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Aniruddha Bagchi
Kennesaw State University, abagchi@kennesaw.edu

Siddhartha Bandyopadhyay
University of Birmingham

Research Article

Aniruddha Bagchi and Siddhartha Bandyopadhyay*

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Abstract: We examine the relationship between the incidence of workplace deviance (on-the-job crime) and the state of the economy. A worker's probability of future employment depends on whether she has been deviant as well as on the availability of jobs. Using a two period model we show that the net impact on deviant behavior to changes in unemployment can go either way depending upon the nature of the equilibrium. Two kinds of equilibria are possible. In one, a non-deviant's probability of being employed increases as expected market conditions improve which lowers the incentive to be a deviant. In contrast, in the other kind of equilibrium, the deviant's probability of being employed increases when market conditions improve which increases the incentive to be a deviant. In either case, there is a setup cost to deviant behavior and the attractiveness of incurring that increases with an increase in expected probability of future employment which unambiguously increases the incentive to be deviant. In the first kind of equilibrium, the two effects counteract each other, while in the second they reinforce each other. Finally, we characterize conditions under which an increase in optimism, i.e. a reduction in the probability of facing a recession unambiguously increases deviant behavior.

Keywords: crime, recession, dynamic deterrence
JEL Classification: D84, E32, J63, K42

1 Introduction

In this paper we examine whether there is any relationship between workplace deviance (on-the-job crime) and the state of the economy i.e. does such behavior increase or decrease with the anticipation of a recession? This "deviant behavior" could be in the form of shirking at work, stealing from the firm, sabotage, harassing other workers etc. Deviant behavior has consequences for a firm's

***Corresponding author: Siddhartha Bandyopadhyay,** Department of Economics, University of Birmingham, Birmingham B152TT, UK, E-mail: s.bandyopadhyay@bham.ac.uk
Aniruddha Bagchi, Coles College of Business, Kennesaw State University, Kennesaw, GA 30144, USA, E-mail: abagchi@kennesaw.edu

profitability. Further, while a deviant employee enjoys current benefits from such behavior, it affects her future employment prospects if caught. Currently, there is no consensus in the literature about whether deviant behavior in the workplace increases or decreases with the state of the economy, nor is there a cogent theoretical framework to analyze such behavior.[1] Popular newspaper accounts suggest that the recent recession may have increased employee theft. For instance an article by Needleman (2008) in the Wall Street Journal suggests employee theft has increased in the recession. In the UK, KPMG's fraud barometer (KPMG 2010) for January 2010 shows employee fraud in book keeping and accounting on the rise in the recent recession. However, one of the few scholarly studies on employee theft (Rickman and Witt 2007) shows strong evidence of employee theft decreasing as unemployment increased in the UK for the period 1999–2000. This suggests that the answer to the question may well depend on the nature or severity of recession and there could well be opposing forces at work in a recession. Further, (as we elaborate below) shirking which is another measure of workplace deviance also does not appear to unambiguously increase or decrease with recession. In order to provide an answer to this question, we build a dynamic model which analyzes how the current market condition as well as expectations about future market conditions affect the intertemporal tradeoffs that people make in deciding how to behave in their current workplace.

We treat workplace deviance as a type of on-the-job crime committed by rational criminal economic agents who derive benefit from their deviant behavior but incur costly sanctions if caught. Thus, we can analyze it using the framework in Becker's (1968) analysis of crime, though as we discuss, the framework would need to be extended to take into account expectations about future market conditions. To see this, recall that in a standard Beckerian model, if people can choose between work and crime, the impact of unemployment increases crime as it lowers the opportunity cost of crime.[2] However, when we modify the model to take account of the fact that

1 There is an introductory discussion in Cook and Zarkin (1985) on the ambiguous relationship between crime and the business cycle. They also provide some empirical evidence that the relationship between crime and the business cycle is counter-cyclical. However, their analysis does not specifically deal with on-the-job crime or labor effort. There has also been some work on the long run relationship between crime and the business cycle using U.K. time series data e.g., Pyle and Deadman (1994) but not for on-the-job crimes.

There is also some literature using an experimental set up of sabotage in the workplace (Harbring and Irlenbusch 2011) when relative performance is used to evaluate workers.

2 Becker's work has been extended to examine several aspects of crime such as examining how economic and law enforcement factors affect crime, including the possibility of multiple equilibria as in Sah (1991), Fender (1999), Burdett, Lagos, and Wright (2003) and Burdett, Lagos, and Wright (2004). There has also been some empirical analysis of crime and unemployment (though

people can both work and commit crime which is what we need to consider when analyzing workplace deviance, the state of the economy plays no role in a standard static framework. Instead, workplace deviant behavior is entirely determined by the probability of apprehension and the severity of punishment. However, once we take into account that being caught in deviant behavior has implications for future employment, the state of the economy plays an important role, albeit a complex one.

To see this, we note two effects that act in opposite directions-deviant behavior today causes lowered chances of employment tomorrow but employment prospects additionally also depend on the general state of the economy tomorrow. Intuitively, if the general state of the economy is such that employment prospects are bleak in the future, loss of employment may not act as much of a deterrent and thus people would commit more on-the-job crime (including shirking) when expecting an economic downturn as the opportunity cost of such behavior goes down with a lowered expected wage in the labor market. However, working against that is the fact that when jobs have to be cut, managers may fire the least productive workers, that is, workers with "bad" records may find it harder to get jobs in a recession which makes the marginal value of abstaining from deviant behavior higher in a tight labor market. Further, indulging in workplace crime may incur a setup cost and may be worth paying only if the potential criminal has a chance to benefit from incurring this one time cost. The direction of the net effect is thus far from clear and we identify two types of regimes where there are different impacts of future market conditions on current workplace behavior. Thus we identify how the state of the economy affects firm profitability not only through well recognized channels such as the strength of demand, wage rates etc. but also through its effect on workplace behavior.

While there are no precise estimates of workplace deviance, the empirical evidence on labor effort and the state of the economy is mixed. Some papers find empirical evidence that labor effort increases in a recession (e.g. Franke and Kaul 1978; Stern and Friedman 1980; Wadhwani and Wall 1991; Drago and Heywood 1992; Agell 1994). Others, such as Spitz (1993) find no such relationship. Surveys conducted on managers give contradictory findings. Some believe that shirking goes down during a recession while others believe that it goes up. In an interview of 47 businesses undertaken by Bewley (1999), it was found that 42% believed labor effort goes up during a recession, while 15% believed it goes down and 42% believed it has no impact. The closest data we have on deviant behavior would be data on recorded employee theft. In a study of employee theft in the UK, Rickman and Witt (2007) find that increases in the unemployment rate decrease employee

without specific reference to on-the-job crime) such as Carmichael and Ward (2000, 2001), Doyle and Ahmed (1999) and Han, Bandyopadhyay, and Bhattacharya (2013).

theft. These contradictory findings on deviant behavior suggests the need to build a theoretical framework to provide a precise answer to the question.

We consider a model where the economy can be in a good state (boom) or a bad state (recession). Given the state of the economy, there is a probability distribution over the future state of the economy. Further, we assume that the prospects of employment depend on (a) the state of the economy and (b) one's past record. During a boom, more people are employed, so an employer may have to employ people even with a "bad" record, while during a recession the employer can afford to be more selective. This bad record can be in the form of having been caught shirking or committing an on-the-job crime including sabotage and harassing other employees. Formally, any kind of deviant behavior which will lead to a "bad" history and sanctions if caught is what we call crime. Thus while crime has benefits, it has costs in terms of sanctions if caught and a lowered probability of future employment. Further, a career in crime has set up costs, so a first time criminal additionally faces a one time fixed cost.

The current state and expectations about the future state are parameters in the model and determine current and future employment. The probability of getting a job from any state to another is however endogenously determined as it depends on current behavior. Further, current behavior in turn determines the crime rate in period 1, which determines the probability of employment in period 2. We assume for simplicity that everyone is employed in a boom, and that only a fraction of the population is employed during a recession; the severity of the recession is measured by labor demand in a recession. A more severe recession is associated with lower labor demand. Our results depend on the characteristics of the equilibrium, and in particular, we find that three possible types of regimes can exist. In one type of equilibrium (Regime 1), only a fraction of people with an unblemished record can find jobs in a recession. Everyone else is unemployed in that case. In another type of equilibrium (Regime 2), all people with an unblemished record find jobs in a recession as do a fraction of currently unemployed people. Finally, in the third type of equilibrium (Regime 3), even a fraction of workers with a bad record get jobs. We analyze what happens when the severity of recession increases, both for small shifts (which does not change the equilibrium regime) as well as for large shifts (which can change the regime). Changes in expectations i.e. changes about the probability of facing a future recession is also analyzed.

We provide an intuitive discussion of our main results. The impact of increased severity of recession (in terms of a lowered probability of finding a job if there is a recession tomorrow) in period 2 on the incentive to commit crime in period 1 depends on the proportion of the workers with a bad record (which is an endogenous variable in our model). Suppose in case of a recession tomorrow,

the equilibrium is regime 1 i.e., a situation where in a recession, no one with a criminal record finds a job, but even some employed people without a criminal record cannot find jobs. Given such an equilibrium, any worsening of the severity of the recession (while staying in regime 1) increases the incentive to commit crime in period 1. Since a person with a bad record is anyway not hired in this case, therefore, any change in the severity of the recession will not have any impact on her behavior. However, a change in the severity matters to a person who has a good record, since such a person has a lower likelihood of being employed in a more severe recession. Thus, an increase in the severity of a recession reduces the incentive to maintain a good record. Consequently, the incentive to commit crime should be higher in this case. This is similar to what is predicted by the standard Becker model.

However, it is also possible that the anticipated equilibrium is regime 3. In this case, all people without a criminal record get a job, but some people with a criminal record also get a job. In this case, an increase in the severity of a recession has an opposite effect. Since people with a good record get a job anyway, therefore, any change in the severity of the recession does not affect their behavior. However, a tightening of the labor market reduces the probability of people with bad records of getting a job. This in turn lowers the incentive to commit crime as the marginal value of staying crime free (and thus having a clean record) increases. This goes against the standard Beckerian result as the future value of staying crime free is higher in a tighter labor market where employers can be more selective about who to hire. In regime 2 there is no net impact as the changes in employment affect only the employment prospect of the currently unemployed and not of those employed in period 1.

