

To be or not to be a drug trafficker: Modeling criminal occupational choices

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Abstract

Violent deaths, kidnapping and extortion have spiked in Mexico's border towns since 2004. Using a formal model and case studies from Mexico, I argue that such phenomena are partially explained by changes in the composition of illegal labor markets. Government permissiveness fostered territorial wars between Mexican drug cartels. To sustain such inter-cartel fights, drug leaders promoted the recruitment of outsiders into their forces; as a result, an illegal labor market –so far closed to non-blood-related individuals– opened and interacted with legal labor market incentives. The outcome was the emergence of a new generation of drug dealers that (a) disdain old mafia laws, (b) are more violent and (c) are also more prone to take part of other forms of “entrepreneurial” illegal occupations such as kidnapping and extortion. Recent changes in the scope, levels and forms of violence in Mexico can be understood by analyzing who is becoming a drug trafficker and why.

“Let’s meet in the Mexican side. If Harvard has given us the honor to come to hell, the city will remain calmed”¹

1 Introduction

Drug traffic violence has recently spiked in Mexico. With over 5,880 homicides in 2009, Mexico is arguably the most dangerous and violent country in Latin America (Fernandez Menendez and Salazar 2008), making countries such as Nicaragua and Colombia look peaceful, a laughable assertion only a few years ago (CIDAC 2009). Indeed, no one then would have predicted that the number of drug-related casualties in Mexico would double the number among coalition troop casualties in Iraq (El Universal, 2009) and escalate to a point where US border towns and states would be calling for federal troops to protect their citizens.

As Figure 1 shows (CNDH 2008), drug-related deaths through 2002 were pretty constant at around 1,200 casualties per year. In only one year, from 2004 to 2005, violent deaths increased 36% from 1,304 to 1,776. Growth rates remained steep until 2007 when another increase in violence took place. This time violent deaths almost doubled. Reported number of deaths may be downward biased given that most of the assassinations are not reported to the authorities. Journalistic accounts (Guerrero 2009a), based on a scan of all the events that had been covered by media and local newspapers, indeed show significantly higher number of deaths. Reforma, one of the most respected newspapers in Mexico, argues that violence doubled again from 2007 to 2008. Some states, like Chihuahua, reported up to ten times more violent crimes in 2008 than 2007. The homicide rate in 2009 is expected to be larger than ever.

(Figure 1 about here)

Although the Mexican government proclaims that most deaths are borne by traffickers, we know that government authorities are also increasingly targeted (Freeman 2006, CNDH 2009). In 2008, 12% of the victims of drug-related violence were policeman and 2% came from the Mexican military. In states like Tijuana, at least 100 policemen die on duty every year (Guerrero 2009a). To put this in perspective, in the entire United States 133 police officers were killed in the line of duty in 2008. Police chiefs in border cities are killed systematically. In some places such as Novalato, Sinaloa, nobody wants to be police chief anymore –actually, the position is vacant. In other places, such as Asención, police chiefs ran away as political refugees (Cabrera

¹Unexpected text message received in McAllen, Texas. Author was being invited, along with Alfredo Corchado journalist of the Dallas Morning News, to have a personal interview with a secret informant of the Golf cartel in Reynosa, Tamaulipas.

2009, Cano 2008, Fernández Menéndez and Salazar Slack 2009). High-profile politicians - mayors, police executives, attorney generals - are also prime targets. Even the head of the state have received serious murder threats, an action that some decades ago would have been thought impossible.

The brutality of the violence has also increased, mainly in the form of execution-style murders. Among all of the homicides related to drug traffic, more than one in ten had signs of torture, their bodies often riddled with messages to other cartels or potential victims and left in the streets. Furthermore, old mafia rules have began to be violated. Until recently, cartels were known for their respect towards the family members of their leaders (Navarro, 2009). Daughters, sons and wives were normally left out of the battles unless they were directly involved in the organization. Now, complete families have been killed, raped and tortured with unprecedented levels of cruelty and violence.

