizing effect of criminal punishment, and how expungements reduce stigmatization costs. Many previous law and economics studies, both theoretical and empirical, focus on the extra-legal negative consequences associated with having a criminal record. A person (or a corporation) who is convicted of a crime is not only sanctioned through criminal law, but may also receive lower wages in the labor market.[10] Moreover, a person with a record may suffer negative social consequences due to other people's reluctance to interact with him.[11] Expungements reduce these costs by making a person's criminal record unavailable to the public, and therefore harder for people to discriminate against a person based on his criminal record. Sealing one's criminal record is not very valuable, however, if the person re-offends subsequent to expunging his record, thereby suffering again the costs associated with having a criminal record.

A static model, which ignores the expected future behavior of ex-convicts, is incapable of capturing the full value of expungements to an ex-convict, because it excludes the possibility of the ex-convict re-obtaining a record. Standard multi-period law enforcement models used to study recidivism allow the incorporation of future considerations of this type.[12] In these models, various policies generate two interrelated incentive effects which are conveniently called specific deterrence effects and general deterrence effects (Funk (2004)). Specific deterrence relates to the crime rate among ex-offenders; whereas, general deterrence relates to the crime rate among people who were never convicted.

[10] Many empirical studies point to this conclusion. Pager (2003) and Pager et al. (2009) are audit studies focusing on the effect of having a record; Lott (1992a) and (1992b) estimate the size of informal sanctions; and Karpoff et al. (2008) estimates the penalties imposed by the market on firms due to financial misrepresentation. Legal scholars also frequently provide anecdotal evidence that support this claim (*see, e.g.,* Murray (2016) and the references cited therein).

[11] The American Bar Association's Database lists more than 45,000 potential collateral consequences associated with having a conviction (National Inventory of Collateral Consequences of Conviction, http://www.abacollateralconsequences.org/search/). *See also* Demleitner (1999) where a variety of social negative consequences are discussed.

[12] Funk (2004) makes a similar observation regarding the specific deterrence reducing effect of stigma, and states that the single period models in Rasmusen (1996) are unable to generate this effect.

If expungements were free (or automatic) for first time offenders, one would expect them to reduce general deterrence, since they reduce the expected costs associated with committing crime.[13] On the other hand, they are likely to increase specific deterrence, because a person who has an expunged record has more to lose by committing crime (in the form of informal sanctions) than a person who has a visible criminal record.[14] Thus, allowing free expungements is likely to generate a trade-off between specific and general deterrence. However, this trade-off vanishes if one can charge a person a price for expungements that equals his reservation price. There is no general deterrence effect, because the person is indifferent between not expunging his record and suffering informal sanctions, and expunging his record at a cost that equals the expected informal sanction associated with having a criminal record. But, the specific deterrence effect is still present, because a person with an expunged record still has more to lose than a person with a visible record, and thus is less likely to commit crime.

Not every person's reservation price for an expungement is the same. Thus, unless the government can price discriminate, it is impossible to charge everyone their reservation price. Fortunately, people with low criminal tendencies (type L) have a higher reservation price for expungements than people with high criminal tendencies (type H), because they are less likely to commit crime in the future and thereby lose some of the value of the expungement. Therefore, setting a price at which only type L people purchase expungements has no effect on the incentives of type H people: Since they do not purchase expungements, they act as if expungements do not exist. Moreover, setting the expungement price equal to a person's reservation price for the expungement has no effect on his ex-ante incentives, because it leaves the expected cost from being punished as a first timer unchanged. Thus, by setting the expungement price equal to type L individuals' reservation prices, one can generate specific deterrence at no general deterrence costs. Hence, when appropriately priced, expungements reduce crime.

The above explanation relies on the type distribution being discrete, i.e. there being sizable proportions of individuals with specific criminal tendencies. However, when each criminal type has a relatively small proportion, the social value of affecting a single type's behavior becomes relatively unimportant. In the extreme case where there is a continuum of types (with zero measure each), the behavior of a single type becomes completely irrelevant. In these cases, the only expungement policies of interest are those that affect the behavior of a continuum of types. But, general deterrence is reduced for people with the lowest criminal tendencies, whenever expungements are priced low enough to induce a continuum of types to purchase expungements. Thus, the trade-off between specific and general deterrence re-emerges. Even in these cases, as I demonstrate in section 3, the primary result continues to hold: one can always reduce crime through expungements by setting a price that targets a continuum

[13] *See*, however, Litwok (2014), finding no general deterrence effects.

[14] Schlosberg et al. (2014) and Litwok (2014) find specific deterrence effects that are consistent with this conjecture.

of types for which the negative general deterrence effect is more than offset by the positive specific deterrence effect.[15] Additionally, because a range of expungement prices lead to a reduction in crime, there is room for error in setting the expungement price, and therefore extreme accuracy in setting the expungement price at the crime minimizing price is not necessary.

Although the primary focus of this article is demonstrating that one may reduce crime by pricing expungements, this practice has additional desirable effects. Among these is providing superior information to the public, which should mitigate, if not eliminate, concerns related to the public's desire to view criminal records. This is because a conviction provides a noisy signal regarding a person's type: Type L people commit crimes (even if less frequently) just like type H people in equilibrium, and, therefore, a criminal conviction, absent expungements, cannot be used to perfectly separate high types from low types. Thus, criminal records provide superior information to the public when expungements are priced properly, because they remove low criminal tendency people from the pool of people with 'unexpunged records'.

As the previous discussion reveals, the model and reasoning presented in this article relies on people having different degrees of criminal 'tendencies' rather than different criminal benefits, as is assumed in many law enforcement models. Therefore, in section 2, I present a Beckerian law enforcement model where –unlike in standard models in which people have constant benefits from crime– individuals' criminal benefits are random variables drawn at the beginning of each period in which the person may commit a crime. This provides a convenient framework to incorporate criminal tendencies through the cumulative distribution functions (CDF) from which criminal benefits are drawn. In particular, if type H people draw their benefits from a CDF which *first order stochastic dominates* the CDF that type L people draw their benefits from, then it naturally follows that type H people have greater criminal tendencies than type L people. In addition to this modification, the model also contains a period in which ex-convicts may expunge their past records by paying a price selected by the government. With the exceptions of these two modifications, the model presented in section 2 is a simple law enforcement model with multiple periods, which is often used to study optimal punishment schemes for repeat offenders.[16] I analyze this model and summarize my findings via three propositions in section 3.