The setup cost always reduces the incentive to commit crime if the labor market is expected to tighten in the future and will counteract the first effect in regime 1 but reinforce it in regime 3. Thus, in regimes 2 and 3, the net incentive to commit crime goes down with anticipated recession, while in regime 1 it can go either way.

Our results differ both from the theoretical prediction in the standard Becker (1968) model which implies that crime increases with an increase in unemployment as well as the theoretical (and empirical) prediction in Rickman and Witt (2007) who on the contrary find that the rate of unemployment has a negative relationship with the crime rate. Once one accounts for the future consequences of crime and trades it off against current profitability, the relationship between deviant behavior and the unemployment rate (or the severity of the recession) could be positive or negative depending on the type of recession.

In the context of the recent recession, there has been some discussion about policies that could increase confidence in the economy. This paper does not deal

with such policies but it can rather be used to determine the impact on workplace discipline if there is an increase in optimism about the future.[3] Our model predicts that an increase in optimism i.e. a decrease in the probability of recession in period 2 (holding the severity of recession constant) always increases the incentive to commit crime in period 1 as long as nearly everyone gets a job in a boom. Thus, there is a difference in the predicted impact of a change in the severity of the recession vs. a change in the degree of optimism. The impact of the former can vary depending on the character of the equilibrium, while the impact of the latter stays the same regardless of the nature of the equilibrium provided that people with bad records gain more relative to people without one.

We set up the model in the next section, solve for period 2 equilibrium in Section 3, and analyze the incentive to commit crime in period 1 in Section 4. Section 5 endogenizes the decision making process of firms and Section 6 concludes.

2 The Model

This is a two period model[4] ($t = 1, 2$) with two possible states $s \in \{H, L\}$ during each period with H representing a boom and L representing a recession or bust. Further, the state in period 1 determines the probability of the state in period 2. In particular, let $\gamma_{ss'}$ be the probability that the state in period 2 is s', given that the state in period 1 is s. For example, if the state in period 1 is H, then the probability of the state being H in period 2 is γ_{HH}, and the probability of the state being L in period 2 is γ_{HL}. It follows that,

$$\gamma_{sH} + \gamma_{sL} = 1 \text{ for } s = \{H, L\}.$$

There are a large number of potential workers in our model. We denote the employment status of a person in period t by an indicator variable Ω_t that takes a value 1 if the person is employed in period t and takes a value of 0 otherwise. At the end of a period, an employed person receives a wage w_s if the state is s.

3 Political leaders the world over have been asked to restore business confidence so that it begins to hire workers. For example, in the UK the Federation of Small Businesses (2011) point out that business confidence has fallen and suggest various policies to restore confidence.

4 While the two period formulation is a simplification, it suffices for our purpose as our aim is to study the way current crime decisions are affected by the fear of loss of future employment prospects and adding more time periods while adding complexity should not change our qualitative findings.

Further, in the spirit of several models of the labor market such as Shapiro and Stiglitz (1984), we assume that wages are lower in a recession, that is $w_L \leq w_H$.[5]

We denote labor demand in state s by e_s. Further, we assume that

$$e_H = 1$$

while

$$0.5 < e_L < 1.$$

Hence, by assumption, no one is unemployed during a boom, while a fraction $(1 - e_L)$ is unemployed during a recession.[6,7] Since the focus of the paper is to explain why the level of deviant behavior in the workplace may be non-monotonically related to the severity of the recession (as opposed to explaining the reason for business cycles), therefore, it suffices for our purpose to assume the level of employment in each state as exogenous. However, Section 5 endogenizes the hiring choice of firms and in the concluding section, we argue that the central idea of the paper would still hold if we had allowed labor demand in period 2 to depend endogenously on the crime rate in period 1.

If employed, an individual can choose to work honestly or indulge in deviant behavior. Throughout the analysis, we use the terms "crime" and "deviant behavior" interchangeably. An unemployed person cannot commit crime in our model because we consider only on-the-job crimes. In contrast, an employed person can choose to either commit a crime or to remain innocent in each period. We denote the set of actions for a generic employed individual by

$$A_t = \{C_t, I_t\}$$

where C_t denotes that the individual chose to commit a crime in period t and I_t denotes a decision to remain honest in period t. If an individual commits a crime, she derives a private benefit of $B \geq 0$ while her payoff is 0 if she chooses to be innocent. The private benefit from crime (which one may interpret as the individual's type) is heterogeneously distributed in the population in the interval $\left[0, \overline{B}\right]$ following the distribution function $G(B)$ with density function $g(B)$.

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5 The question of how to use wages or compensation contracts to deter workplace deviance is a complex issue. Examples of early work in this topic are Eaton and White (1982, 1983), Shapiro and Stiglitz (1984), Akerlof and Yellen (1986) and Bewley (1999).

6 The rationale for the assumption that $e_L > 0.5$ will be clear when we analyze the equilibrium. Essentially, this ensures that there are equilibria in which some people with a deviant record in period 1 are hired in period 2.

7 It would have made no substantial difference in the results even if we had assumed that e_H was less than 1 but greater than e_L. The implications of relaxing the assumption $e_H = 1$ are discussed in Section 4.

An individual incurs a cost of $\tau > 0$ in her first crime episode and a cost of 0 in subsequent episodes (which is a normalization). The cost τ can be thought of as a set-up cost of crime. This framework has similarities with Mocan, Billups, and Overland (2005) who allow individuals to allocate their time in the acquisition of either legal human capital or criminal human capital. As they note (see p. 660), "individuals become more skilled criminals through learning-by-doing." Deutsch, Simon, and Spiegel (1990) provide empirical evidence that there is indeed substantial learning-by-doing in criminal activity. In our model, we allow an individual to decide whether or not to acquire the criminal human capital by paying a one-time fee. The set-up cost can also include any emotional cost associated with committing crime. From the second time onwards, such a set up cost will be lower due to a lowering of the learning cost or any psychic or emotional cost associated with committing a crime. Hence, one could have assumed that the fixed cost associated with crime is τ_1 for the first instance of crime and τ_2 for the second instance such that $\tau_1 > \tau_2$. Since τ_2 would unnecessarily complicate the analysis, therefore, we assume it to be 0.

The employer imperfectly monitors actions in the workplace. Only a fraction of deviant behavior is punished with $p \in [0,1]$ being the conviction probability. We assume that the conviction probability p is exogenous. Such an assumption allows us to demonstrate the main result (that an increase in the severity of a recession need not lead to an increase in workplace deviance) in the simplest possible manner. Later on, in the concluding section, we discuss the effect of endogenizing this variable. The monetary value of a convicted person's punishment is denoted by f. It is helpful to think of this monetized value as a fine (perhaps in terms of withheld bonuses) though in the concluding section we discuss what would happen if instead the penalty took the form of imprisonment.

We assume that the enforcement agency publicly releases the record of a person. We denote the record of a person by R. The record of a person can be "bad" if an employed person is convicted, or it can be "good" if she has either not committed a crime or has not been caught in an act of crime and "no record" if a person does not have an employment history. Note once again that an unemployed person cannot be convicted in a period since we consider only on-the-job crimes.

Recall, in any period, employers hire the entire population in a boom and only a fraction e_L in a recession. Employers are profit maximizers and as we explain below, first prefer hiring previously hired workers with a good record, then prefer hiring previously unemployed persons and finally prefer previously hired workers with a bad record. Therefore, in the model, the record (and previous employment status) of a person affects her likelihood of being employed if there is a recession in period 2. In the discussion of period 2, we provide a rationale for this preference.

The utility of a person in period 2 is given by

$$U_2(A_2, s_2, B) = \Omega_2[w_{s_2} + \max\{B - \Lambda\tau - pf, 0|t = 2\}]$$

where Λ is an indicator variable that takes the value 1 for the first offense and 0 otherwise. Notice that the term $B - \Lambda\tau - pf$ is the net expected benefit from deviant behavior in period 2 while the net benefit from remaining innocent in period 2 is 0. Notice that the utility of an unemployed person in period 2 is 0 since for this person, $\Omega_2 = 0$. Similarly, the utility of an employed person in period 1 is given by

$$U_1(A_1, s_1, B) = \Omega_1[w_{s_1} + \max\{B - \tau - pf, 0\}] + E_1[U_2(A_2, s_2, B)|\Omega_1, A_1] \qquad [1]$$

where $E_1[U_2(A_2, s_2)|\Omega_1, A_1]$ is the expected utility in period 2 assuming agents take optimal actions in period 2. The optimal actions will depend on the parameters of the economy and on the action in period 1.

3 Analysis of Period 2

We first analyze an individual's optimal behavior in period 2. In period 2, an employed person commits crime for the first time if and only if expected net benefit from crime is positive

$$B - pf - \tau \geq 0$$
$$\Leftrightarrow B \geq pf + \tau \equiv B_2^*.$$

Similarly, an employed person commits crime for the second time in period 2 if

$$B \geq pf \equiv B_2^{**}.$$

Thus, it follows from the expressions above that $B_2^* > B_2^{**}$ i.e., the threshold for committing crime is lower for a person who had already committed a crime previously. This is because such a person does not have to incur the setup cost of crime again.

In order to complete the analysis for period 2, we need to specify the firm's preference between hiring *(i)* an experienced worker with a good record, *(ii)* an experienced worker with a bad record, and *(iii)* an inexperienced worker. We assume that a firm prefers *(i)* over *(iii)* and *(iii)* over *(ii)*. The firm's preference of *(i)* over *(iii)* is consistent with the observation that employers value experience because previously unemployed workers may have lost some skills due to having been out of the job market. This is what is called the "scar of unemployment" (Arulampalam 2001). As for the comparison between *(iii)* and *(ii)*, there is a tension between the higher productivity of an experienced worker

(albeit with a bad record) and the higher incentive to indulge in deviant behavior of a person who has already incurred the set up cost. We assume that the latter effect outweighs the former. In any case, what matters most for our analysis is that the firm prefers an experienced worker with a good record over an experienced worker with a bad record and the spirit of the argument would not change if we were to assume that the inexperienced workers are the least preferred category.