Other forms of crime, such as kidnapping and extortion have also spiked (Zepeda Leucona 2008, Ortega 2008). Businesses located at border towns have become easy prey for extortioners who ask for monthly fees of up to 5,000 USD in exchange for “protection” to avoid being kidnapped or assassinated (Garza 2009). As a result a large number of Mexican businesses, particularly restaurants, have moved into America and tourism has plummeted. Newspaper editors, journalists and managers have also migrated into the US looking for the protection and security that only the US can offer (Sierra 2009, Ramírez 2009).

The causes behind this change in level, scope and forms of violence remain debatable. Several explanations have been proposed to explain this increase in violence (Rios and Sabet 2009, Guerrero 2009a) but no convincing theory has been set forward to understand both changes in levels and the scope/forms of violence.

This paper contributes to the literature by elucidating a phenomenon that has caused not only increases in levels but also in the scope and type of violence: the emergence of a new type of drug trafficker. I argue that inter-cartel territorial wars created a necessity to recruit outsiders into drug cartel forces. As a result, the illegal-drugs labor market, which is normally closed to non-family-related individuals, opened and interacted with the incentives generated by legal labor markets. The outcome was the emergence of a new generation of drug dealers that (a) neglect old mafia laws, (b) are more violent and (c) are more prone to diversify their criminal portfolios by taking part in other illegal occupations such as kidnapping and extortion. In short, increases in the levels/scope/form of violence can be partially explained by changes in the type of individual who decides to become a drug trafficker. This paper is the first attempt to formally comprehend criminal versus legal occupational choices in Mexico.

I rely on formal modeling as my main tool. By making use of two main streams of labor economics literature: (a) the classic approach of Becker (1968) where individuals face single

criminal vs. legitimate market wages and (b) the Roy (1951) model perspective of different returns to skills in the criminal vs. legitimate labor market sectors, I model career decisions made by Mexican criminals. The model sheds light on the important and severely understudied relationship between law enforcement policies, formal labor markets and crime rates. In particular, it shows that (a) wage structure, (b) income inequality, (c) state capacity and (d) individual's levels of risk aversion have played a decisive role in sorting individuals into criminal activities. Those with high entrepreneur skills and high tastes for violence are the ones who have recently joined the cartel forces. The result has been an change in the profile of organized crime. New drug traffickers have increased general levels of violence, and by performing other forms of criminal activities, have also increased rates of kidnappings and extortion.

The paper is organized as follows. In the first section, I present an account of recent increases in levels/scope/forms of violence in Mexico and an account on how changes in (a) cocaine demand, (b) law enforcement, and (c) labor markets incentives have interacted to generate the most violent period in Mexico's recent history. In this section, I present the reasons why a new generation of drug traffickers have emerged and the short term consequences of this phenomena. A second section develops a theoretical model to understand why this new generation of drug traffickers is different from the old one. The model shows how changes in illegal/legal labor market incentives have caused changes in occupational sorting, promoting endogenous selection of more violent people into the drug industry. Each of my results is linked to the empirical evidence presented in the first section. Finally, I conclude by summarizing my main results and linking them with policy recommendations. In an appendix, I present particular points where I would like to get feedback and summarize some mathematical concerns.

2 A new and increased drug violence

Mexico has long been a player in international drug trafficking. Its two main drug cartels – known as Juarez and Golf– are fairly well established and have been running very profitable businesses for decades. Its products –mainly cocaine, marihuana and opium– supply about 80% of the demand of illicit drugs in the US, and the US is by far the largest illegal drug demander of the world.

Yet in recent years Mexico has experienced puzzling changes in its levels, forms and types of drug related violence. Not only have levels of violence jumped (i.e. number of fatalities) but even more puzzling, violence has become more cruel and savage than ever. Further, forms of organized crime such as kidnappings and extortion have spiked.

Changes in levels of violence can be understood by analyzing changes drug demand, law enforcement and security policies. First, as demand for cocaine in the US has shrunk, Mexican drug cartels have faced stronger incentives to control their territories and invade others'. Cartels

have thus engaged in bloody inter-cartel fights to control what is left from an increasingly feeble market. Second, with democratization and the consequential decentralization of the Mexican state, Mexico's federal government has become less able to enforce control over drug cartels. As a result, inter-cartel territorial fights have emerged. Finally, violence has also increased due to changes in Mexico's security policies. Recently, Mexico has pursued a more active policy to reduce drug traffic. The so called "drug war" has resulted in increased rates of seizures and in the capture of several high-profile drug traffickers which in turn, has increased intra-cartel instability.