In section 4, I outline an extension where stigma is endogenously determined and I highlight the simple normative implications that follow from the propositions in section 3. Section 5 contains concluding remarks. An appendix in the end contains the proof of a proposition.

[15] It is also important to note that when the type distribution places large weights on types around the lowest type, the general deterrence to be sacrificed to achieve specific deterrence becomes minimal. A bi-(or multi-)modal distribution with one peak at the lowest criminal tendency is an example that satisfies this property and one that is useful for thinking of a society where most individuals commit crimes only under the rarest of conditions. This point is formalized in a discussion following proposition 3.

[16] *See, e.g.,* Miceli (2013) and Mungan (2010), which both use such models and provide brief reviews of existing literature on the economic analysis of repeat offender laws.

2. Model

I consider a three period model where risk-neutral individuals receive benefits from committing a harmful act. Each individual may commit this act twice, once in the first period, and once in the third period. Individuals make criminal decisions separately at the beginning of each of these periods (unlike the alternative simplifying case considered in the literature, e.g., Emons (2007), where the person binds himself to a particular path of action). The law enforcement system catches offenders with a probability of p in each of these periods. If a person commits the offense in the first period, and is subsequently caught, he has an option to expunge his record in the second period at a cost of X chosen by the government. I refer to this cost as the *price* of expungements in the proceeding parts. People also receive external benefits at the end of periods 1 and 3. The magnitudes of these benefits depend on the person's offense history. These benefits are η for people who have no (or an expunged) record, and λ for people who have a record. Thus $\sigma \equiv \eta - \lambda > 0$ is the informal sanction, or stigma, attached to having a record. The sanctions for committing crime similarly depend on a person's history, and are s_1 for people never convicted before, and s_2 for people who have been previously convicted.[17]

Individuals' criminal benefits in periods one and three are random variables, denoted as b_1 and b_3 respectively, which are drawn in the beginning of each period. The heterogeneity in people's criminal tendencies is captured by types, $t \in T \subset (0,1)$, which determine the distribution function from which people draw their criminal benefits. In particular, F^t denotes a type t individual's cumulative distribution function, such that F^h first order stochastic dominates F^l for all $l, h \in T$ with $l < h$, i.e. $F^l(b) > F^h(b)$ for all $b \geq 0$. This essentially implies that it is harder to deter type h people relative to type l people, which means that type h people have greater criminal tendencies than type l people. To make this assumption easily tractable, I assume that $F^t(b) = t\int_0^b f(x)dx + (1-t)$, where $(1-t)$ is the probability with which a type t individual's criminal benefit draw equals 0, and $tf(x)$ is a type t individual's density function over positive benefits from crime. An intuitively appealing feature of this functional form is that it generates a probability (of $1-t$) with which individuals refrain from committing crime, regardless of the expected punishment associated with crime. Thus, by setting a very low t for type l individuals, one can formalize the idea that there are people who very rarely even consider committing crime.

[17] There is variation in laws on whether an expunged record 'counts' for purposes of categorizing a person as a repeat offender. To name a few, laws in Pennsylvania, New Jersey and California explicitly count expunged records (see 18 Pa.C.S. §9122(c), NJ A206 (4), and Cal. Penal Code §1203.4) whereas under the Federal First Offender Act expunged records do not count directly, but, may count in determining "upward departures" in sentencing. The co-existence of expungements and this type of history-dependent punishment requires internal record keeping for law enforcement purposes.

The assumption that the sanction is s_2 for people who have expunged their records is imposed to guarantee that differences in formal sanctions provide no incentives to expunge. Results extend to cases where the (average) sanction for offenders with expunged records, s^e, is such that $s^e + \sigma > s_2$.

To preserve the focus of the article, I assume that all policy variables except X, i.e. s_1, s_2, and p, are exogenously given, mainly because the results presented hold for any given set of policy variables. Nevertheless, in section 4.1., I discuss the effects of endogenously determining these variables.

3. Analysis:

This section proceeds by backward induction to derive individual's decision making processes and to formalize the effects of X on general deterrence, specific deterrence, and total crime rates.

3.1. Period 3 Decisions

In the third period, a person (of any type) may belong to one of three categories of individuals. These categories are denoted as R, E and N. Category R consists of people who enter the third period with (unexpunged) records, because they were caught while committing crime in period one and have not expunged their records in period two. Category E contains people who have expunged their records in the second period, subsequent to being caught while committing crime in the first period. Finally, people in category N are people who have no criminal records, either because they have not committed crime, or because they were not caught after committing crime.

Next, let a person's expected pay-off from committing crime in the third period as a function of his category be denoted as ψ_3^C for $C \in \{R, E, N\}$, and, similarly, let his pay-off from not committing crime be denoted as v_3^C. Thus, a person in category C commits crime in the third period if $\psi_3^C > v_3^C$.[18] Using this observation, a person's third period pay-off, $\pi_3^C(b_3)$, as a function of his third period criminal benefit draw and his category, C, can be described as:

$$\pi_3^R(b_3) = \begin{cases} \psi_3^R = b_3 + p(\lambda - s_2) + (1-p)\lambda & \text{if} \quad b_3 > ps_2 \\ \nu_3^R = \lambda & \text{if} \quad b_3 \leq ps_2 \end{cases} \tag{1}$$

$$\pi_3^N(b_3) = \begin{cases} \psi_3^N = b_3 + p(\lambda - s_1) + (1-p)\eta & \text{if} \quad b_3 > p(s_1 + \sigma) \\ \nu_3^N = \eta & \text{if} \quad b_3 \leq p(s_1 + \sigma) \end{cases} \text{; and} \tag{2}$$

$$\pi_3^E(b_3) = \begin{cases} \psi_3^E = b_3 + p(\lambda - s_2) + (1-p)\eta & \text{if} \quad b_3 > p(s_2 + \sigma) \\ \nu_3^E = \eta & \text{if} \quad b_3 \leq p(s_2 + \sigma) \end{cases} \tag{3}$$

In the expressions for ψ_3^C above, the second term denotes the probability of getting caught (p) times the external benefit (λ or η) minus the formal sanction for committing crime (s_1 or s_2), and the third term denotes the probability of evading detection ($1-p$) times the external third period benefit (λ or η). On the other hand, if a person does not commit crime, he simply receives his external third period benefit (λ or η).