4 Analysis of Period 1

In order to determine U_1, we need to determine the value of $E_1[U_2(A_2, s_2, B)|\Omega_1, A_1]$. It follows from eq. [1] that the decision of a person to commit crime or to remain honest in period 2 depends on her private benefit B from crime as well as her expected cost of committing crime in period 1. Note that the expected cost of committing crime in period 1 depends on the expected employment status in period 2. In order to determine the expected utility of a person in period 2, we need to first determine the expected value of Ω_2 and this is done below.

Let $q(A_1, s_1)$ be the probability that Ω_2 takes a value of 1 in period 2 (that is, it is the probability that a worker is employed in period 2). In this model, q depends on two factors: *(i)* the action of an individual in period 1 since it stochastically affects the individual's record R, and *(ii)* the state of the economy in period 1, given by s_1, because it determines the likelihood of the state of the economy being H or L in period 2. Therefore, the utility in period 1 is given by

$$\begin{aligned} U_1(A_1, s_1, B) &= \Omega_1[w_{s_1} + \max\{B - \tau - pf, 0\}] + E_1[U_2(A_2, s_2, B)|\Omega_1, A_1] \\ &= \Omega_1[w_{s_1} + \max\{B - \tau - pf, 0\}] \\ &\quad + q(A_1, s_1)[w_L + \max\{B - \Lambda\tau - pf, 0\}] + \gamma_{s_1 H}(w_H - w_L). \end{aligned} \quad [2]$$

In the right hand side of eq. [2], the first term is the payoff that a person receives in the first period and the second and third terms capture the continuation payoffs. In period 2, the person receives at least $(w_L + \max\{B - \Lambda\tau - pf, 0\})$ if she is employed and an additional wage premium $(w_H - w_L)$ if there is a boom in period 2. The chance of being employed in period 2 is $q(A_1, s_1)$ and the chance of a boom is $\gamma_{s_1 H}$. Hence, the sum of the second and third terms capture the continuation payoff in period 2, conditional on information available in period 1.[8]

8 The fact that employment prospects tomorrow depends on behavior today is consistent with the theory that it is optimal to treat repeat offenders disadvantageously (see Polinksy and Shavell 1998).

It follows from eq. [2] that if a person commits a crime in period 1 i.e., if $A_1 = C$, then the benefit from the crime is B plus a lowered cost of committing crime next period (i.e. τ won't have to be incurred next period) while the cost from the crime depends on $\tau + pf$ as well as on the changed probability of employment because of committing crime in period 1 given by $q(I, s_1) - q(C, s_1)$ which captures the additional benefit of being crime free.

An individual commits a crime in period 1 if her private benefit from crime is greater than or equal to a threshold level and she does not commit a crime if her private benefit is below that threshold level. We refer to this threshold level as the *marginal criminal type*. Let $\tilde{B}$ denote the marginal criminal type. Then the following conditions must be satisfied: *(i)* the benefit from committing crime must be equal to the cost of committing crime of the marginal criminal, *(ii)* the benefit from committing crime must be less than the cost of committing crime if the private benefit is less than the marginal criminal type, and *(iii)* the benefit from committing crime must be greater than the cost of committing crime if the private benefit is greater than the marginal criminal type. This is illustrated in Figure 1. As shown in the diagram, the marginal criminal type $\tilde{B}$ is indifferent between committing a crime and remaining innocent.

We denote the cost of crime when the benefit is B, the marginal criminal is $\tilde{B}$ and the state is s_1 by

$$\Delta_{s_1}(B, \tilde{B}) \equiv \tau + pf + q(I, s_1)[w_L + \max\{B - \tau - pf, 0\}] - q(C, s_1)[w_L + \max\{B - pf, 0\}].$$

Note that $\Delta_{s_1}(B, \tilde{B})$ depends on the parameters τ, p and f as well as the change in probability of being employed in period 2 for being deviant in period 1. The right hand side of the above expression will be explained in detail later.

Let $\lambda(\tilde{B})$ be the proportion of the workforce (or the workers employed in period 1) with a bad record at the beginning of period 2 given that the marginal

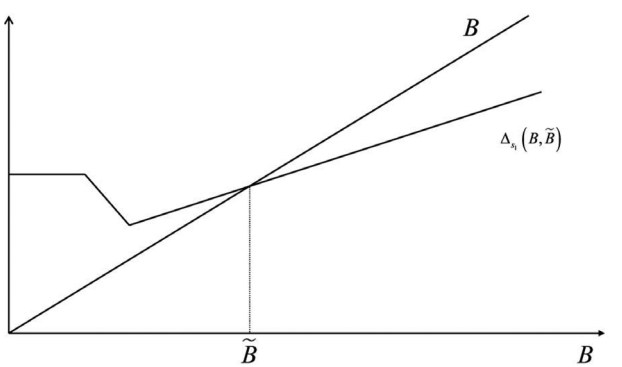

Figure 1: This diagram compares the cost of crime with its benefit given that the type of the marginal criminal is $\tilde{B}$.

criminal type is $\tilde{B}$. Hence, it is given by the product of the probability of being caught and the probability of having a benefit high enough to commit crime i.e.

$$\lambda(\tilde{B}) \equiv p[1 - G(\tilde{B})].$$

Similarly, the proportion of workforce (or the workers employed in period 1) with a good record is

$$1 - \lambda(\tilde{B})$$

if the marginal criminal type is $\tilde{B}$. Let the state in period 1 be s_1 where $s_1 = H, L$. Hence, if the marginal criminal type in period 1 is $\tilde{B}$, then the fraction of the population with no record is

$$1 - e_{s_1},$$

the fraction of the population with a good record is

$$(1 - \lambda(\tilde{B}))e_{s_1},$$

while the fraction of the population with a bad record is

$$\lambda(\tilde{B})e_{s_1}.$$

We now determine the probability of being employed in period 2.

4.1 Probability of Employment in Period 2

If there is a boom in period 2, then everyone is employed regardless of record. However, if there is a recession in period 2, then only a fraction of the population can gain employment and hence, in this case, a person's record matters. Suppose there is a recession in period 2. Then, three kinds of regimes can occur: (a) Only a fraction of the population with a good record is employed (Regime 1), (b) all individuals with a good record are employed and only a fraction of those with no record are employed (Regime 2), and (c) all individuals with a good record or no record are employed, while only a fraction of individuals with a bad record are employed (Regime 3). Given the marginal criminal type $\tilde{B}$, Regime 1 occurs if

$$(1 - \lambda(\tilde{B}))e_{s_1} \geq e_L,$$

i.e. the number of people not convicted in period 1 is greater than labor demand in a recession. Hence, only a fraction of employed people without a criminal record in period 1 are employed in period 2. Given that these are the most preferred employees, no other category of workers is employed.

Regime 2 occurs if

$$\left(1-\lambda\left(\tilde{B}\right)\right)e_{s_1}+\left(1-e_{s_1}\right)\geq e_L > \left(1-\lambda\left(\tilde{B}\right)\right)e_{s_1},$$

i.e., after employing all workers without a criminal record, only some of the workers unemployed in period 1 (given by $1-e_{s_1}$) are employed. No convicted person in period 1 is employed in period 2. Regime 3 occurs if

$$e_L > \left(1-\lambda\left(\tilde{B}\right)\right)e_{s_1}+\left(1-e_{s_1}\right). \qquad [3]$$

i.e., in this case, even some period 1 convicts are hired as labor demand exceeds the number of people without a record as well as the number of unemployed. In particular, when there is a boom in period 1, then Regime 1 occurs if the marginal criminal type $\tilde{B}$ is such that $\left(1-\lambda\left(\tilde{B}\right)\right)\geq e_L$, Regime 2 does not occur at all (since there are no unemployed people in period 1 if it is a boom) and Regime 3 occurs if $e_L > \left(1-\lambda\left(\tilde{B}\right)\right)$. By definition, $\lambda\left(\tilde{B}\right)$ is a decreasing function of $\tilde{B}$, and hence, $\left(1-\lambda\left(\tilde{B}\right)\right)$ is an increasing function of $\tilde{B}$. Therefore, when there is a boom in period 1, then Regime 1 occurs for relatively high values of $\tilde{B}$ and Regime 3 occurs for relatively low values of $\tilde{B}$. This is depicted in the upper panel of Figure 2. Further, when there is a recession in period 1, then Regime 1 does not occur at all (since in regime 1 there are no people unemployed in period 1), Regime 2 occurs if the marginal criminal type $\tilde{B}$ is such that $\left(1-\lambda\left(\tilde{B}\right)\right)\geq 2-\frac{1}{e_L}$ and Regime 3 occurs if $2-\frac{1}{e_L} > \left(1-\lambda\left(\tilde{B}\right)\right)$.[9] Therefore, when there is a recession in period 1, then Regime 2 occurs for relatively high values of $\tilde{B}$ and Regime 3 occurs for relatively low values of $\tilde{B}$. This is depicted in the bottom panel of Figure 2.