Understanding increases in the forms and scope of violence requires a different explanation. Such changes can only be understood by assessing who is becoming a drug trafficker and why the profile of these individuals is different from the previous generation.

An argument to understand changes in drug-related violence is developed in this section.

Changes in cocaine demand are certainly one of the main suspects to explain changes in violence levels. There has been a general decline in cocaine use in the US over the last twenty years. Almost 3 percent of Americans were cocaine users in 1985; that number is about 0.5% currently (SAMHSA, annual), a highly significant reduction. Among high schoolers, cocaine has halved since the 1980s and 1990s². The general tendency of cocaine consumption is presented in Figure 2.

(Figure 2 about here)

The cocaine boom happened during the 80's. Back then, cocaine was socially accepted in high status circles. Yet, at the beginning of the nineties cocaine consumption started to drop. Association of cocaine with HIV and the emergence of a new more health-oriented culture among high-income/high-status individuals explains a big part of this decline. The market has since reduced, returning in just a decade to pre-boom levels. According to consumer surveys, demand for cocaine has remained pretty much stable since 2002 (SAMSHA annual).

As demand fell, competition and violence among cartels have grown. Inter-cartels wars have emerged to control the few routes that remain largely profitable. Two examples are Ciudad Juárez (El Paso, Texas) –the main port of entrance of cocaine into Chicago– and Tijuana – California's drug provider. Both have become increasingly violent. Bloody wars have been fought between Tijuana/Juárez cartel and its common enemy the Sinaloa Cartel (Guerrero 2009b).

Furthermore, the decrease in the demand for cocaine in the US has led to a realignment of

²Marijuana use has also fallen since its peak in the late 1970s, especially among high school youth, where there has been a 25% decrease in regular use over the last 8 years (Johnston and O'Malley, annual)

the cocaine market in two more ways: (a) more cocaine is directed toward European consumption, in particular Spain (Fernández Menéndez and Salazar Slack 2009); and (b) a local Mexican market has emerged (SSA 2002). The link between diminished demand and violence is, again, profits. Fewer users in the US leads to an even more competitive, tighter market to kill over.

With a smaller US market, Mexican cartels have looked to other potentially profitable markets. Though Europe is not a market that Mexican cartels are particularly comfortable with (due to geographic distance), Mexican cartels have begun business. Countries like Brazil and Argentina have become substantial players in Europe, too, adding to violence since gangs from Mexico are engaging in confrontations with cartels from these countries. Pressure from competition has increased the level of violence within Mexico. As the supply of cocaine from Mexico has increased in Europe, cocaine use has surged, particularly in the United Kingdom and Spain (European Monitoring Center on Drugs and Drug Addiction, 2007)³.

Changes in state capacity and law enforcement have also played a role in explain the spike in violence. In particular, democratization has reduced the centralization of the Mexican state and its ability to enforce informal pacts that were kept between drug traffickers and government officials during the nineties.

Following the Mexican revolution, Mexico was ruled by a single hegemonic party -the Institutional Revolution Party (PRI) - for more than seventy years. During the PRI regime, authorities agreed to allow drug cartels to perform their illegal activities as long as a strict code of conduct was respected (Resa Nestares 2001b). As Ricardo Monreal, the former Governor of the state of Zacatecas and ex-PRI official described, authorities used “extra-official mechanisms” to enforce a set of informal rules that every cartel had to follow (Guerrero, 2009). Among the most important one was an strict requirement of order and respect for each cartel territories. The size and borders of territories were delimited and granted by the PRI ⁴

The enforcement of these rules was possible because of the strict control that the PRI-regime had over state and municipal governments, as well as other branches of government such as the judicial authorities and local polices. Corruption was well institutionalized and as such the pact

³Demand patterns pertaining to type of drug have also affected the cartels. Extra-official accounts show that 2005 was the first year that Mexico’s organized crime cartels received larger profits from marijuana than from cocaine (Fernández Menéndez and Salazar Slack 2008, p. 25). This is a symptom of a reduction in general profits. Marijuana used to be a secondary market for Mexicans because it generates lower average profits as it is required to compete (in price and quality) with locally-grown American marijuana (Rios and Sabet 2008).

