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Knowledge society and crime: an ambiguous relation

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Abstract

This article aims at studying the impact of return on education on criminal behaviour. A dynamic model of time allocation between investment in human capital, labour and criminal activity is developed, assuming that these activities are substitutable and endogenous. Our attention focuses on the transmission channels of legal opportunities and highlights the conditions under which the involvement of a country in a "knowledge society" produces a decrease in crime level.

1. Introduction

The idea that offenders respond to the costs and benefits of crime dates from the eighteenth century with Beccaria and Bentham. Becker (1968) and Ehrlich (1973, 1975) provided the first modern and mathematical treatment of the subject, giving a new impetus to the school of thought initiated in the 18th century. The main contributions of Crime Economics can be split into two main categories: the first category of works aims at studying the effects of legal opportunities while the second focuses on risks and costs induced by the choice of illegal activity[1]. Crime Economics mainly emphasizes the deterrent effect of expected punishment, with an attention devoted to legal sanctions (see Polinsky and Shavell 2000 for a survey), including both the probability of being caught and the severity of the sanction. Our article emphasizes on the role played by legal opportunities on crime level.

The first natural question on legal opportunities is whether crime is responsive to labour market incentives. Recent studies conclude that crime is increasing with local unemployment and decreasing with wages (Grogger 1998, Raphael and Winter-Ebmer 2001, Gould *et al.*, 2002, Machin and Meghir 2004, Fougere *et al.* 2005). Grogger proposes a time-allocation model between legal and illegal activities, assuming that these activities are substitutable and, after econometric estimates, shows a significant negative relationship between wages and crime. Gould *et al.* studied 582 English counties during the 1980s and confirmed empirically a strong positive link between unemployment and crime against property and between low wages and various forms of crime. Machin and Meghir confirm such a result with an analysis of wages in English and Welsh counties over the period 1975-1996. Fougere *et al.* confirmed on the basis of data from French Departmental districts, that youth unemployment is one of the main determinants of crime level.

As long as education increases legal employability, it increases the opportunity costs of crime and tends to reduce post-school criminal activity[2]. Obviously, if education is completely general, enhancing by the same proportion legitimate and illegitimate wages, time allocation is not necessarily affected. In contrast, if education is completely specific to legitimate activities, it is likely to reduce the incentive to commit crime. This issue will be carefully examined later.

In fact, two distinctions are to be made in order to analyze the impact of education. The first distinction is between contemporaneous effect of school attendance on crime and the effects of educational attainment on subsequent crime. First, time spent in school immediately reduces criminal activity through an 'incapacitation effect' (Gottfredson 1985, Farrington *et al.* 1986, Witte and Tauchen 1994, Jacob and Lefgren 2003). The second effect is a subsequent change in time allocation between legal and illegal activities due to an increase in legal wages. Empirically, these two effects seem to be verified. A key difficulty in estimating the effect of education on criminal activity is that unobserved characteristics affecting schooling decisions are likely to be correlated with unobservables influencing the decision to engage in crime. Several methods (instrumental variables, exogenous change in education law, self report…) confirm the causal relationships between education and present as well as subsequent crime (Lochner 2004, Lochner and Moretti 2004, Merlo and Wolpin 2009,

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[1] Social interactions, even if not taken into account below, can be of importance to explain crime.

[2] Education may also teach individuals to be more patient or change preferences toward risk as in Becker and Mulligan (1997). Last but not least, education could convey a civic externality to society and lead the students to be law abiding as emphasized by Usher (1997). We do not address these three latter subjects.

Heckman *et al.* 2010). In this context, youth will tend to make an early choice between little education and a life of crime or a good education and a largely crime-free life[3]. Empirically, it is possible to confirm the role of past experience on the decision to commit a crime (Sah 1991, Glaeser *et al.* 1996, Fajnzylber *et al.* 2002). An input of this paper is precisely to produce some theoretical evidence of this dynamic process.

A second distinction has to be made between individual and collective levels of education. Fajnzylber *et al.* (2002) use aggregated time series data for developed and developing countries and find that the average education level in a country does not have a significant effect on crime. Such a difference with individual level can be understood: an individual increase in education leads to better perspectives on legal market, which is not always verified if education is improved globally over the country. In such a case, education is no longer a guarantee to find a "good job"[4]. Thus, the return on education is of prime importance to understand the link between human capital and crime, but little theoretical evidence has been produced on this point. This is precisely what this paper aims at.