The probability of being employed in period 2 depends upon the action of an individual in period 1, the state in period 1 and the appropriate regime in which the equilibrium occurs in period 1. These probabilities are presented in Table 1. We now explain these probabilities. First, consider the probability $q(C,H)$ of being employed in period 2 if there is a boom in period 1 and an individual commits a crime in period 1. Such an individual will have a bad record with probability p and a good record with probability $(1-p)$. Suppose Regime 1 occurs, that is, during a recession only a fraction of the individuals with a good record are employed and the others are not employed. An individual who committed a crime in period 1 will be employed in period 2 only when there is either a boom in period 2 or a recession in period 2 and this individual was not convicted in period 1. In the latter case, this individual can be employed only if she is assigned to a job from amongst the pool of workers

9 Note that $2-\frac{1}{e_L}\leq e_L$ because $(1-e_L)^2\geq 0$.

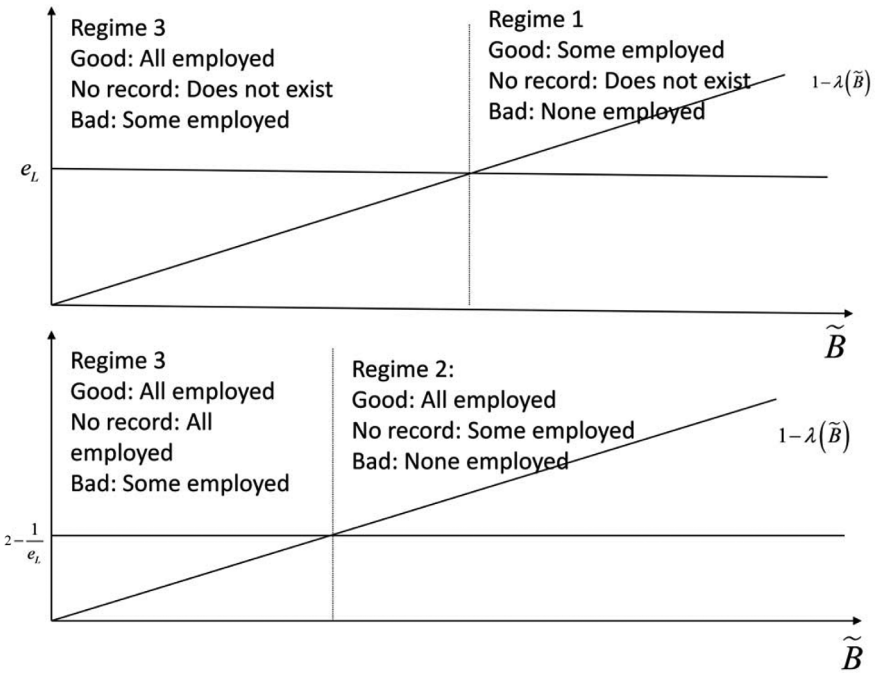

Figure 2: The upper panel shows the different regimes when there is a boom in period 1 followed by a recession in period 2. The bottom panel shows the different regimes when there is a recession in both periods.

Table 1: The probability of being employed in period 2 as a function of the action and state in period 1.

$q(A_1, s_1)$	Regime 1	Regime 2	Regime 3
$q(C, H)$	$\gamma_{HH} + \gamma_{HL}(1-p)\frac{e_L}{1-\lambda(\tilde{B})}$	–	$1-\gamma_{HL}p\frac{1-e_L}{\lambda(\tilde{B})}$
$q(I, H)$	$\lambda_{HH} + \gamma_{HL}\frac{e_L}{1-\lambda(\tilde{B})}$	–	1
$q(C, L)$	–	$1-\gamma_{LL}p$	$1-\gamma_{LL}p\frac{1-e_L}{\lambda(\tilde{B})e_L}$
$q(I, L)$	–	1	1

with a good record. Conditional on a good record the probability of being employed is given by the ratio of employment slots (e_L) and the number of people with a good record ($1-\lambda(\tilde{B})$). The probability of a boom in period 2 is γ_{HH} and the probability of this individual being employed with a good record

during a recession is given by the joint probability of a recession (γ_{HL}) and not being caught ($1-p$). Thus, the probability of employment if the state is L in period 2 conditional on crime in period 1 is given by $\gamma_{HL}(1-p)\frac{e_L}{1-\lambda(\tilde{B})}$. Hence, $q(C,H)=\gamma_{HH}+\gamma_{HL}(1-p)\frac{e_L}{1-\lambda(\tilde{B})}$ under Regime 1. In contrast, under Regime 3, during a recession, only a fraction of individuals with a bad record are unemployed while the others are all employed. If an individual commits a crime, then the joint probability of a recession and the individual having a bad record is $\gamma_{HL}p$. Notice that the number of "unemployment spots" is $(1-e_L)$ and these have to be rationed among the number of individuals with a bad record given by $\lambda(\tilde{B})$. Hence, the probability that an individual with a bad record will be unemployed in a recession is $\frac{1-e_L}{\lambda(\tilde{B})}$ and consequently, $q(C,H)=1-\gamma_{HL}p\frac{1-e_L}{\lambda(\tilde{B})}$. Similarly, we obtain the other expressions. The probabilities are plotted as a function of the marginal criminal type in Figure 3.

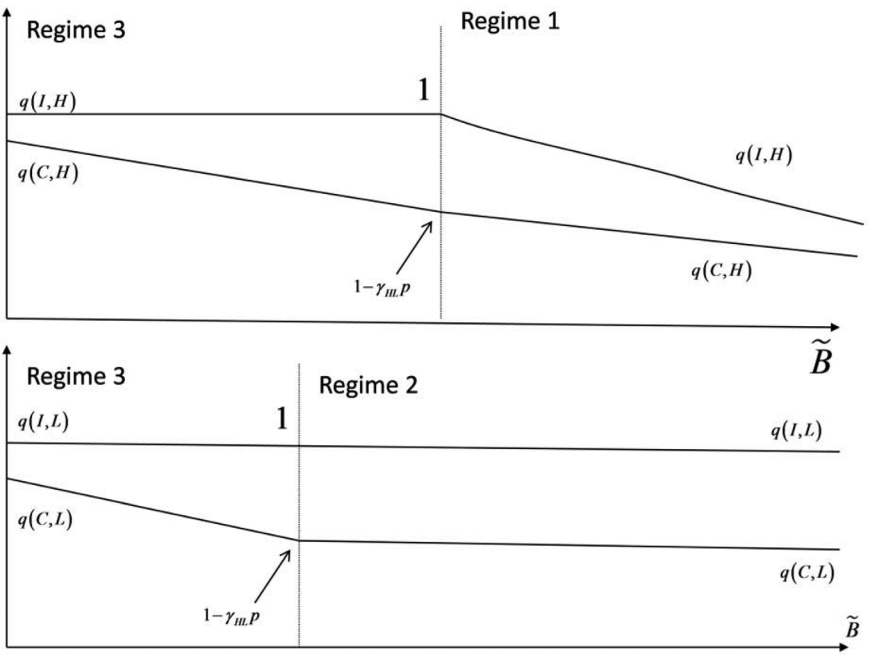

Figure 3: The upper panel shows the probability of being employed in period 2 if there is a boom in period 1. The lower panel shows the probability of being employed in period 2 if there is a recession in period 1.

4.2 Equilibrium if There Is a Boom in Period 1

Suppose that there is a boom in period 1. Now consider the decision of an employed worker in period 1 whose private benefit is B'. Recall that the marginal criminal type has benefit $\tilde{B}$. If a person with private benefit B' decides to commit a crime, then her continuation utility is given by

$$U_1\left(C,H,B'\right) = w_H + B' - \tau - pf + q(C,H)[w_L + \max\{B - pf, 0\}] + \gamma_{HH}(w_H - w_L)$$

where $q(C,H) = \gamma_{HH} + \gamma_{HL}(1-p)\frac{e_L}{1-\lambda\left(\tilde{B}\right)}$ if the marginal criminal type $\tilde{B}$ belongs to Regime 1 and $q(C,H) = 1 - \gamma_{HL}p\frac{1-e_L}{\lambda\left(\tilde{B}\right)}$ if the marginal criminal type $\tilde{B}$ belongs to Regime 3. Similarly, her continuation utility if she decided to remain innocent in period 1 is

$$U_1\left(I,H,B'\right) = w_H + q(I,H)[w_L + \max\{B - \tau - pf, 0\}] + \gamma_{HH}(w_H - w_L).$$

where $q(I,H) = \gamma_{HH} + \gamma_{HL}\frac{e_L}{1-\lambda\left(\tilde{B}\right)}$ if the marginal criminal type belongs to Regime 1 and $q(I,H) = 1$ if the marginal criminal type belongs to Regime 3. Now consider a worker with private benefit $B' > \tilde{B}$. Such a worker must prefer to commit a crime instead of remaining innocent. Hence the following inequality must hold for $B' > \tilde{B}$:

$$U_1\left(C,H,B'\right) > U_1\left(I,H,B'\right),$$

that is,

$$\begin{aligned} B' > \Delta_H\left(B',\tilde{B}\right) \equiv \tau + pf + q(I,H)\left[w_L + \max\left\{B' - \tau - pf, 0\right\}\right] \\ - q(C,H)\left[w_L + \max\left\{B' - pf, 0\right\}\right]. \end{aligned}$$

In the expression above, the term $\Delta_H\left(B',\tilde{B}\right)$ captures the cost of committing a crime when a worker has a private benefit of B' and the marginal criminal type is $\tilde{B}$, given that $s_1 = H$. Similarly, if a worker has private benefit $B'' < \tilde{B}$, then she prefers to remain innocent instead of committing a crime, that is the following inequality must hold:

$$B'' < \Delta_H\left(B'',\tilde{B}\right).$$

Finally, if a worker has the private benefit of $\tilde{B}$, then she is indifferent between committing a crime and remaining innocent. Therefore, the following equality must hold for an employed worker with type $\tilde{B}$:

$$\tilde{B} = \Delta_H\left(\tilde{B},\tilde{B}\right) \equiv \tau + pf + q(I,H)\left[w_L + \max\left\{\tilde{B} - \tau - pf, 0\right\}\right] - q(C,H)\left[w_L + \max\left\{\tilde{B} - pf, 0\right\}\right], \quad [4]$$

that is, at $\tilde{B}$ the following equality must be satisfied:

$$\tilde{B} - \Delta_H\left(\tilde{B},\tilde{B}\right) = 0.$$

In eq. [4], the term

$$\theta_H\left(\tilde{B}\right) \equiv q(I,H)\left[w_L + \max\left\{\tilde{B} - \tau - pf, 0\right\}\right] - q(C,H)\left[w_L + \max\left\{\tilde{B} - pf, 0\right\}\right] \quad [5]$$

is known as the *dynamic deterrence* effect.[10] This effect is the opportunity cost of crime because it captures the future payoff that a worker has to sacrifice if she commits a crime in period 1.[11]

We now determine the impact of a change in the labor demand e_L during a recession on the dynamic deterrence effect. This allows us to analyze the relationship between the severity of a recession and the incentives to commit crime. For the discussion below, it will be helpful to use a notation that captures the marginal criminal's utility in period 2 if she is employed in period 2 and is paid the minimum wage of w_L. Therefore, let $V_2(A_1)$ be the utility of the marginal criminal if she took an action A_1 in period 1, is employed in period 2 and is paid the minimum wage of w_L. Thus,

$$V_2(A_1 = C) = w_L + \max\left\{\tilde{B} - pf, 0\right\}$$

denotes the utility of the marginal criminal in period 2 if she is hired in period 2 but had committed a crime in period 1, while

$$V_2(A_1 = I) = w_L + \max\{B - \tau - pf, 0\}$$

denotes the utility of the marginal criminal in period 2 if she is hired in period 2 and if she had not committed a crime in period 1.