⁴The other nine rules included (1) No dead people in the streets, (2) No drugs in the schools, (3) No media scandals, (4) Periodic seizure of illegal drugs and imprisonment of lower level traffickers, (5) Generation of economic revenues for small, poor communities, (6) No gangs, (7) No deals with other levels/branches of government and/or bureaucracy., (8) Mistakes are to be punished with imprisonment, not death, (9) Revenues must return to Mexico in the form of investments.

remained a relatively stabilizing force in the country (Resa Nestares 2001b).

Democracy changed the picture. In 2000, Vicente Fox a charismatic leader of right opposition party (National Action Party, PAN), was elected president in what many analysts believe to be the first truly democratic election in Mexican history. The arrival of Fox in power brought several changes, among them a dramatic redefinition of the relationship between the government and drug cartels. Mexico's democratization reduced government centralization, weakening Fox's ability to enforce the old pact (Patin 2007, Valle 2009). Instability was further enhanced by a particularity of the Mexican cartels: unlike Colombia, Mexican cartels were and had always been competitive and in opposition to each other. A lack of state capacity to enforce the old pact reduced the costs of engaging in territorial inter-cartel fights (Freeman 2006).

In order to invade other territories, cartels needed to increase their forces. Both Sinaloa and Golfo cartels recruited new, young members to expand their power. In previous years, drug traffickers were normally recruited from family/friendship networks via recommendation. The drug labor market was relatively closed to outsiders as getting in required connections and loyalty assessments. As the environment changed, most of the new members were outsiders, "hired" from within the Mexican military forces.

These new drug traffickers, known as "Negros" if affiliated with the Sinaloa cartel, and "Zetas" if affiliated with the Golfo cartel, had important characteristics; they were more violent than traditional traffickers, more prone towards diversifying their criminal portfolios (performing different illegal occupations such as kidnapping and extortion), and generally neglected old-mafia laws and honor codes (Valle 2009, Jorge 2009). In general, they were "more sophisticated and more savage (WOFA 2007)."

Their cruelty was much higher. Unlike traditional drug traffickers who concentrated their efforts only in transporting illicit drugs, Zetas are real criminal entrepreneurs. They kidnap, extortion and run all kinds of illegal business such as prostitution, human traffic, and even illegal immigration. They also use strong intimidation techniques such as burning the dead bodies of their enemies in fueled barrels. An FBI assessment report shows that new members "are allegedly more violent than their leaders and may be behind much of the drug-related turmoil occurring along the border (WOFA 2007). The Negros have a penchant for assassinating policemen with high-powered assault weapons, a practice that back in the PRI-regime days was uncommon. They even invented the term "police-killer" to refer to a high-assault weapon that can pierce policemen bullet-proof's vests.

The social characteristics of Zetas and Negros are also different from those of the traditional traffickers. They tend to be more urban, have higher levels of formal education and share the tastes of the Mexican middle classes. Even their music preferences are different; they listen to American rappers, not to the traditional Mexican "corridos."

(Figure 3 about here)

In December of 2003 both cartels finally fought each other and the result was the bloodiest inter-cartel war Mexico has ever witnessed. The epicenter was Nuevo Laredo. When the Golfo cartel was weakened by the arrest of its leader –Osiel Cardenas–, the Sinaloa cartel began a war to take control of the border city of Nuevo Laredo. Furthermore, Golfo started a fight against “chachos” and “texas” two small local gangs (Corchado 2009a). Nuevo Laredo is a crucial port of entrance into the US: 40 percent of all Mexican exports cross into the US via this small town. With just 350,000 inhabitants, Nuevo Laredo is the fastest way to Dallas coming from Mexico City. From there, drugs are distributed to New Orleans, Houston and Chicago (Corchado 2009a). Just during 2005, there were more than 180 killings in Nuevo Laredo, a city of 350,000 inhabitants, and national figures were much higher. Shootouts on city streets became common, some lasting as long as 30 minutes, prostitution, kidnappings and extortion became out of control (WOFA 2007). In the words of Raul Casso (2009), Attorney General of Laredo, “it was Al Capone type stuff.”