As (1)-(3), above, demonstrate, a person in category $C \in \{R, E, N\}$ commits crime if his criminal benefit draw exceeds the expected total third period sanction (i.e. the expected formal sanction plus the expected reduction in external benefits). More specifically, let $\tau_3^R \equiv ps_2$, $\tau_3^N \equiv p(s_1 + \sigma)$ and $\tau_3^E \equiv p(s_2 + \sigma)$. Then, a person in category C commits crime in the third period if $b_3 > \tau_3^C$, and,

[18] I am assuming that people who are indifferent do not commit crime.

therefore, a type t person's likelihood of committing crime in the third period is given by:

$$1 - F^t(\tau_3^C) = q^C(t) \tag{4}$$

In the proceeding parts, I frequently express probabilities and pay-offs without reference to their arguments (e.g. I express $q^C(t)$ as q^C and $\psi_3^R(b_3)$ as ψ_3^R) to abbreviate notation.

3.2. Period 2 Decisions

The second period is relevant only for individuals who have committed a crime in the first period and were subsequently caught and punished. These individuals face two choices. They may expunge their records at a cost of X and enter the third period in category E. Alternatively, they may elect to not expunge their records and enter the third period in category R.

The expected second (plus third) period pay-off associated with the first option is given by:

$$\pi_2^E(X,t) = -X + (1-q^E)\eta + \int_{\tau_3^E}^{\infty} \psi_3^E t f(b) db \tag{5}$$

This is because the person will not commit crime in the third period with a probability of $(1-q^E)$ (per (4) above), in which case he will receive a third-period pay-off of $\nu_3^E = \eta$. On the other hand, if he draws a third period criminal benefit of $b_3 > \tau_3^E$ (which happens with probability q^E), his third period pay-off, namely ψ_3^E, will depend on his particular draw. Thus, $\int_{\tau_3^E}^{\infty} \psi_3^E t f(b) db$ represents his expected third period pay-off from committing crime.

If, on the other hand, he does not expunge his record, his second (plus third) period expected pay-off is:

$$\pi_2^D(t) = (1-q^R)\lambda + \int_{\tau_3^R}^{\infty} \psi_3^R t f(b) db \tag{6}$$

Therefore, a person expunges his record if $\pi_2^E \geq \pi_2^D$, which simplifies to:

$$X^t \equiv (1-pq^E)\sigma - \int_{\tau_3^R}^{\tau_3^E} (b - ps_2) t f(b) db \geq X \tag{7}$$

X^t, defined above, specifies the demand for expungements as a function of one's type. Proposition 1, below, specifies the relationship between people's criminal tendencies and their demand for expungements.

Proposition 1: *(i) The demand for expungements is decreasing in criminal tendencies (i.e. $\partial X^t/\partial t < 0$). (ii) All types have positive reservation prices for expungements, i.e. $X^t > 0$ for all t. (iii) Thus, by pricing expungements at*

X^s, one can induce only those types with $t \leq s$ to purchase expungements, i.e. one can separate types with $t \leq s$ from types with greater criminal tendencies for any s.

Proof: (i) Differentiating X^t wrt t, as expressed in (7), reveals that $\frac{\partial X^t}{\partial t} = -p\sigma\frac{\partial q^E}{\partial t} - \int_{\tau_3^R}^{\tau_3^E}(b-ps_2)f(b)db$. (4) reveals that $\frac{\partial q^E}{\partial t} = 1 - \int_0^{\tau_3^E} f(b)db$, and, therefore $\frac{\partial X^t}{\partial t} = -p\sigma(1 - \int_0^{\tau_3^E} f(b)db) - \int_{\tau_3^R}^{\tau_3^E}(b-ps_2)f(b)db < 0$.

(ii)

$$X^t = (1-pq^E)\sigma - \int_{\tau_3^R}^{\tau_3^E}(b-ps_2)tf(b)db \qquad \text{(P.1.)}$$

$$> (1-pq^E)\sigma - \int_{\tau_3^R}^{\tau_3^E}(\tau_3^E-ps_2)tf(b)db$$

$$= \sigma(1+q^E(1-p)-q^R) > 0$$

(iii) Follows directly from parts (i) and (ii).■

It is worth highlighting the intuition behind the two components of X^t specified in (7). The first term (i.e. $(1-pq^E)\sigma$) describes the gain, in the form of reduced expected stigma, associated with expunging one's record. Intuitively, this gain ought to be lower for people with high criminal tendencies, because they expect to re-stigmatize themselves by re-offending in the third period more frequently than people with low criminal tendencies. This is, in fact, the case since (as (4) reveals) q^E is increasing in t, and thus $(1-pq^E)\sigma$ is smaller for people with high criminal tendencies.

The second term describes the commitment loss associated with expunging one's record. In particular, by expunging his record, a person binds himself to not committing crime when he draws a third period benefit below $\tau_3^E = p(s_2+\sigma)$. On the other hand, if a person had not expunged his record, he would commit a crime in the third period in a wider range of circumstances, i.e. when his draw exceeds $ps_2 < p(s_2+\sigma)$. Thus, expunging one's record implies a commitment to refrain from criminal acts, which is, intuitively, a greater sacrifice for people with high criminal tendencies, since they are more likely to find themselves in situations where they could, but for external costs, profitably commit crimes.

Proposition 1, above, exploits these observations and points out that the decreasing demand for expungements can be used to separate high criminal tendency people from low criminal tendency people, and that this can be done for any targeted type, i.e. one can achieve separation for any definition of "high" versus "low" criminal tendency. Section 4.2. discusses the potential normative desirability of achieving such separation.