What is the impact of return on education on dynamic criminal choice? Do we have necessarily a decreasing relation between return on education and crime level? Stated differently, if a "knowledge society" is understood as an economy where education is of prime importance to find a good job, is "knowledge society" good for crime or for safety? These are the main questions examined in this paper. A priori, the impact of return on education on crime is not clear. On the one hand, education is more efficient in a knowledge society and educated people less prone to spend time on illegal market. On the other hand, non-educated people have less opportunity on legal market. This paper formalizes the channels by which human capital plays a key role in the time allocation process between legal and illegal activities, and addresses the link between knowledge society and crime. For that purpose, we develop a dynamic model of time allocation between investment in human capital, labour and criminal activity, assuming that these activities are endogenous and substitutes.

2. A dynamic model of time allocation between legal and illegal activities

We develop a two-periods model of time allocation: the period when the individual usually carries out his legal activities in school; more mature age when he usually works. Other time allocation models between crime and legitimate economic activity have proposed modifications to the seminal papers of Becker (1968) and Ehrlich (1973). Most notably, Block and Heineke (1975) or Witte (1980) conclude that to propose adequate policy guidelines, empirical analysis is needed due to ambiguous theoretical results. Flinn (1986) introduces dynamics and incorporates human capital accumulation. But in his model, the skill formation process is considered as exogenous and cannot capture the dynamics of individual decisions about education, work and crime. Grogger (1998) addresses the specific question of wages in a time allocation model, but does not incorporate endogenous choice. Guha (2012) also deals with the issue of time allocation between criminal (piracy) and legal (fishing) activities and establishes counter-intuitive results about police patrols and crime mitigation.

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[3] Education of youth can be understood as a rationale for a specific juvenile justice system, more lenient than the adult one (Pyne 2010).

[4] Cross-national analysis does not preclude of differences in criminal behaviour. Using annual data on criminal activity for twenty Italian regions, Buonanno and Leonida (2006) find that education has a negative and significant effect on regional crime rate.

Time-allocation model in Lochner (2004) considers investment in education and crime as endogenous in order to discuss the dynamic relationship between education and crime. Education policies and their potential role in a crime-fighting strategy are also broadly discussed. But the role of the return to education is not really addressed in literature and it is not clear whether the building of "knowledge society" drives necessarily to a decrease in crime level. This is the main point of the instant paper, which also addresses the above questions in a coherent framework.

For this purpose, we propose a new time-allocation model of criminal behaviour, assuming that investment in education, labour and crime are endogenous. We focus on risk neutral individuals seeking to maximize total earnings on two independent markets of employment: one for legal activities and one for illegal activities. The actualization rate – and its differences among individuals – is not addressed in the instant paper[5]. The problem facing a potential criminal is how to allocate a fixed amount of time (normalized to 1) to legal and illegal activities: between education and a criminal activity during the first period; between labour and a criminal activity during the second period. During the second period, returns on each market are assumed to be linearly dependent on working time, but the risks of illegal activity is increasing with time devoted to this market. We also suppose that the wage of a representative[6] individual on legal market positively depends on time dedicated to school during the first period. This model is based on several assumptions which must be specifically discussed.

First, human capital acquisition is only based on investment on legal market during the first period. A criticism can be made that this contrast is too stark. Indeed, the age of transition between the two stylized periods is supposed here to be exogenous whereas the question of time allocation between education and work could be considered of prime importance in a « knowledge society ». Thus, the individual could choose the end of the first period. In the instant paper, we do not focus on this issue.

Secondly, we consider that illegitimate opportunities are not affected by education, which is completely specific to legitimate activity. Indeed, we could suppose that education changes illegal opportunities. Through opportunities, which could not arise without minimum education. This kind of opportunities could include "white-collar" crime as well as interesting positions in crime industry. But also through the risks and costs of illegal activities which could decrease with education. For example, educated criminals could be better able to escape detection. In the instant paper, education only develops skills of interest for legal market. This way, high-level positions in crime industry are not allowed by better formal education. What is more, legal and illegal activities are considered, as in Ehrlich (1973), to be purely substitutable and not complementary. Obviously this assumption is a simplification of reality since illegal earnings may appear outside as inside of a given legal working framework. In such a situation, it is not possible to take "white-collar" crime into account. The risks and costs of illegal activities are also supposed to be unchanged by human capital accumulation process. More precisely, the marginal probability of conviction in the second period is supposed to be the same for all individuals, whatever their education level. In this simplified framework, we suppose that avoidance abilities and detection probabilities are supposed to be homogeneous among individuals, which differs from Bebchuk and Kaplow (1993) or Friehe (2008) including heterogeneity in such probabilities.