Violence was further enhanced by the arrival of Felipe Calderón into office. The new president of Mexico, also from the PAN, took office in December of 2006. By then, the problem of drug trafficking was extremely severe. Violence between the two main Mexican cartels was peaking. The conflict was already generating a death toll of about 2,200 individuals per year in 2006, and Calderón was committed to eliminating the cartels. Drug traffickers controlled several border cities; Zetas had control over most of the local media in Laredo and in some regions of Mexico –such as the mountains of Chihuahua, Michoacán and Guerrero– the state was *de facto* expelled (Artz 2009). Net economic losses (mainly in the form of inversion losses) attributed to drug traffic had quadrupled from 2003 to 2007. It was estimated that Mexico lost about 11 billion dollars in inversions only in 2007 (Rios and Sabet 2009) (Figure 4).

(Figure 4 about here)

It did not take long until Felipe Calderón realized that to increase the governability of his country, he would have to reduce the influence of cartels. His justification was straightforward: no other policy could be efficiently implemented without first recovering official control over the areas where drug trafficking was openly taking place (Fernandez Menendez and Salazar 2009, Corchado 2009).

Calderón targeted his efforts into three main areas: (a) decreasing the amount of drugs that cross the border, (b) capturing high-profile cartel leaders, and (c) destroying illegal crop cultivation. As Figure 5 shows, there has been a large increase in money and weapons confiscation since 2006. The amount of dollars confiscated increased 14 times, and large weapons, fuel, and grenade seizures rose seven-fold from 2006 to 2007.

The short-term outcome of such policies was a further increase in violence. In particular, the capture of drug lords shook up the internal structure of the cartels, resulting in more violence within the cartels themselves. Cartels disintegrated into several cells, generating larger internal fights over the succession of the territories. Violence is evidence of the weakening of the cartels, not - as several media accounts have portrayed- of their power (Guerrero 2009a, Freeman 2008). Furthermore, the seizure of illegal drugs, the confiscation of money, weapons, goods and the eradication of illegal crops, has led to a shrinking in the profitability of drug traffic and an associated increase in violence. Large confiscations lead to punishment in the internal structure of the cartels. People in charge of the cargo are killed as well as all those who were suspected to be unfaithful to the organization (Gonzalez 2007).

(Figure 5 about here)

To summarize, *levels* of violence have increased as a result of inter-cartel fights promoted by (a) a reduction in the demand of cocaine inside the US, (b) a reduction in the capacity of the state to enforce territorial borders between cartels, and more recently (c) a fall in cartels' profits caused by larger seizures and confiscations. Further, *levels* of violence have also increased as a result on internal cartel destabilization caused by the capture of drug lords. But, neither of the two theories above can explain why violence also changed in *scope and form*. Such changes are the result of the emergence of a new generation of drug dealers. Several questions emerge. Why are these drug traffickers different from the old ones? Why are they more violent? Who is becoming a drug trafficker and why? The following section presents a formal model to address these questions. I show that answers are to be found in wage structure, income inequality, state capacity and individual's levels of risk aversion

3 Who becomes a drug trafficker?

In this section I present a theoretical model to understand puzzling changes that have transformed organized crime violence in Mexico during the last years. By showing the incentives that people follow to become a drug trafficker, and how those incentives interact with the legal labor market, I argue that the recruitment of a new generation of drug traffickers brought highly violent and entrepreneurial individuals into the criminal labor markets. The combination of changes in drug traffickers profiles and diminished state capacity is the cause behind changes in levels/scope/form of violence in Mexico.