3.3. Period 1 decisions

In the first period, all individuals decide between committing and refraining from committing crime and consider their second and third period best responses (described in (1)-(3) and (7) above) while doing so. Not committing crime implies a pay-off of η in the first period, and that a person enters the third period in category N (and skips the expungement period, since he has no record). Thus, the pay-off from not committing crime is:

$$\begin{aligned} \nu_1^t &= \eta + E(\pi_3^N) \\ &= (2 - q^N)\eta + \int_{\tau_3^N}^{\infty} \psi_3^N t f(b) db \end{aligned} \tag{8}$$

where $E(\pi_3^N)$ denotes the expected third period pay-off. On the other hand, if a person commits crime, with a probability of $(1-p)$ he is not caught, and therefore he obtains the same pay-off as a person who refrains from committing crime (i.e. ν_1) in addition to the benefit of b_1 from committing crime. With the residual probability of p, his first period pay-off is $b_1 + \lambda - s_1$, and his combined second and third period pay-off is the greater of π_2^E and π_2^D, since he expunges his record if $\pi_2^E \geq \pi_2^D$. Thus, his total expected pay-off from committing crime is:

$$\psi_1^t = b_1 + p(\lambda - s_1 + \max\{\pi_2^E, \pi_2^D\}) + (1-p)\nu_1^t \tag{9}$$

Hence, a person commits crime if $\psi_1^t > \nu_1^t$, which is equivalent to:

$$C(b_1, X, t) = b_1 + p[\lambda - s_1 - \nu_1^t + \max\{\pi_2^E(X,t), \pi_2^D(t)\}] > 0 \tag{10}$$

This expression leads to the following observation, which plays an important role in the derivation of additional results.

Observation 1: *(i) For all $t \in T$ and all $X \geq 0$, there exists $b_1^t(X)$, such that*

$$C(b_1, X, t) \geq 0 \text{ if and only if } b_1 \geq b_1^t(X) \tag{11}$$

(ii) Moreover, $b_1^t(X) > 0$ for all X and t if $s_2 \geq s_1$.

The first part of the observation follows easily from the facts that $\partial C/\partial b_1 > 0$, $\lim_{b_1 \to \infty} C = \infty$, and $\lim_{b_1 \to -\infty} C = -\infty$. Part (ii) of Observation 1 simply states that, unless first time offenders are punished more severely than repeat offenders, people who draw sufficiently low criminal benefits in the first period elect to refrain from committing crime. This is a rather intuitive result, and the contrary case, where some people commit crimes even when their draw is $b_1 = 0$, is possible only if by committing crime a person increases his expected future pay-off, i.e. unless there is an investment value to committing crime. This is because, his present pay-off from committing crime is unambiguously negative (since $b_1 = 0$, and the expected formal plus informal first period sanction is $p(s_1 + \sigma) > 0$). The only instance where committing crime has a sufficient investment value is when $s_1 \gg s_2$, i.e. committing crime greatly reduces the future punishment for committing crimes, and thereby increases future expected gains by more than present expected losses from committing crime. Because repeat

offenders are almost always punished more severely than first-time offenders, I assume that this condition does not hold. Moreover, as will be evident from the proceeding analysis, the contrary assumption implies that expungements have an even smaller effect on general deterrence, and therefore may only broaden the conditions in which expungements can be used to reduce crime.

Sections 3.1.-3.3. fully describe individuals' best responses to the government's policies. The next section links individuals' best responses to crime rates and discusses the general and specific deterrence consequences of expungement policies.

3.4. General and Specific Deterrence, and Crime Minimizing Expungement Prices

To calculate crime rates, let $\theta_1^t = 1 - F^t(b_1^t)$ denote the first period crime rate among type t individuals (where $b_1^t = b_1^t(X)$ is defined in (11)). To calculate the third period crime rate among each type, note that $(1-p)\theta_1^t$ proportion of type t people enter the third period in category N despite committing crime in the first period, and that $(1-\theta_1^t)$ proportion of type t people enter the third period in category N because they have not committed crimes in the first period. Thus, the probability of committing crime is q^N for $(1-p\theta_1^t)$ proportion of type t people. Moreover, $p\theta_1^t$ proportion of type t people enter the second period with a record, and they expunge their records if $X \leq X^t$. Letting

$$q^S(X,t) = \begin{cases} q^E \text{ if } X \leq X^t \\ q^R \text{ if } X > X^t \end{cases} \tag{12}$$

the proportion of type t ex-convicts committing crime in the third period can be expressed as $pq^S\theta_1^t$. Thus, the third period crime rate among type t people is $\theta_3^t \equiv (q^N(1-p\theta_1^t) + pq^S\theta_1^t) = \theta_1^t p(q^S - q^N) + q^N$, and therefore the total crime rate among type t people is

$$\theta^t \equiv \theta_1^t + \theta_3^t = \theta_1^t(1 + p(q^S - q^N)) + q^N \tag{13}$$

This expression combined with (10) reveals a very simple, yet interesting, result that relates to the concepts of general and specific deterrence. Specific deterrence is associated with the incentives of ex-convicts: a policy that reduces the proportion of ex-convicts committing crime is said to have a specific deterrence effect. This corresponds to a reduction in q^S in the current model. General deterrence, on the other hand, refers to the first period incentives of individuals to commit crime. Thus, a reduction in general deterrence corresponds to an increase in θ^t in the current model.

Proposition 2, below, formalizes results that pertain to general and specific deterrence, and it, and other derivations, use the following notation:

$$\underline{t} \equiv \min T \tag{14}$$

Proposition 2: *(i) Setting the price of expungements at $X^{\underline{t}}$, relative to not allowing expungements, generates specific deterrence of type $\underline{t}$ people without reducing the specific deterrence of other types or the general deterrence of any*

type. (ii) Thus, if there is a positive measure of type $\underline{t}$ individuals, pricing expungements at $X^{\underline{t}}$ reduces crime relative to not allowing expungements.