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10 The way the term dynamic deterrence is used is similar in spirit to Imai and Krishna (2004) i.e. "current criminal activity adversely affects future employment outcomes". See discussion in the concluding section for the tradeoff this implies in terms of optimal punishment.

11 Notice that in our model, an individual worker is insignificant compared to the entire workforce; hence, each worker takes the crime rate as given and determines her optimal action. This would not have been the case if we had considered deviant behavior by unions, such as strikes. The reason is that unions would have the power to shift the equilibrium crime rate, while an individual worker takes the crime rate as given.

The expression for $\theta_H(\tilde{B})$ given above is not very convenient for our purpose. Hence, we manipulate the expression in eq. [5] and obtain the following decomposition:

$$\begin{aligned}\theta_H(\tilde{B}) = &\{q(I,H) - q(C,H)\}V_2(A_1 = I) \\ &- q(C,H)\{V_2(A_1 = C) - V_2(A_1 = I)\}.\end{aligned} \quad [6]$$

Notice that the terms $q(C,H)$, $q(I,H) - q(C,H)$, $V_2(A_1 = I)$ and

$$V_2(A_1 = C) - V_2(A_1 = I) \quad [7]$$

are all non-negative. To explain briefly, $q(I,H) - q(C,H)$ is the change in probability of employment conditional on an unblemished record in period 1 while

$$V_2(A_1 = I)$$

is the net utility in a single period for a person contemplating crime for the first time. Thus, $\{q(I,H) - q(C,H)\}V_2(A_1 = I)$ is (proportional to) the net benefit of staying crime free in period 1 in terms of utility obtained in period 2, i.e., it is the increased probability of employment conditional on not committing crime multiplied by the utility of a person who does not commit crime in period 1. On the other hand, by not committing crime, the worker forgoes an advantage in terms of lowered second period utility as she has to pay an additional cost in period 2 if she commits a crime in period 2. That is captured by

$$q(C,H)\{V_2(A_1 = C) - V_2(A_1 = I)\}.$$

Thus the net benefit of staying crime free depends on the improved probability of employment and the increased cost of committing crime in the second period.

4.2.1 Impact of a Decrease in the Severity of a Recession

We now consider the impact of a decrease in the severity of a recession. In our model, this is captured by an increase in the labor demand during a recession e_L from e_L^0 to e_L^1; $e_L^1 > e_L^0$. Consider the upper panel of Figure 2. Notice that the boundary between the regimes is determined by the intersection of $1 - \lambda(\tilde{B})$ and e_L. Therefore, if e_L goes up from e_L^0 to e_L^1, the boundary shifts to the right. Pick a value of $\tilde{B}$ and notice that any of three possible outcomes can occur because of the rightward shift of the boundary between Regime 1 and Regime 3: The marginal criminal type $\tilde{B}$ lies (a) to the right of the boundary (in Regime 1) both for $e_L = e_L^0$ as well as for $e_L = e_L^1$, (b) to the left of the boundary (in Regime 3) both for $e_L = e_L^0$ as well as for $e_L = e_L^1$, and (c) to the right of the boundary (in Regime 1) for

$e_L = e_L^0$ and to the left of the boundary (in Regime 3) for $e_L = e_L^1$. Observe that an increase in e_L leads to a regime change only for the third case. We now analyze how $\Delta_H\left(B, \tilde{B}\right)$ changes in response to an increase in e_L.

First consider (a). In this case, the marginal criminal type $\tilde{B}$ changes but the equilibrium remains in Regime 1 both for $e_L = e_L^0$ as well as for $e_L = e_L^1$. Suppose a person decides to remain innocent at some level of benefit B. Then there are two impacts on her continuation utility: *(i)* She has a higher probability of being employed in period 2. *(ii)* Conditional on being employed, the utility of an innocent person in period 2 is less than the utility of a criminal (that occurs because of the set up cost of crime, given by τ).

In Regime 1, an increase in e_L increases $q(C,H)$ but it increases $q(I,H)$ by more. Hence, if we are in Regime 1 both before and after a change in e_L, then an increase in e_L leads to an increase of both $q(C,H)$ and $q(I,H) - q(C,H)$. An increase in $q(I,H) - q(C,H)$ implies that the additional probability of being hired in period 2 conditional on having a good record (as opposed to a bad record) increases and this enhances *(i)* mentioned above. Therefore, following eq. [6], an increase in $q(I,H) - q(C,H)$ increases the incentive to stay innocent in period 1 by increasing dynamic deterrence. There is however a second effect described by *(ii)* above that dampens dynamic deterrence. To see this, notice that a person who remained innocent in period 1 is at a disadvantage in period 2 compared to a person who committed a crime previously. The magnitude of this disadvantage is given by eq. [7]. An increase in e_L leads to an increase in $q(C,H)$ which is the weight on the *disadvantage factor* and this enhances the power of *(ii)*. Consequently, following eq. [6], an increase in $q(C,H)$ increases the incentive to commit a crime in period 1 by decreasing dynamic deterrence.[12] In summary, in this case, the incentive to commit crime can go either way.

We now consider (b), that is the case in which the equilibrium is Regime 3 both for $e_L = e_L^0$ as well as for $e_L = e_L^1$. In this case, an increase in e_L increases $q(C,H)$ and has no impact on $q(I,H)$. As discussed above, a decrease in $q(I,H) - q(C,H)$ decreases the incentive to remain innocent in period 1 and an increase in $q(C,H)$ reinforces the same effect. Hence, dynamic deterrence decreases and this decreases $\Delta_H\left(B, \tilde{B}\right)$. Hence, the cutoff value of B for the marginal criminal type goes down unambiguously. This implies that in this case, a reduction in the severity of a recession leads to an increase in crime.

12 Note, we are interested in the dynamic deterrence effect or the incentive to commit crime rather than the crime rate as changes in employment affect the total number of employed workers so the number of people who commit crime could (for example) increase because there are more people who can commit on the job crime if e_L has increased even if the incentive to commit crime goes down i.e. $\tilde{B}$ goes up.

Finally, we consider (c), that is the case in which one shifts from Regime 1 for $e_L = e_L^0$ to Regime 3 for $e_L = e_L^1$. In this case, $q(C,H)$ changes from

$$\gamma_{HH} + \gamma_{HL}(1-p)\frac{e_L^0}{1-\lambda(\tilde{B})}$$

to

$$1 - \gamma_{HL}p\frac{1-e_L^1}{\lambda(\tilde{B})}.$$

Observe from Figure 3 that $\frac{e_L^0}{1-\lambda(\tilde{B})} < 1$ because e_L^0 belongs to Regime 1. Further, since e_L^1 belongs to Regime 3, therefore, $\frac{e_L^1}{1-\lambda(\tilde{B})} > 1$ from which it follows that $\frac{1-e_L^1}{\lambda(\tilde{B})} < 1$ as well. Hence, let

$$\frac{e_L^0}{1-\lambda(\tilde{B})} = 1 - \epsilon_0;\ \epsilon_0 > 0,$$

and

$$\frac{1-e_L^1}{\lambda(\tilde{B})} = 1 - \epsilon_1;\ \epsilon_1 > 0.$$

Therefore, the change in $q(C,H)$ is given by

$$\begin{aligned}
&\left\{1 - \gamma_{HL}p\frac{1-e_L^1}{\lambda(\tilde{B})}\right\} - \left\{\gamma_{HH} + \gamma_{HL}(1-p)\frac{e_L^0}{1-\lambda(\tilde{B})}\right\} \\
&= \{1 - \gamma_{HL}p(1-\epsilon_1)\} - \{\gamma_{HH} + \gamma_{HL}(1-p)(1-\epsilon_0)\} \\
&= \gamma_{HL}\{(1-p)\epsilon_0 + p\epsilon_1\} > 0.
\end{aligned}$$

Hence, an increase in e_L leads to an increase in $q(C,H)$ and this decreases the dynamic deterrence effect. The corresponding change for $q(I,H)$ is given by

$$\begin{aligned}
&1 - \gamma_{HH} - \gamma_{HL}\frac{e_L^0}{1-\lambda(\tilde{B})} \\
&= \gamma_{HL}\epsilon_0 > 0.
\end{aligned}$$

Hence, the change in $q(I,H) - q(C,H)$ is given by

$$\begin{aligned}
&\gamma_{HL}\epsilon_0 - \gamma_{HL}\{(1-p)\epsilon_0 + p\epsilon_1\} \\
&= \gamma_{HL}p(\epsilon_0 - \epsilon_1).
\end{aligned}$$

Notice that the above expression has an ambiguous sign. If this is negative, then the dynamic deterrence effect goes down unambiguously. However, the expression above can be positive as well in which case the net impact on dynamic deterrence can be positive. To summarize, if e_L^0 is such that the equilibrium is

Regime 1 and e_L^1 is such that the equilibrium is Regime 3, then a reduction in the severity of the recession has an ambiguous effect on crime.

The following proposition summarizes the three cases discussed above.