3.1 Theoretical model

Individuals allocate their time t in either i illegal activities (drug trafficking) or l legal activities. Time used in illegal activities is denoted as t_i ; t_l denotes time used at legal activities. Individuals

are endowed with one unit of time such that

$$t_l + t_i = 1$$

There are two periods: the PRI-regime P_{pri} –when a pact was enforced between drug cartels and government– and the PAN-regime P_{pan} –when because of state weakness and decentralization, the pact could no longer be enforced. Assume that during P_{pri} there were no entry costs for legal activities but illegal activities remained closed to the general population. Only those who belonged to traditional cartel families could have $t_i^* > 0$. During P_{pan} , cartels began to expand their recruitment mechanisms as preparation for territorial wars. Assume that during P_{pan} there are no entry costs for either legal or illegal activities.

Returns to illegality I and legality L are given by

$$\begin{aligned} L &= t_l * w_l \\ I &= t_i * w_i \end{aligned}$$

where

$$\begin{aligned} w_l &= m_l + e_l & (1) \\ e_l &\sim N(0, \sigma_l^2) \\ e_l &= f(\xi, \nu, \tau) \end{aligned}$$

$$\begin{aligned} w_i &= m_i + e_i & (2) \\ e_i &\sim N(0, \sigma_i^2) \\ e_i &= f(\xi, \nu, \tau) \end{aligned}$$

and $\frac{\partial e_l}{\partial \xi} > 0$, $\frac{\partial e_l}{\partial \nu} < 0$, $\frac{\partial e_l}{\partial \tau} > 0$, $\frac{\partial e_i}{\partial \xi} > 0$, $\frac{\partial e_i}{\partial \nu} > 0$, $\frac{\partial e_i}{\partial \tau} > 0$.

Equations (1) and (2) can be understood as describing earnings distributions composed by a baseline salary (m_l and m_i) and a payment to non-observable abilities (e_l , e_i). Both w_l and w_i can take negative values. A very unable drug dealers may loose the merchandize during transportation and would have to pay for it; a very incompetent entrepreneur in the legal labor market may end up with liabilities. If e_l or e_i are positive, individual has higher ability than average and thus, receives a higher salary. Non-observable abilities are a function of tastes for violence ν , entrepreneurial ability ξ and others τ . Note that e_l and e_i are both increasing in ξ and τ , but only e_i is increasing in ν .

Let σ^2 be the variance in individuals' non-observable abilities. Assume that $\sigma_i^2 > \sigma_l^2$. Studies of criminal labor markets and my own field work (Levitt and Venkatesh 1998, Corchado 2009c) have shown that income differentials tend to be higher in illegal markets. Salaries at both the bottom/top of the illegal income distribution are much lower/higher than legal incomes.

Define ρ as the correlation between e_l or e_i . Let $\rho_\xi > 0$ be the correlation between e_l and e_i with respect to entrepreneurial ability, $\rho_\nu < 0$ be the correlation between e_l and e_i with respect to tastes for violence, and $-1 < \rho_\tau < 1$ be the correlation between e_l and e_i with respect to other abilities.

It has been empirically shown that entrepreneurial ability is highly rewarded in both legal and illegal labor markets (Fairlie 2002, Rios 2009, Fairlie and Woodruff 2004). Successful drug dealers possess unobserved characteristics, such as low levels of risk aversion and a preference for autonomy, that are highly correlated with entrepreneur ability. Actually, among criminals who become legal workers, the probability of becoming a successful entrepreneurs is much higher for those that did their criminal careers in the illegal drugs industry (Fairlie 2002). Furthermore, success or failure among the upper-level drug dealers and smugglers is partly determined by their business skills, i.e. marihuana dealers have proven to have highly sophisticated strategies to maximize his clientele while minimizing his exposure to arrest and competition (Adler 1985 and Sullivan 1989 as cited by Fairlie 2002). The existence of high returns to entrepreneurial ability in contested in labor economics, yet studies with credible instruments for entrepreneurial ability have proven large effects of such ability in income (McKenzie and Woodruff 2006)

Tastes for violence are rewarded in illegal labor markets but punished in legal labor markets. Violence is highly rewarded in the drug industry. Ethnographic studies have showed that dealers that thrive in the drug industry are brave and savage (Corchado 2009c, Sierra 2009, Rios 2009a). They are not afraid of dying or killing. Other very desirable personality traits such as dependability and responsibility are rewarded in legal labor markets (Heckman 2003). Violence in the legal industry is associated with impatience and other non-positive characteristics.