Proof: (i) Let $X^P > X^{\underline{t}}$ be a prohibitively expensive expungement price, i.e. one where no type purchases expungements, such that offering expungements at X^P is functionally equivalent to not allowing expungements. (10) implies that $C(b_1, X^P, t) = C(b_1, X^{\underline{t}}, t)$, since, per (5), (6), and (7), $\max\{\pi_2^E(X,t), \pi_2^D(t)\} = \pi_2^D(t)$ for all $X \geq X^{\underline{t}}$. Thus, $b_1^t(X^{\underline{t}}) = b_1^t(X^P)$ for all $t \in T$, and, therefore, $\theta_1^t(X^{\underline{t}}) = 1 - F^t(b_1^t(X^{\underline{t}})) = 1 - F^t(b_1^t(X^P)) = \theta_1^t(X^P)$for all $t \in T$. Thus, allowing expungements at a price of $X^{\underline{t}}$ has no general deterrence effect relative to not allowing expungements. But, $q^S(X^{\underline{t}}, \underline{t}) = q^E(\underline{t}) = 1 - F^{\underline{t}}(p(s_2 + \sigma)) < 1 - F^{\underline{t}}(ps_2) = q^R(\underline{t}) = q^S(X^{\underline{t}}, \underline{t})$. Hence, allowing expungements at a price of $X^{\underline{t}}$ increases the specific deterrence of type $\underline{t}$ people relative to not allowing expungements. Finally, reducing X from X^P to $X^{\underline{t}}$ does not affect q^S for any $t \in T\backslash\{\underline{t}\}$, since $\pi_2^E(X,t) < \pi_2^D(t)$ for all $X \geq X^{\underline{t}}$ and all $t \in T\backslash\{\underline{t}\}$.

(ii) The crime rate among type t people is given by $\theta^t(X) = \theta_1^t(X)(1 + p(q^S(X,t) - q^N(t)) + q^N(t)$. Thus, expungements can affect crime rates only through their effect on θ_1^t and q^S. As shown in part (i), reducing X from X^P to $X^{\underline{t}}$ has no effect on θ_1^t for any $t \in T$, neither does it affect $q^S(X,t)$ for any $t \in T\backslash\{\underline{t}\}$. But, the same price change reduces $q^S(X, \underline{t})$ from $q^R(\underline{t})$ to $q^E(\underline{t})$, thus $\theta^{\underline{t}}(X^{\underline{t}}) < \theta^{\underline{t}}(X^P)$. Hence, if type $\underline{t}$ people have a positive measure, reducing X from X^P to $X^{\underline{t}}$ reduces crime through its specific deterrence effect on type $\underline{t}$ people.■

Proposition 2 demonstrates how the negative relationship between people's demand for expungements and their criminal tendencies can be used to produce specific deterrence of people with low criminal tendencies, and perhaps more importantly, without the need for sacrificing deterrence elsewhere. However, as the proposition notes, this is possible only if type $\underline{t}$ people have a positive measure. Moreover, this proposition also implicitly relies on people expunging their records in the second period when they are indifferent between doing so and not expunging their records. The latter assumption becomes less important when there is a continuum of types, in which case, it is also natural to assume that no type has positive measure. Finally, although I do not formally consider errors here, the implementation of this proposition would require setting a very precise price for expungements: any price above $X^{\underline{t}}$ results in no one buying expungements, whereas a price below $X^{\underline{t}}$ results in a reduction of general deterrence for type $\underline{t}$ people.

Assuming that T consists of a continuum of types directly and indirectly addresses these points. In particular, (i) it guarantees that results obtained do not rely on a particular type of individual having a positive measure; (ii) the indifference assumption has no effect, and (iii) small deviations from a targeted expungement price (smaller than $X^{\underline{t}}$) do not produce large effects on crime rates, and thus, one can instead specify a price range for expungements such that any price in that range induces a reduction in crime rates. Thus, the remaining analysis focuses on the case where $T = [\underline{t}, \overline{t}]$. To formalize results in this case, let $g(t)$ denote the density function for types such that $g(t) > 0$ for all $t \in T$.

Using this notation in conjunction with (13), the total crime rate is given by

$$\Theta(X) = \int_{\underline{t}}^{\bar{t}} \theta^t(X) g(t) dt \tag{15}$$

The next proposition shows that by pricing expungements appropriately one can reduce Θ below what it would be absent expungements. Moreover, because there is a range of prices that guarantees this result, small deviations from the expungement price that minimizes Θ still result in a crime level below that which would be observed without expungements.

Proposition 3: *(i) Crime can be reduced by allowing expungements. In particular, there exists a range of prices, such that offering expungements at any of these prices results in less crime than not allowing expungements, i.e. there exists X^l such that $\Theta(X) < \Theta(X^P)$ for all $X \in [X^l, X^{\underline{t}})$ and all $X^P \geq X^{\underline{t}}$. (ii) The crime minimizing expungement price results in more [less] specific [general] deterrence than a regime where expungements are not available.*

The intuition behind the proof of this proposition (which can be found in the appendix) is closely related to the observation that the critical type, $t^* > \underline{t}$, who is paying exactly his reservation price for expungements, behaves the same way in the first period as he would have if expungements were not available. Thus, there is no loss of general deterrence for this type. The reason for this is that he is offered a price for expungements that exactly equals the expected stigmatization costs he would suffer otherwise, and, therefore, his ex-ante expected cost associated with committing crime in the first period is unchanged. However, by expunging his record, the ex-offender restores his reputation, and, therefore, has more to lose by committing crime in the third period. Thus, he is less likely to commit crimes in the future, which implies an increase in the specific deterrence of this type. In sum, there is no loss in the general deterrence of a type t^* individual, but, there are positive specific deterrence effects.

A corollary is that, types with slightly smaller criminal tendencies (e.g. types with $t^* - \varepsilon$) face slightly smaller ex-ante costs associated with committing crime in the first period, because their reservation prices for expungements are slightly higher than the expungement price. This causes a negative general deterrence effect for these individuals. However, when ε is small, these general deterrence reductions are smaller than the discrete increase in specific deterrence caused by expungements (due to reductions in the probability of committing crime in the third period from q^R to q^E). Hence, the expungement price can be chosen high enough to make sure that the variation in the reservation prices of individuals who purchase expungements (i.e. $X^{\underline{t}} - X^{t^*}$) is small enough to make negative general deterrence effects smaller than the specific deterrence effect for each type. In theory, this can be achieved by starting with an expungement price at which no individual purchases expungements, and subsequently driving the price down until only a small fraction of individuals purchase expungements.