Proposition 1 *Suppose there is a boom in period 1. (a) If the equilibrium belongs to regime 1 both before and after an increase in e_L, the net impact on crime can go either way. (b) If the equilibrium belongs to regime 3 both before and after an increase in e_L, then it increases the incentive to commit crime. (c) If the equilibrium belongs to regime 1 to begin with and after an increase in e_L it moves to regime 3, then an increase in e_L can cause crime to go either way.*

It is also interesting to examine how Proposition 1 would change if the set-up cost of crime τ was assumed to be 0. In order to determine the answer to this question, first note from eq. [7] that

$$V_2(A_1 = C) - V_2(A_1 = I) = 0$$

whenever $\tau = 0$. Hence, in this case,

$$\theta_H(\tilde{B}) = \{q(I,H) - q(C,H)\}V_2(A_1 = I).$$

When e_L increases, then $V_2(A_1 = I)$ does not change but $q(I,H) - q(C,H)$ does. Therefore, by applying similar reasoning as above, we obtain the following corollary:

Corollary 1 *Suppose $\tau = 0$. Also let there be a boom in period 1. (a) If the equilibrium belongs to regime 1 both before and after an increase in e_L, then it decreases the incentive to commit crime. (b) If the equilibrium belongs to regime 3 both before and after an increase in e_L, then it increases the incentive to commit crime. (c) If the equilibrium belongs to regime 1 to begin with and after an increase in e_L it moves to regime 3, then an increase in e_L can cause crime to go either way.*

When $\tau = 0$, then we have a sharper prediction in case (a). Thus, when $\tau = 0$, the impact on crime is unambiguous within a regime, but this is not the case across regimes, because an increase in e_L changes the incentive to commit crime quite differently in cases (a) and (b). In addition, the result in (c) stays the same even when $\tau = 0$.

4.2.2 Impact of a Differential Treatment of Workers Based upon Past Record

One possibility that has not been considered so far is that in period 2, firms may treat workers differently depending upon their past record. Indeed, one may expect

an employer to pay less to a worker who has a bad record in period 1, or to monitor such a worker more stringently, or to impose a higher fine on a repeat offender. The ultimate impact of such a policy is to reduce $V_2(A_1 = C)$ compared to what we obtained in the section above. For small reductions in $V_2(A_1 = C)$, we will still have $V_2(A_1 = C) > V_2(A_1 = I)$ as in the sections above, and Proposition 1 continues to hold. The interesting change occurs when $V_2(A_1 = C) < V_2(A_1 = I)$. This assumption is maintained only for the remainder of this subsection. To analyze this case, it is convenient to re-write the dynamic deterrence term $\theta_H(\tilde{B})$ as follows:

$$\theta_H(\tilde{B}) = \{q(I,H) - q(C,H)\}V_2(A_1 = I) + q(C,H)\{V_2(A_1 = I) - V_2(A_1 = C)\}.$$

We now examine how the marginal criminal type $\tilde{B}$ changes with an increase in e_L from e_L^0 to e_L^1. Notice that a change in e_L changes only the terms $(q(I,H) - q(C,H))$ and $q(C,H)$. Now consider Case (a) as above. In this case, the marginal criminal type $\tilde{B}$ changes but the equilibrium is Regime 1 both for $e_L = e_L^0$ as well as for $e_L = e_L^1$. Note that an increase in e_L leads to an increase of both $q(C,H)$ and $(q(I,H) - q(C,H))$, and consequently, the dynamic deterrence effect increases. Consequently, $\tilde{B}$ increases and the incentive to commit crime goes down unambiguously. This is similar to the result obtained in Corollary 1 (but different from Proposition 1). Next, consider (b), that is the case in which the equilibrium is Regime 3 both for $e_L = e_L^0$ as well as for $e_L = e_L^1$. In this case, an increase in e_L increases $q(C,H)$ but $q(I,H)$ remains constant. Consequently, the dynamic deterrence effect goes down and the incentive to commit crime increases unambiguously.[13] This is same as the result obtained in Proposition 1 (and Corollary 1). Finally, consider (c), that is the case in which one shifts from Regime 1 for $e_L = e_L^0$ to Regime 3 for $e_L = e_L^1$. In this case, there is an increase in $q(C,H)$ but the effect on $(q(I,H) - q(C,H))$ is ambiguous. Hence, a decrease in the severity of the recession may shift the incentive to commit crime either way. This is also same as in Proposition 1 (and Corollary 1). In summary, a decrease in the severity of a recession can have an ambiguous effect on the incentive to commit crime, even if firms treat workers with a bad record more harshly.

4.2.3 Impact of an Increase in Optimism

We now consider an increase in optimism about the future, given that there is a boom in period 1. In our model, an increase in optimism given that $s_1 = H$ is captured by an increase in γ_{HH} from γ_{HH}^0 to γ_{HH}^1; $\gamma_{HH}^1 > \gamma_{HH}^0$. Notice that this leads

13 The easiest way to draw this conclusion is by observing eq. [5].

to a decrease in γ_{HL} from γ_{HL}^0 to γ_{HL}^1; $\gamma_{HL}^1 < \gamma_{HH}^0$, because $\gamma_{HH} + \gamma_{HL} = 1$. Recall that the boundary between the regimes is determined by the intersection of $1 - \lambda(\tilde{B})$ and e_L. Hence, there cannot be any regime change in this case because an increase in γ_{HH} does not shift the boundary. Therefore, we consider two cases in which the marginal criminal type lies to the (a) right of the boundary in Regime 1 or (b) to the left of the boundary in Regime 3.

First, consider the case in which the marginal criminal type lies in Regime 1. To analyze this case, note that $\frac{e_L}{1-\lambda(\tilde{B})} < 1$ in Regime 1. Hence, an increase in γ_{HH} and a corresponding decrease in γ_{HL} leads to an increase in $q(C,H)$ and this increases the incentive to commit crime. Further, $q(I,H) - q(C,H)$ is given by $\gamma_{HL} p \frac{e_L}{1-\lambda(\tilde{B})}$ and this decreases because of the reduction in γ_{HL}. Note that the latter effect also works in the same direction. Hence, an increase in γ_{HH} increases crime by reducing dynamic deterrence.

Next, consider the case in which the marginal criminal type lies in Regime 3. In this case, an increase in γ_{HH} and a corresponding decrease in γ_{HL} leads to an increase in $q(C,H)$ and this increases the incentive to commit crime. It can also be checked that $q(I,H) - q(C,H)$ goes down as well and this also reinforces the incentive to commit crime. Hence, in this case also, an increase in γ_{HH} increases crime by reducing dynamic deterrence.

We summarize these findings below.

Proposition 2 *Suppose there is a boom in period 1. An increase in optimism leads to an increase in crime.*

The key reason why Proposition 2 holds is that in our model,

$$\frac{\partial q(C,H)}{\partial \gamma_{HH}} > \max\left\{\frac{\partial q(I,H)}{\partial \gamma_{HH}}, 0\right\}. \quad [8]$$

The above inequality means that an increase in optimism about the future benefits workers who commit a crime more than workers who choose to remain innocent. As long as eq. [8] holds, Proposition 2 will continue to hold. However, the result can be overturned if that is not the case. To examine this issue, it is instructive to consider a slightly altered model than the one considered in the paper. In this altered model, assume that if there is a boom in period 2, then workers with a good record still find employment in period 2 with probability 1 but those with a bad record are employed in period 2 with probability $\phi(\tilde{B})$; $\phi(\cdot) \leq 1$.

Suppose the marginal criminal type lies in Regime 1. Then,

$$q(C,H) = \gamma_{HH}\left[(1-p) + p\phi(\tilde{B})\right] + \gamma_{HL}(1-p)\frac{e_L}{1-\lambda(\tilde{B})}$$

and

$$q(I,H) = \gamma_{HH} + \gamma_{HL}\frac{e_L}{1-\lambda(\tilde{B})}.$$

Therefore,

$$q(I,H) - q(C,H) = \gamma_{HH}p(1-\phi(\tilde{B})) + \gamma_{HL}p\frac{e_L}{1-\lambda(\tilde{B})}.$$

It then follows that

$$\frac{\partial q(C,H)}{\partial \gamma_{HH}} = p\phi(\tilde{B}) + (1-p)\left[1 - \frac{e_L}{1-\lambda(\tilde{B})}\right] \quad [9]$$

and

$$\frac{\partial q(I,H)}{\partial \gamma_{HH}} - \frac{\partial q(C,H)}{\partial \gamma_{HH}} = p\left[1 - \phi(\tilde{B}) - \frac{e_L}{1-\lambda(\tilde{B})}\right]. \quad [10]$$

It follows from eq. [9] that $\frac{\partial q(C,H)}{\partial \gamma_{HH}} > 0$. However, the expression in eq. [10] has an indeterminate sign. If $\phi(\tilde{B})$ is close enough to 1, then eq. [10] is negative and eq. [8] is satisfied. Consequently Proposition 2 continues to hold. However, if $\phi(\tilde{B})$ is sufficiently smaller than 1, then eq. [10] can be positive. In this case [8] is violated and the effect of an increase in optimism on the incentive to commit crime can go either way. A similar conclusion holds if the marginal criminal type lies in Regime 3.

4.3 Equilibrium if There is a Recession in Period 1

Suppose there is a recession in period 1. As before, let the marginal criminal type be $\tilde{B}$. If a worker has the private benefit of $\tilde{B}$, then she is indifferent between committing a crime and remaining innocent. Therefore, the following inequality must hold for an employed worker with type $\tilde{B}$:

$$\begin{aligned}\tilde{B} = \Delta_L(\tilde{B},\tilde{B}) \equiv \tau + pf \\ + q(I,L)V_2(A_1 = I) - q(C,L)V_2(A_1 = C).\end{aligned} \quad [11]$$

As before for $\tilde{B}$ to be the marginal criminal it must be that:

$$\tilde{B} - \Delta_L(\tilde{B},\tilde{B}) = 0.$$

In eq. [11], the term

$$\theta_L(\tilde{B}) \equiv q(I,L)V_2(A_1 = I) - q(C,L)V_2(A_1 = C) \quad [12]$$

is the *dynamic deterrence* effect. We determine the impact of a reduction in the severity of a recession on the dynamic deterrence effect. To do so, we manipulate the expression in eq. [12] and obtain the following decomposition:

$$\theta_L(\tilde{B}) = \{q(I,L) - q(C,L)\}V_2(A_1 = I) \\ - q(C,L)\{V_2(A_1 = C) - V_2(A_1 = I)\}.$$

Notice that the terms $q(C,L)$, $q(I,L) - q(C,L)$, $V_2(A_1 = I)$ and

$$V_2(A_1 = C) - V_2(A_1 = I)$$

are all non-negative.