Net returns of t_i are uncertain and conditional to whether an individual is (or not) captured by the police. With probability $p(t_i)$ the individual is captured and is forced to pay a fine $F(t_i) > 0$. Note that time is assumed to be proxy for the size of the crimes (i.e. each hour that criminals spend in criminal activities yields a fixed number of same sized crimes)

Assume that $p' > 0$, $p'' > 0$, $p(1) \leq 1$, and $F' > 0$. The probability of being captured and the fine increase as time devoted to illegal activities increases. The probability of being captured is a convex function (Reuter 1993). Because of law enforcement difficulties, if an individual is a full time criminal, the probability of being captured can be less than one.

Individuals' utility function is given by $U(w)$ where w is total income and has two potential realizations. With probability $p(t_i)$ $w = w_u$, where w_u is total income when individual was captured (criminal was unsuccessful). With probability $(1 - p(t_i))$ $w = w_s$, where w_s is total income when individual was not captured (criminal was successful).

Both potential realizations of w can be decomposed as:

$$\begin{aligned} w_s &= (1 - t_i)w_l + t_iw_i \\ w_u &= w_s - F(t_i) \end{aligned}$$

Following convention, $U'(w) > 0$, $U(w)'' < 0$. Thus, $U(w_s) > U(w_u)$, $U'(w_s) < U'(w_u)$ and $U''(w_s) < U''(w_u)$. Note also that given that $F' > 0$, $\frac{dw_s}{dt_i} > \frac{dw_u}{dt_i}$

Individuals maximization problem will be given by:

$$\begin{aligned} &\max_{t_i, t_l} p(t_i)U[t_lw_l + t_iw_i - F(t_i)] + (1 - p(t_i))U[t_lw_l + t_iw_i] \\ \text{s. t.} \quad &t_i \geq 0; \\ &t_l \geq 0; \\ &t_l + t_i = 1 \end{aligned}$$

Which can also be stated as:

$$\begin{aligned} &\max_{t_i} p(t_i)U[(1 - t_i)(w_l) + (t_i)w_i - F(t_i)] + (1 - p(t_i))U[(1 - t_i)(w_l) + (t_i)w_i] \quad (3) \\ \text{s. t.} \quad &t_i \geq 0 \end{aligned}$$

3.2 Main results

In P_{pri} , equation (3) becomes trivial since general population individuals can only choose $t_i^* = 0$. In P_{pan} , individuals solve equation (3) yielding the following FOC:

$$p'(t_i)[U(w_u) - U(w_s)] - p(t_i)U'(w_u)F' + (w_i - w_l)[EU'(w)] = 0 \quad (4)$$

$EU'(w) = [(1 - p(t_i))U'(w_s) + p(t_i)U'(w_u)]$ can be conceptually understood as the expected change in utility when salary changes. Recall that because utility is concave, salaries change at a different rate if individual is convicted than if not. Utility changes faster when the individual pays a fine.

Note that in P_{pan} a new labor market is open and new incentives are generated. Now, in-

dividuals can choose a $0 \leq t_i^* \leq 1$. In particular, we can identify three potential solutions for t_i^* : if $\text{FOC} > 0$ $t_i^* = 1$, if $\text{FOC} = 0$ $0 \leq t_i^* \leq 1$ and if $\text{FOC} < 0$ $t_i^* = 0$. The key to solve the model is then identify the conditions under which $0 \leq t_i^* \leq 1$.

Proposition 1: Independently of penalties and conviction rates, a necessary –but not sufficient– condition for an individual to become criminal is that his expected salary as a criminal is larger than his expected salary in the legal labor market. The first term of equation (4) is always going to be negative because $p'(t_i) > 0$ and $U(w_u) - U(w_s) < 0$. The second term is also going to be negative because $p(t_i) > 0$, $U'(w_u) > 0$ and $F' > 0$. We can also know that $EU'(W) > 0$ because $U'(W) > 0$ and $p(t_i) > 0$. In order to offset the negative values of the first and second terms, we need $w_i > w_l$.