It is also worth noting that as the density of types close to $\underline{t}$ increases, the amount of general deterrence that needs to be sacrificed (to increase the

specific deterrence of a targeted measure of individuals) is reduced. To see this, note that when expungements are priced at $X^{\underline{t}+\delta}$, there is an increase in the specific deterrence of all individuals with $t \in [\underline{t}, \underline{t}+\delta]$ compared to the case where there are no expungements. Call the proportion of these individuals α. The amount of general deterrence that needs to be sacrificed to increase the specific deterrence of these α individuals, depends on the size of δ. Thus, if one alters $g(.)$, the density function over types, to assign greater weight to types around $\underline{t}$, and one simultaneously reduces δ to keep $\int_{\underline{t}}^{\underline{t}+\delta} g(t)dt = \alpha$ constant, one reduces the amount of general deterrence that must be sacrificed to generate specific deterrence for a measure of α people. Thus, as $g(.)$ is altered and δ is lowered towards zero in this manner, the continuous case converges towards the discrete case considered in proposition 2 where no general deterrence needs to be sacrificed to increase the specific deterrence of α individuals.

4. Normative Implications

4.1. Optimal Deterrence

The analysis in section 3 is purely positive, i.e. it is concerned only with the incentives and behavior of individuals. However, because it is typically desirable to reduce crime, the normative implication is generally straightforward: Expungements ought to be used to minimize crime. In fact, this conclusion always follows if one does not include criminals' benefits in the social welfare calculus, as suggested by Stigler (1970), since then the objective becomes the minimization of social harm caused by crime. However, if one includes criminal benefits in the social welfare function, under some circumstances, criminal punishment may result in what is called over-deterrence in the literature, i.e. the deterrence of behavior that generates greater benefits (b) to the actor than the harm (h) it causes to society. If over-deterrence is a possibility, then it is *a priori* unclear whether reducing crime through the use of expungements is optimal. Next, I outline under what circumstances over-deterrence may become a problem, and explain how using expungements may be socially desirable even in those circumstances.

Although I have assumed that p, s_1 and s_2 are exogenously given, the existing economic models of law enforcement show that it is generally optimal to choose a low p and increase s_1 and s_2 as much as possible, because it is typically more expensive to increase p than s_1 and s_2. (Polinsky and Shavell (2007) extensively surveys this literature). Thus, the previous literature generally assumes that there is a maximum sanction, w, that s_1 and s_2 may not exceed. The result is that, absent expungements, sanctions are set at the maximal level, and the optimal p is determined by the trade-off between enforcement costs and gains from reducing crime. Hence, as established in Becker (1968), under-deterrence, i.e. setting sanction schemes such that people with $b < h$ commit crime, becomes optimal.

The impact of adding expungements to this model is straightforward; one reduces the cost of under-deterrence by allowing expungements at the crime minimizing price (and thereby reducing total crime) as explained in the previ-

ous parts of this article. A secondary effect is that the optimal investment in enforcement costs (i.e. investments to increase p), under plausible assumptions, is reduced through the availability of expungements, because expungements reduce under-deterrence, and therefore the benefit from increasing p. The primary result presented in the article, namely that expungements can be used to reduce crime, is unaffected by these considerations.

The foregoing arguments show that unless there are further complications, over-deterrence cannot be an issue. Further complications may exist, if punishment may somehow generate significantly asymmetric costs for individuals.[19] In the present context, punishment may generate different informal sanctions for different people. For instance, if wage reductions that result from criminal convictions depend on the person's salary and/or profession, people at higher paying jobs may suffer greater informal sanctions. In limited circumstances –identified in Mungan (2015)– these asymmetries may cause over-deterrence problems for people who suffer extraordinarily large informal sanctions from convictions. Even in these limited cases, expungements can be offered at prices which are only acceptable for people who would be over-deterred when expungements are not available (since these people have greater reservation prices for expungements). This argument is formalized in the static context in Mungan (2015) and can be combined with the multiple period analysis proposed in the current article.[20]

4.2. Better Information

One of the advantageous features of pricing expungements (formalized in Proposition 1) is that they allow separation between high and low criminal tendency people. There are arguments made in the criminology literature that criminal tendencies are correlated with character traits that third parties may value.[21] Thus, people may value the information that criminal records reveal about others' criminal tendencies, and may decide whether to make costly specific investments in others based on this information. Therefore, the separation

[19] *See, e.g.,* Shavell (1990) and Mungan (2011) where the punishment for attempts and regulation violations, respectively, have different effects on people with different likelihoods of causing harm through their violations.

[20] In fact, by plugging in (6) and (8) into (10) one can calculate the threshold first period criminal benefit draw that induces a person to commit crime in the first period as:

$$b_1^* = (1-q^N)(s_1+\sigma)+\sigma+q^R s_2 - \int_{\tau_3^R}^{\tau_3^N} btf(b)db$$

For people with $\sigma > s_2 - s_1$, this expression is greater than τ_3^E, implying that the first period level of over-deterrence without expungements is greater than the third period level of over-deterrence for people with expunged records. Moreover, since $p < 1$, the number of instances in which over-deterrence becomes a problem for people with expunged records is even smaller. Thus, over-deterrence can be mitigated with expungements in the three period model presented in this article as well.

[21] *See, e.g.,* Hirschi and Gottfredson (1990), which identifies self-control as an important determinant of criminal or deviant behavior. Another strand of the literature finds correlation between counter-productive behavior at work and self-control (Marcus and Schuler (2004) and Bechtoldt et al. (2007)).

induced by pricing expungements can result in greater returns from these investments by providing less noisy information about people with records to third parties. This is certainly true when expungements are costly enough to induce only those individuals with very low criminal tendencies to seal their records. Because, then, an expungement amounts to transferring a person with the lowest criminal tendency from the group of people with records to the group of people without records. This reduces the variance of the type distribution in both groups, and, thereby increases the value of information provided by criminal records. However, if third parties care about the information provided by criminal records (or lack thereof), they may adjust their behavior towards exconvicts based on the quality of the information provided by those records, and, therefore, the equilibrium magnitude of stigma may respond to the expungement regime. An assumption underlying the analysis in section 3 is that the magnitude of informal sanctions does not depend on the availability of expungements. Next, I consider the impact of relaxing this assumption.