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[5] For dynamic model with actualization rates and optimal deterrence over several periods, see Davis (1988).
[6] Taking into account heterogeneity among the population of potential offenders do not change the stylized facts shown in this paper.

In fact, if our simplifying assumptions were relaxed, the results would appear to be ambiguous. Indeed, we could account for the possibility that (legally) educated criminals might be caught with a lower probability or might have access to better illegitimate opportunities. But, symmetrically, we could account for the possibility of human capital accumulation specific to « crime industry ». In this context, less formal education would signify more crime in first period and better abilities on illegal market (both for opportunities and punishment avoidance) for the second period. For example, Mocan *et al.* (2005) consider two kinds of human capital: legal human capital, which determines earnings in the legal sector, and criminal human capital for illegal earnings. As our paper is interested in (legal) knowledge society, we do not take this possibility into account. We keep in mind that relaxing our simplifying assumptions provides ambiguous results on the real impact of education on criminal abilities. In other words, it seems difficult to fully understand if the best place for criminal learning is a classroom or mean streets.

2.1. A decision model for the potential offender

Let's see the arbitration process of a given agent between legal and illegal markets during the two periods. t_1 and t_2 correspond to the time allocated to illegal activity during the distinct periods. These times can be zero or one for each individual, with corner solutions in order to have no negative values.

First Period

During the first period the agent has no legal revenue. Thus, there is a time allocation between investment in human capital and illegal activity. The latter is remunerated but risky. The expected monetary value earned in first period can be written as follows under the assumptions given above:

$$V(t_1) = It_1 - \pi f t_1^2$$

I denotes the productivity of criminal activity, ie the income derived per unit of time dedicated to illegal activity. π corresponds to the probability of being caught *per unit of time dedicated to illegal activities.* It is consistent to assume that the probability of being caught increases with the involvement in crime and we assume a linear relationship. Finally, f is the intensity of the penalty imposed on a criminal *per unit of time dedicated to crime.* It is also consistent to assume that punishment will be heavier that involvement in illegal activities is important (even if all the crimes are not known by the court) and we assume a linear relationship[7]. These assumptions will be kept in second period.

Second period

During the second period, the individual may have a remunerated legal activity. The representative revenue on legal market appears to be of tremendous importance in time allocation between legal and illegal activities. As part of our model, investment in human capital during the first period has an impact on legal wage. We consider that it can be written:

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[7] We assume that the penalty scheme is the same in juvenile justice system and in the adult one. We could also consider that the juvenile system is more lenient as in Pyne (2010).

$$s(t_1) = s_0(1 - \kappa t_1)$$

s_0 is a baseline wage, based on the specificities of labour market. It is the representative wage earned in case of a first period only spent on legal activity. The value of this parameter, as well as its determinants, is not at the heart of this article. Without loss of generality, we suppose that the wages on legal market cannot be negative even if the agent spends all the first period on illegal market. More formally, $1 - \kappa \geq 0$ so that $\kappa \leq 1$.

Here, we suppose that human capital investment during the first period increases the income earned during the second period. κ is understood as an estimate of the return on investment in human capital. Indeed, it constitutes a measure of the value of time spent in the educational system: an additional unit of time spent at school induces a relative increase in legal wage of κ. The more the country invested in knowledge society – human capital crucial in the economy – the higher this parameter[8]. In our framework, the value of κ verifies $\kappa \leq 1$.

During the second period, the agent has two sources of revenue: the legal income received for each unit of time dedicated to legal activity, with constant returns for a given time dedicated to illegal activities in first period; the illegal income related to criminal activity. The agent allocates time between these two sources of income. It is possible to write as follows the expected monetary value earned in second period for a risk neutral individual[9]:

$$V(t_2) = s(t_1)(1 - t_2) + It_2 - \pi f t_2^2$$

2.2. Resolution of the program

In order to maximize the expected monetary value over the two periods, the agent chooses simultaneously t_1 and t_2:

$$V = V(t_1) + V(t_2)$$

In case of interior solutions, we have[10]:

$$t_2* = \frac{I - s_0(1 - \kappa t_1*)}{2\pi f}$$

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[8] Several methods of estimation can be used to evaluate this parameter (see notably the econometric methods initiated by Mincer 1974). In order to test whether our theoretical work can be verified on a country panel, such kind of methods could be mobilized in a future research.

[9] As already stated above, the human capital accumulation in « crime industry » is not taken into account in this model. Thus, marginal benefit as well as marginal probability of arrest are not affected by the time dedicated to crime or education during the first period. Such investments are able to have ambiguous effects and their role would gain to be carefully measured. Formally, in our simplified framework, the parameters I and π do not depend on t_1.