4.3.1 Impact of a Decrease in the Severity of a Recession

We now consider the impact of a decrease in the severity of a recession. As before, this is captured by an increase in the labor demand during a recession e_L from e_L^0 to e_L^1; $e_L^1 > e_L^0$. As discussed immediately after eq. [3], the boundary between the regimes is determined by the intersection of $1 - \lambda(\tilde{B})$ and $2 - \frac{1}{e_L}$. Therefore, if e_L goes up from e_L^0 to e_L^1, the boundary shifts to the right. Pick a value of $\tilde{B}$ and notice that any of three possible outcomes can occur because of the rightward shift of the boundary between Regime 2 and Regime 3: The candidate value of the marginal criminal type $\tilde{B}$ lies (a) to the right of the boundary (in Regime 2) both for $e_L = e_L^0$ as well as for $e_L = e_L^1$, (b) to the left of the boundary (in Regime 3) both for $e_L = e_L^0$ as well as for $e_L = e_L^1$, and (c) to the right of the boundary (in Regime 2) for $e_L = e_L^0$ and to the left of the boundary (in Regime 3) for $e_L = e_L^1$. Observe that an increase in e_L leads to a regime change only for the third case. Below, we consider how $\Delta_L(B, \tilde{B})$ changes in response to an increase in e_L.

First consider (a). In this case, the equilibrium belongs to Regime 2 both for $e_L = e_L^0$ as well as for $e_L = e_L^1$. In Regime 2, an increase in e_L has no impact on either $q(C,L)$ or on $q(I,L)$. Hence, if the marginal criminal type belongs to Regime 2, then an increase in e_L has no impact on $\Delta_L(B, \tilde{B})$ and hence, there is no change in the equilibrium level of the marginal criminal type. Consequently, in this case, a decrease in the severity of a recession has no impact on crime.

We now consider (b), that is the case in which we are in Regime 3 both for $e_L = e_L^0$ as well as for $e_L = e_L^1$. In this case, an increase in e_L increases $q(C,L)$ but has no impact on $q(I,L)$. As discussed above, a decrease in $q(I,L) - q(C,L)$

decreases the incentive to remain innocent in period 1. Further, an increase in $q(C,L)$ reinforces the same effect. Hence, dynamic deterrence decreases and this decreases $\Delta_L\left(B,\tilde{B}\right)$. Consequently, the equilibrium level of the marginal criminal type goes down unambiguously, that is, crime (adjusted for employment level) increases.

Finally, we consider (c), that is the case in which the equilibrium is in Regime 2 for $e_L = e_L^0$ and shifts to Regime 3 for $e_L = e_L^1$. This implies that when e_L increases from e_L^0 to e_L^1, then $q(I,L) - q(C,L)$ changes from

$$\gamma_{LL} p$$

to

$$\gamma_{LL} p \frac{1 - e_L^1}{\lambda\left(\tilde{B}\right) e_L^1}.$$

Observe from Figure 3 that since e_L^1 belongs to Regime 3, therefore, $2 - \frac{1}{e_L} > \left(1 - \lambda\left(\tilde{B}\right)\right)$, from which it follows that $\frac{1-e_L^1}{\lambda\left(\tilde{B}\right)e_L^1} < 1$. This implies that $q(I,L) - q(C,L)$ decreases when e_L increases from e_L^0 to e_L^1 and this decreases the incentive to remain innocent in period 1. Further, $q(C,L)$ increases from

$$1 - \gamma_{LL} p$$

to

$$1 - \gamma_{LL} p \frac{1 - e_L^1}{\lambda\left(\tilde{B}\right) e_L^1}$$

and this reinforces the same effect. Therefore, when e_L increases from e_L^0 to e_L^1, then dynamic deterrence decreases and this decreases $\Delta_L\left(B,\tilde{B}\right)$. Consequently, the marginal criminal type i.e. $\tilde{B}$ goes down unambiguously. To summarize, if e_L^0 belongs to Regime 2 and e_L^1 belongs to Regime 3, then a reduction in the severity of the recession increases crime (adjusted for employment level).

We summarize the analysis with the following proposition

Proposition 3 *Suppose there is a recession in period 1. (a) If the equilibrium belongs to regime 2 both before and after an increase in e_L, then there is no impact on crime. (b) If the equilibrium belongs to regime 3 both before and after a change in e_L, then an increase in e_L increases crime (adjusted for the level of employment in period 1). (c) If the equilibrium belongs to regime 2 to begin with and after a change in e_L it moves to regime 3, then an increase in e_L increases crime (adjusted for the level of employment in period 1).*

4.3.2 Impact of an Increase in Optimism

We now consider an increase in optimism about the future, given that there is a recession in period 1. In our model, an increase in optimism given that $s_1 = L$ is captured by an increase in γ_{LH} from γ_{LH}^0 to γ_{LH}^1; $\gamma_{LH}^1 > \gamma_{LH}^0$. Notice that this leads to a decrease in γ_{LL} from γ_{LL}^0 to γ_{LL}^1; $\gamma_{LL}^1 < \gamma_{LH}^0$, because $\gamma_{LH} + \gamma_{LL} = 1$. Recall that the boundary between the regimes is determined by the intersection of $1 - \lambda(\tilde{B})$ and $2 - \frac{1}{e_L}$. Hence, there cannot be any regime change in this case because an increase in γ_{LH} does not shift the boundary. Therefore, we consider two cases in which the marginal criminal type lies to the (a) right of the boundary in Regime 2 or (b) to the left of the boundary in Regime 3.

First, consider the case in which the marginal criminal type lies in Regime 2. In this case, a decrease in γ_{LL} leads to an increase in $q(C, L)$ and this increases the incentive to commit crime. Further, $q(I, L) - q(C, L)$ is given by $\gamma_{LL}p$ and this decreases. Note that the latter effect also works in the same direction. Hence, an increase in γ_{LH} increases crime by reducing dynamic deterrence.

Next, consider the case in which the marginal criminal type lies in Regime 3. In this case, a decrease in γ_{LL} leads to an increase in $q(C, L)$ and this increases the incentive to commit crime. It can also be checked that $q(I, L) - q(C, L)$ goes down as well and this also reinforces the incentive to commit crime. Hence, in this case also, an increase in γ_{LH} increases crime by reducing dynamic deterrence.

We summarize these findings below.

Proposition 4 *Suppose there is a recession in period 1. An increase in optimism leads to an increase in crime.*

As in Proposition 2, one can see that the key reason why Proposition 4 holds is that in our model,

$$\frac{\partial q(C, L)}{\partial \gamma_{LH}} > \max\left\{\frac{\partial q(I, L)}{\partial \gamma_{LH}}, 0\right\}. \quad [13]$$

The above inequality means that an increase in optimism about the future benefits workers who commit a crime more than workers who choose to remain innocent. As long as eq. [13] holds, Proposition 4 will continue to hold. However, the result can be overturned if that is not the case. In order to show this, consider the altered model described after Proposition 2. In that altered model, it is assumed that if there is a boom in period 2, then workers with a good record still find employment in period 2 with probability 1 but those with a bad record are employed in period 2 with probability $\phi(\tilde{B})$; $\phi(\cdot) \leq 1$.

Suppose the marginal criminal type lies in Regime 3. Then, it can be shown that

$$\frac{\partial q(C,L)}{\partial \gamma_{LH}} = p\left[\phi\left(\tilde{B}\right) + \frac{1-e_L}{\lambda\left(\tilde{B}\right)e_L} - 1\right] \quad [14]$$

and

$$\frac{\partial q(I,L)}{\partial \gamma_{LH}} = 0.$$

It follows from eq. [14] that $\frac{\partial q(C,H)}{\partial \gamma_{LH}}$ has an indeterminate sign. If $\phi\left(\tilde{B}\right)$ is close enough to 1, then eq. [14] is positive and therefore eq. [13] is satisfied. Consequently, Proposition 4 holds. However, if $\phi\left(\tilde{B}\right)$ is sufficiently smaller than 1, then eq. [14] is negative. In this case eq. [13] is violated and an increase in optimism decreases the incentive to commit crime. Hence, the crime rate goes down in this case. It can also be shown that if the marginal criminal type lies in Regime 2, then Proposition 4 continues to hold even with the altered model.

5 Robustness Checks: Endogenizing the Employment Decision

In the discussion above, the decision making process of the firms were not explicitly modeled. In this section, we therefore endogenize the employment decision of the firms and consider its impact on the main results of the paper.

Consider a perfectly competitive industry with a large number of identical firms. For this industry, the (inverse) demand curve is

$$p = \alpha - q$$

and the supply curve is

$$p = \beta + q.$$

Hence, in equilibrium, the price and aggregate quantity are

$$p^* = \frac{1}{2}(\alpha - \beta) \text{ and } q^* = \frac{1}{2}(\alpha + \beta).$$

The parameter α varies according to the state of the economy. In particular, it takes a value of α_H during a boom and α_L during a recession; $\alpha_H > \alpha_L$. Each worker produces one unit of output.

In each period, the aggregate employment depends on the state of the economy in that period and the record of the workers. Consider period 1. The gross value of marginal product (excluding deviance costs) of each worker is

$$\frac{1}{2}(\alpha_{s_1} - \beta)$$

where s_1 is the state in period 1. In this period, all workers are identical since none of them have any record. However, the firms can anticipate that the probability that a worker will engage in deviant behavior in period 1 is $\lambda(\tilde{B})$. Suppose a firm incurs a loss of m for each instance of deviance. Then, the net value of marginal product of a worker in period 1 is

$$\frac{1}{2}(\alpha_{s_1} - \beta) - \lambda(\tilde{B})m.$$

The net value of marginal product curve is depicted by the horizontal lines in Figure 4. The supply curve of labor is determined by a function $w(e)$ where e is the level of employment. The labor supply curve is determined by the labor leisure choice of individual workers; $w'(e) > 0$.