4.3. Interactions between Expungements and the Magnitude of Informal Sanctions: Stigma-Intensification

Interactions between the law enforcement regime and the magnitude of informal sanctions have been studied in Rasmusen (1996), which focuses on the job prospects of individuals. Rasmusen considers employers who offer individuals wages equal to the average productivity of the group they belong to (i.e. people with records vs. people without records). In Rasmusen's adverse selection model,[22] people with higher criminal tendencies have lower productivity, and, therefore, people with records have a lower average productivity in equilibrium. Thus, the difference between the wages for people with records and without records determines the magnitude of stigma. The analysis is slightly complicated by the cyclical relationship between the magnitude of stigma and the criminal behavior of potential offenders: stigma is a function of employers' wage offers which depend on the criminal behavior of the different types of potential offenders; and the behavior of potential offenders, in turn, depends on the magnitude of stigma that emerges as a result of employers' decisions. Hence, the equilibrium magnitude of stigma is obtained when the stigma imposed equals the stigma anticipated by offenders. To compactly express this condition, let $\mathbf{B}(\sigma^a)$ be the behavior distribution of potential individuals as a function of the magnitude of stigma they anticipate (σ^a), and let $\sigma^e(\mathbf{B})$ be the amount of stigma that emerges as a function of the behavior of potential offenders. Then, the equilibrium magnitude of stigma (σ^*) is characterized by $\sigma^e(\mathbf{B}(\sigma^*)) = \sigma^*$.

Insights from Rasmusen's model can be used to make simple conjectures regarding the effects of allowing expungements at high prices in which only the very low criminal tendency individuals purchase them.[23] The effect of such

[22] Rasmusen (1996) also considers a moral hazard model where the commission of a crime leads to reduced productivity. The implications of the two models are very similar. In both cases, a criminal record signals a lower productivity.

[23] An important question is whether separating equilibria continue to exist when the magnitude of stigma is endogenized. The answer is affirmative, and is closely related to observations

policies is essentially to shift a proportion of individuals with low types from the category of individuals with records to the category of individuals without records. This move not only increases the average productivity of individuals without records by mixing into it more people with the lowest criminal tendencies (and therefore the highest productivity) but it also reduces the average productivity of people with records for the same reason.[24] The result is an increase in the equilibrium stigma attached to having a record.[25]

This observation implies an incidental, but potentially important effect, which may be called *stigma-intensification*: allowing expungements essentially reduces the number of individuals stigmatized, but, increases the magnitude of stigmatization.[26] Stigma intensification further contributes to the crime reducing aspect of expungements by increasing the general deterrence of high types.[27] To see this, note that the crime rate (as derived in (13)) among individuals with $t > t^*$ is given by:

$$\theta^t = \theta_1^t + p\theta_1^t q^R + q^N(1 - p\theta_1^t) \tag{16}$$

An increase in σ^* caused by stigma intensification affects θ^t only through its

made in Jovanovic (1982) which shows that the unravelling effect observed in Milgrom (1981) and Grossman (1981) can be avoided through costly signals.

The intuition is best illustrated by focusing on a pooling equilibrium obtained when the expungement price is set just low enough to induce all types to purchase the expungement. Starting from this equilibrium and slightly increasing the price of expungements causes the highest types to refrain from purchasing expungements (since $\frac{\partial X^t(\sigma^a)}{\partial t} < 0$, they are the first ones to switch their behavior). This change in behavior, in turn, increases the equilibrium level of stigma, because it increases the proportion of high tendency individuals with records. Thus, the equilibrium measure of high types, who switch behavior (from expunging to not expunging), is exactly that which equates the increase in expungement prices to the increase in the equilibrium stigma. Hence, a new, separating equilibrium is obtained, where only individuals with the highest criminal tendencies do not purchase expungements.

[24] Similar observations are made in Iacobucci (2014) and Mungan (2016b) in which the magnitude of reputational sanctions are determined endogenously.

[25] Under the assumptions in Rasmusen's adverse selection model, the stigma implied by employers' wage offers can be expressed as

$$\sigma^e(B(\sigma^a)) = \frac{\int(1 - z(t))\kappa(t)g(t)dt}{\int(1 - z(t))g(t)dt} - \frac{\int z(t)\kappa(t)g(t)dt}{\int z(t)g(t)dt}$$

where $z(t)$ is the proportion of type t individuals with records, $\kappa(t)$ is the productivity of individuals as a function of their types, and the first and second term are, respectively, the average productivity of individuals without records (i.e. η) and with records (i.e. λ). Pricing expungements to induce only people with the lowest criminal tendencies to purchase expungements causes an increase [decrease] in $z(\underline{t})$ in the former [latter] group. This causes an upward shift in σ^e, and, therefore, the equilibrium magnitude of stigma is increased.

[26] The opposite of this phenomenon, namely stigma dilution, is formalized in Mungan (2016a) in a different context. The rationale behind stigma dilution in that context is similar: increasing the number of people who are stigmatized leads to a reduction in the magnitude of stigma.

[27] For types $t < t^*$, stigma restoration also mitigates the general deterrence reducing effect of allowing expungements by increasing the cost of obtaining a record in the third period. However, reducing the price of expungements still produces net losses in the general deterrence of these individuals.

impact on θ_1^t and q^N. Thus, the over-all effect of an increase in σ^* is:

$$\frac{\partial \theta^t}{\partial \sigma^*} = \frac{\partial \theta_1^t}{\partial \sigma}(1 + p(q^R - q^N)) + \frac{\partial q^N}{\partial \sigma}(1 - p\theta_1^t) < 0 \tag{17}$$

since $q^R > q^N$, $\frac{\partial \theta_1^t}{\partial \sigma} < 0$ and $\frac{\partial q^N}{\partial \sigma} < 0$.