[10] Corner solutions are as follows: $t_2* = 0$ or $t_2* = 1$ and $t_1* = 0$ or $t_1* = 1$.

$$t_1* = \frac{I - s_0\kappa\left(1 - t_2*\right)}{2\pi f}$$

The interior solutions of these two equations can be written as follows:

$$t_1* = \frac{I - s_0\kappa\left(1 - \dfrac{I - s_0}{2\pi f}\right)}{2\pi f - \dfrac{s_0^2\kappa^2}{2\pi f}}$$

$$t_2* = \frac{I - s_0 + \dfrac{s_0\kappa}{2\pi f}\left(I - s_0\kappa\right)}{2\pi f - \dfrac{s_0^2\kappa^2}{2\pi f}}$$

Hereafter, we also study directly the variable t_1*+t_2* (between 0 and 2 in our framework), which can be written:

$$T* = t_1* + t_2* = \frac{2I - s_0\left(1 + \kappa\right)}{2\pi f - s_0\kappa}$$

3. Return on education and crime: an ambiguous relation

We analyze how T* depends on several key parameters. Broadly speaking, the agent allocates time to crime up to the point where marginal gain of crime equals marginal loss. The later is both due to the expected sanction and opportunity loss on legal market. In this context, the influence of several parameters is unambiguous. First, the productivity I of criminal activity, has a positive impact on crime levels. An exogenous change in I may be due to a change in the "industry of crime" which modifies the return on illegal activity. The structuring of an organized Mafia with codes of conduct, networks and courts is able to establish a kind of monopoly - or oligopoly if several Mafias coexist. It is also possible to analyze mafia struggle as a decrease in monopoly power and therefore productivity. These analogies with the theory of industrial organization explain the term of "industry of violence" (see notably the survey conducted by Franchetti and Sydney, in the late 19th century's Sicily, cited by Dickie, 2007). Secondly, marginal loss due to crime increases with the probability and the severity of the sanction, which implies a drop in total crime when severity increases. The impact of return on education is more ambiguous and constitutes our main result.

It is possible to write:

$$\frac{\partial T^*}{\partial \kappa} = \frac{s_0\left(2I - s_0 - 2\pi f\right)}{\left[2\pi f - s_0\kappa\right]^2}$$

An increase in return on education induces a fall in crime if and only if:

$$s_0 \geq 2I - 2\pi f$$

This condition is equivalent to the following one:

$$T^* = t_1^* + t_2^* \leq 1$$

One could consider that the involvement of a given country in a knowledge society necessarily drives it to a lower crime level. Indeed, most of time, such a drive signifies more education at macro level and less crime. But in fact, when education becomes crucial to find a "good job", inequalities between those who are educated and those who are not increase. It is possible to distinguish two effects: first, an incentive to invest in education during the first period, instead of committing crimes; secondly, a strengthening of criminal paths during the second period for those who are poorly educated. In this context, the influence of the return on education on crime is complex. If wage level is too low, the influence of return on education is negative for safety. Thus, the involvement of a given country in a knowledge society – an increase in the parameter κ - produces an increase in crime level because the second effect is more important than the first one. In such a context, the crucial role of human capital reinforces criminal trends and induces more time devoted to illegal activities. Otherwise, the first effect dominates and involvement in knowledge society produces a drop in crime level.

The above condition on s_0 is equivalent to a condition on initial level of crime. If crime level is already high - $T^* = t_1^* + t_2^* \geq 1$, involvement in knowledge society (an increase in the return on education) reinforces criminal paths because young offenders become more and more deprived on legal market.

4. Conclusion

Education appears to be of prime importance in criminal choice. The purpose of this paper is more precisely to understand the consequence on crime of the involvement of a given country in "knowledge society", ie the increasing importance of human capital to find a good job. Thanks to our model, the channels by which human capital plays a role in the time allocation process between legal and illegal activities are highlighted. If unambiguous influence of several parameters is shown thanks to our framework, the impact of return on education appears to be more complex. In this context, the conditions on wages under which "knowledge society" is good for safety are established.

Several extensions to this work could be conducted in future research. First, more works need to be done to understand the role of human capital when legal and illegal activities can be substitutes as well as complementary. Our assumption is indeed a simplification as illegal

earnings may appear outside as inside a legal working framework. Then, the individual relation to time could be considered in a model including several periods, as actualization rates appear to be crucial in dynamic criminal choice. Finally, it would be really interesting to test whether such theoretical work can be verified on a country panel differently involved in "knowledge society", ie with various rates of return on education.

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