The employment in the economy is determined by the intersection of the net marginal product curve and the labor supply curve. We assume that

$$\alpha_H \geq \beta + 2(m + w(1)). \qquad [15]$$

This ensures that everyone (including those with a bad record) is employed if there is a boom in period 1, that is,

$$e_1(H, \tilde{B}) = 1.$$

If there is a recession in period 1, then it follows from Figure 4 that some workers are unemployed and the rate of employment depends positively on $\tilde{B}$, that is

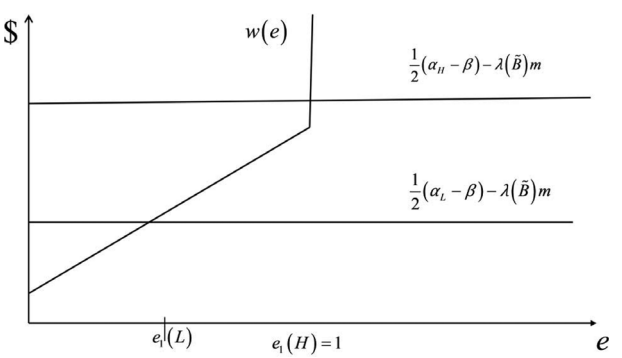

Figure 4: The net value of marginal product of a firm is given by the horizontal line whose height depends on the state of the economy. The supply curve of labor is given by $w(e)$.

$$e_1(L,\tilde{B}) < 1 \text{ and } \frac{\partial e_1(L,\tilde{B})}{\partial \tilde{B}} > 0.$$

Let $w_1(s_1,\tilde{B})$ denote the wage rate in period 1 if the state is s_1 and the marginal criminal type is $\tilde{B}$. Notice that

$$\frac{\partial w_1(s_1,\tilde{B})}{\partial \tilde{B}} > 0,$$

that is, in period 1, the wage rate decreases with the incentive to commit crime. This is different from the previous model with exogenous firms because that model assumes that the wage rate depends on the state of the economy but not the crime rate.

Now consider period 2. The net value of marginal product in period 2 is a step function. This function attains its highest value for experienced workers with a good record, followed by inexperienced workers, followed by experienced workers with a bad record. The wage rate is determined by the intersection of the wage schedule with the net value of marginal product schedule. As long as eq. [15] holds, it can be shown that everyone will be employed if there is a boom in period 2. Following similar lines, it can be shown that

$$e_2(L,\tilde{B}) < 1, \frac{\partial e_2(L,\tilde{B})}{\partial \tilde{B}} > 0$$

and

$$\frac{\partial w_2(s_2,\tilde{B})}{\partial \tilde{B}} > 0.$$

In period 2, the employment rate in a recession as well as the wage rate depends on the marginal criminal types in both periods. However, the marginal criminal type in period 2 will have no role to play in the analysis, therefore, we suppress it. In this model, the wage rates in the two periods can be different, even for the same state. This model will also require a modification of Figure 2 because $e_2(L,\tilde{B})$ is now an increasing function of $\tilde{B}$, instead of being a constant function. However, there are still two regimes (for each initial state). A decrease in the severity of a recession in this model is captured by an increase in α_L and we show below that in this model, such a change has similar effects as in Propositions 1 and 3.

Suppose there is a boom in period 1. In this model, the dynamic deterrence effect is still given by a similar expression as eq. [6] with the differences being as follows: *(i)* In the expressions for $V_2(\cdot)$, we replace w_L with $w_2(L,\tilde{B})$, and *(ii)* in the expressions for $q(C,H)$ and $q(I,H)$, we replace e_L with $e_2(L,\tilde{B})$.

First, consider the case in which the equilibrium is Regime 1 before and after the increase in α_L. An increase in α_L increases $e_2(L,\tilde{B})$ and $w_2(L,\tilde{B})$. These changes in turn increase $(q(I,H)-q(C,H))$, $q(C,H)$, and $V_2(A_1=I)$ but leaves $[(V_2(A_1=C)-V_2(A_1=I))]$ unchanged. Hence, it follows that both terms of the dynamic deterrence effect eq. [6] increase. Consequently, the net effect of an increase in α_L can go either way. This result is same as in Proposition 1.

Next, consider the case in which the equilibrium is Regime 3 before and after the increase in α_L. An increase in α_L decreases $(q(I,H)-q(C,H))$, increase $q(C,H)$ and $V_2(A_1=I)$ but leaves $[(V_2(A_1=C)-V_2(A_1=I))]$ unchanged. Hence, it follows that second term of the dynamic deterrence effect eq. [6] increases, while the first term can go either way. Consequently, the net effect of an increase in α_L in this case can go either way. This result differs from Proposition 1 but it is consistent with the central idea of the paper that a decrease in the severity of a recession can cause the incentive to commit crime go either way.

One can similarly derive the effect of an increase in α_L when there is a regime change.

6 Extensions and Concluding Remarks

We have presented an intertemporal model of workplace deviance or on-the-job criminal behavior to analyze the way this varies with the state of the economy. There is a dearth of theoretical work in this area which tries to model workplace deviant behavior in relation to the state of the economy. Even the empirical literature is limited in this area and the little information that we have via managerial interviews (as mentioned in Section 1) has contradictory findings with some suggesting shirking increases in a recession while others believe that it decreases. This paper fills a void in the literature by modeling this phenomenon and finds that the relationship is ambiguous and whether deviant behavior goes up or down in a recession depends on the strength of competing effects.

It is plausible that deviant behavior in the workplace affects labor productivity. One example of deviant behavior is shirking. If there is an increase in shirking, then this decreases the average productivity of workers. Similarly, other kinds of deviant behavior such as bullying is not conducive for a productive working environment. This paper demonstrates that the decision to be deviant which affects productivity of workers depends non-monotonically on the state of the economy. Our results are robust to endogenous hiring choice by firms.

A number of assumptions were made in the model. We briefly discuss the implications of relaxing them for our results. First, we assume that the conviction probability is exogenous. Let us consider very briefly the effect of endogenizing the variable. One can conjecture that an employer is likely to expend more resources on monitoring when the equilibrium crime rate is high (that is when $\tilde{B}$ is low) and vice-versa. Thus, it must be the case that $p'(\tilde{B}) < 0$. By definition, the proportion of workers with a bad record is given by

$$\lambda(\tilde{B}) \equiv p(\tilde{B})\left[1 - G(\tilde{B})\right]$$

and this term will still be negatively related with $\tilde{B}$ although the absolute value of the slope will be greater when we allow for an endogenous $p(\tilde{B})$. In terms of Figure 2, this means that the size of Regime 3 will shrink. However, there will still be two regimes and we will still obtain the result that an increase in the severity of a recession need not lead to an increase in workplace deviance.

Further, we assume that the penalty for crime takes the form of a fine. In reality, the punishment could also be in the form of imprisonment that renders the convict inactive next period. This would imply that the attractiveness of crime would go down if there is a decrease in the severity of the recession (or equivalently, an increase in e_L). However, that does not substantially change the incentives in comparison with a fine of equivalent disutility. As before, it depends on the regime. If one is in regime 1 or 2, then an increase in e_L which does not change the regime makes no difference to the marginal criminal as they remain unemployed if caught. So there is no additional disincentive from being in prison (and hence being inactive in the labor market). The incentive for the marginal case would change if one is in regime 3 in which case some people with bad records are hired. In such a case, the attractiveness of employment in terms of an increase in e_L decreases crime. Of course, if imprisonment of criminals causes a labor deficit, wages would rise which would in turn increase the value to being innocent.

It is worth noting that though we look at on-the-job crime, the channel via which people without a criminal record face different probabilities of employment affect other types of crime including that committed by unemployed people. Unemployed people also face a choice similar to the worker in our model, when facing a crime opportunity B he has to consider not just the "static" effect of being caught today but the decreased probability this will have on his employment in the future. Again, in a recession employers can be more choosy and thus anticipation of recession may cause dynamic deterrence to increase for the unemployed similar to the employed worker. Indeed, there is suggestive evidence that crime in general may have fallen during the current recession. For instance, an article in the Guardian (Travis 2010) reports that crime has reduced

in the UK in recent years in spite of the recession although it was widely feared that it would go up. Dynamic deterrence may be one possible explanation of this phenomenon. One can thus look at how unemployed people face different probabilities of employment in different regimes and show changes that affect the incentive to commit crime when e_L changes. While we model the decision making of perfectly competitive firms (who face productivity losses from deviant behavior) in Section 5, one can also look at how incentives in terms of penalties and dismissal should optimally vary across the business cycle to find out if, for example, a "firing policy" conditional on crime in period 1 induces higher profits by lowering deviant behavior and how such policy changes across the business cycle.[14] Thus, we can formally model how the optimal personnel decisions of firms should vary with market conditions.[15] Finally, as the severity of recession determines the relationship between crime and the state of the economy one can look at sectors which are more or less affected by recession and use data on some measure of shirking (such as sickness absence) or workplace deviance (perhaps measured by employee theft) to test our hypotheses about how these vary with the business cycle. It should be noted that contradictory findings from empirical studies across different time periods should not surprise us as our model predicts that the relationship may go either way and depends on the relative severity of the recession.

Finally, future work can consider how the "state of the economy" i.e. how severe the recession is coupled with firm specific shocks (e.g. two otherwise identical firms end up with higher or lower number of deviant types) can explain the entry and exit process of firms. Several papers analyze this process with regards to firm specific productivity shocks (e.g. Jovanovic 1982; Hopenhayn 1992). Interaction with the state of the economy may offer more insights into when entry and exit of firms occur with regards to demand conditions. This is left for future research.

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14 See Dickens et al. (1989) for work on optimal monitoring and penalty to deter on the job crime, though not in the context of business cycles.

15 A similar issue arises when we consider the issue of recidivism and rehabilitation. There is interesting research on the impact of human capital development of prisoners to improve their (post-release) labor market opportunities but, which consequently, affects the deterrent effect (see for example, Imai and Krishna 2004).

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