This result may be somewhat surprising. How is it that an increase in stigma does not lead people with high criminal tendencies to commit crime more often by further worsening their labor market opportunities? It is true that a prior, unexpunged, record worsens a person's external benefits, and, thus, may induce him to commit crime more often, but, only relative to his pre-record-self. In other words, the amount of stigma broadens the gap between a person's pre-record and post-record inclinations ($q^R - \theta_1^t$) to commit crime, but by reducing θ_1^t, and not by increasing q^R (i.e. $\partial q^R/\partial \sigma = 0$). This is essentially because stigma is a fixed cost, which does not affect the behavior of people who have already obtained records.[28]

4.4. Non-monetary Payments and Installments for Expungement

Throughout previous sections, I referred to the *price* of expungements, which naturally brings to mind a system where expungements are purchased with money. A regime of this type may make it impossible for liquidity constrained low criminal tendency individuals to purchase expungements, and this may adversely affect some of the desirable features of the expungement regime proposed. These problems can be mitigated by using non-monetary alternatives to allow a defendant to signal his future productivity and therefore his higher willingness to pay for an expungement. In fact, in many jurisdictions people have the opportunity to do community service to enter diversion programs. Hence, there are alternative methods, besides the paying of a fine, through which the defendant can incur the cost of an expungement. These methods can be used to reduce the impact that a person's wealth may have on his ability to expunge his record.

One problem with non-monetary payments is that they are, at least partially, non-transferable: one person's loss is not an equal gain for another person. Thus, the presence of liquidity constrained individuals is likely to cause some additional welfare costs due to non-transferability and/or other frictions. These costs, too, would have to be traded-off against the welfare gains from reducing crime.

5. Conclusion

Underlying the commentary and legal scholarship on expungements and other forms of criminal record sealing practices seems to be the idea that people who have made unusual mistakes or have committed crimes under very rare circumstances deserve a second chance. This article demonstrates that it is exactly

[28] A model that incorporates additional considerations may perhaps imply a positive relationship between the amount of stigma and the propensity of a person in category R to commit crime. These additional effects would have to more than off-set the crime reduction effect expressed in (17) to cause ambiguities regarding the impact of costly expungements on deterrence described in the previous section.

this group of individuals who should be willing to make substantial sacrifices to obtain a second chance. Thus, the criminal justice system can separate people based on their criminal tendencies by making expungements costly. This type of pricing not only gives people with low criminal tendencies a second chance, but also reduces crime by generating specific deterrence. These features of making it costly to expunge criminal records should be taken into account in policy debates surrounding new reform proposals regarding expungements.

Appendix

Proof: (i) Plugging in (13) into (15) and noting, per (12), that $q^S(X,t) = \begin{cases} q^E \text{ if } X \leq X^t \\ q^R \text{ if } X > X^t \end{cases}$, reveals that Θ can be expressed as:

$$\Theta(X) = \begin{array}{l} \int_{\underline{t}}^{\overline{t}} (\theta_1^t(1+p(q^E-q^N))+q^N)g(t)dt \text{ if } X < X^{\overline{t}} \\ \int_{\underline{t}}^{t^*} (\theta_1^t(1+p(q^E-q^N))+q^N)g(t)dt + \int_{t^*}^{\overline{t}} (\theta_1^t(1+p(q^R-q^N))+q^N)g(t)dt \text{ if } X \in (X^{\underline{t}}, X^{\overline{t}}] \\ \int_{\underline{t}}^{\overline{t}} (\theta_1^t(1+p(q^R-q^N))+q^N)g(t)dt \text{ if } X \geq X^{\underline{t}} \end{array} \quad \text{(P.2.)}$$

where $t^*(X)$, the type who is indifferent between expunging his record and not expunging his record at price X, is defined by manipulating (7) as

$$t^*(X) = \frac{(1-pq^E)\sigma - X}{\int_{ps_2}^{p(s_2+\sigma)} (b-ps_2)f(b)db} \text{ for all } X \in (X^{\underline{t}}, X^{\overline{t}}] \quad \text{(P.3.)}$$

(P.2.) implies that

$$\Theta^N \equiv \Theta(X) \text{ is a constant for all } X \geq X^{\underline{t}} \quad \text{(P.4.)}$$

On the other hand, for all $X \in (X^{\underline{t}}, X^{\overline{t}}]$,

$$\frac{d\Theta(X)}{dX} = p\theta_1^{t^*}(q^R(t^*)-q^E(t^*))g(t^*) - pf(b_1^{t^*})\int_{\underline{t}}^{t^*}(1+p(q^E-q^N))g(t)dt \quad \text{(P.5.)}$$

since $\frac{dt^*}{dX} = -1$ as implied by (P.3.), and $\frac{d\theta_1^t}{dX} = f(b_1^{t^*})\frac{C_X}{C_{b_1}} = -f(b_1^{t^*})p$, as implied by (10), (11) and the fact that $\theta_1^t = 1 - F(b_1^t)$. Thus, $\frac{d\Theta(X)}{dX} > 0$, if

$$A(t^*(X)) \equiv \theta_1^{t^*}(q^R(t^*)-q^E(t^*))g(t^*) - f(b_1^{t^*})\int_{\underline{t}}^{t^*}(1+p(q^E-q^N))g(t)dt > 0 \quad \text{(P.6.)}$$

It follows that $A(t^*(X^{\underline{t}})) = A(\underline{t}) = \theta_1^{\underline{t}}(q^R(\underline{t}) - q^E(\underline{t}))g(\underline{t}) > 0$, and therefore, there exists $\varepsilon > 0$ such that $A(t^*(X)) > 0$ for all X such that $X^l \equiv X^{\underline{t}} - \varepsilon \leq X$. Thus, $\Theta(X) < \Theta^N$ (as defined in (P.4.)) for all $X \in [X^l, X^{\underline{t}})$.

(ii) The crime minimizing expungement price, X^*, is in the interval $[X^{\bar{t}}, X^{\underline{t}})$, due to part (i) and, because, as is evident from (P.2.), $\frac{d\Theta(X)}{dX} < 0$ for all $X < X^{\bar{t}}$. Thus, when expungements cost X^*, all ex-convicts of types $t \in [\underline{t}, t^*(X^*)]$ are specifically deterred, since $q^S(t) = q^E(t) < q^R(t)$ for all $t \in [\underline{t}, t^*(X^*)]$. Similarly, $\theta_1^t(X^*) > \theta_1^t(X^P)$ for all $t \in [\underline{t}, t^*(X^*)]$ and all $X^P > X^{\underline{t}}$, which means that there is a loss in general deterrence. ■

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