This result is simple but shows consistency with reality. Given that illegal markets yield more uncertain results (including life-time prison or worse, extradition), individuals will only consider illegality if expected salaries are much higher in such markets. Zetas' and Negros' wages are much higher than formal labor markets (Rios 2009a). Their annual salaries are approximately \$28,000 which is considerable higher than what they would be paid in legal markets given their normally low level of formal education. A college-educated Mexican has an average salary of \$7,200; the top decile of college-educated have salaries of around \$43,000. Salaries are certainly considered when deciding to enroll as Zeta. In the words of one of them: "I rather living like a king for three years that as a beggar my whole life (Corchado 2009)"

Yet, higher illegal salaries does not necessarily imply that someone will become a drug trafficker. Further required conditions will be described below.

Proposition 2: The fraction of time spent in criminal activities

1. Is negative function of income at the legal industry
2. Is positive function of income in the illegal industry
3. Decreases as labor markets become more unequal

Recall that w_i and w_l are determined partially by stochastic processes. Thus, from equations (1) and (2) we can show that if $w_i > w_l$, then $(e_i - e_l) > (m_l - m_i)$. The upper-bound fraction of time spent in criminal activities will be given by:

$$\begin{aligned} P &= Pr[(e_i - e_l) > (m_l - m_i)] \\ &= 1 - \Phi(m_l - m_i) \end{aligned} \tag{5}$$

where $(e_i - e_l) \sim N(0, \sigma_l^2 + \sigma_i^2)$, and

$$\Phi(m_l - m_i) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{(m_l - m_i)} \exp\left[\frac{-x^2}{2(\sigma_l^2 + \sigma_i^2)}\right] \delta x. \quad (6)$$

Note that $\frac{dP}{d(m_l - m_i)} > 0$, $\frac{d(m_l - m_i)}{dm_i} < 0$, $\frac{d(m_l - m_i)}{dm_l} > 0$ and $\frac{dP}{d(\sigma_l^2 + \sigma_i^2)} < 0$.

Furthermore, $|\frac{dP}{d(m_l - m_i)}| > |\frac{dP}{d\sigma_i^2}| > |\frac{dP}{d\sigma_l^2}|$.

The expected increase in time devoted to criminal activities will be larger when baseline wages change than when the dispersion of wages changes. As equation (6) shows, both m_i and m_l affect P quadratically, while $(\sigma_l^2 + \sigma_i^2)$ affects it linearly. We also expect inequality in legal labor markets to affect P less than inequality in illegal markets because we know that $\sigma_l^2 < \sigma_i^2$ ⁵. In other words, people will be more prone towards legality if illegal wages are generally diminished than if illegal wages' distribution is truncated.

The policy implications of this result are straightforward. As I discussed in the last section, Felipe Calderón has focus his efforts in capturing high-profile cartel leaders. Capturing drug lords is portrayed as more efficient because (a) it generates instability inside the cartel structure and (b) it sets an example for those who want to become part of the drug industry. My model predicts that (b) is mistaken. Capturing drug leaders is equivalent to reducing the variance of salaries inside the illegal markets by truncating the upper bound of drug traffickers' wage distribution. This is a less efficient deterrent than it would be to capture individuals from all wage levels inside the drug labor market. Mexico would do better in reducing the number of drug traffickers if they focus in capturing a random selection of all people involved in the business, instead of just the heads of the organization.

Proposition 3: Even if the expected salary of the individual in the illegal labor market is higher than his legal wages, he may not become a criminal if:

1. $U(w)$ is sufficiently concave.
2. The probability of conviction is sufficiently high.
3. The fine, given conviction, is sufficiently high.

Even if $w_i > w_l$, to have a solution in the range $0 < t_i^* < 1$ we need

$$(w_i - w_l)[EU'(W)] \geq p'(t_i)[U(w_u) - U(w_s)] - p(t_i)U'(w_u)F'$$

⁵Along this model we assume that labor markets clear and are perfectly competitive. If this were not the case, we would have W determined not only by the distribution of individual's ability but by other factors such as search costs, barriers to entry/exit, and so on.

$EU'(W)$ can also be expressed as $U'(w_s) + p(t_i)(U'(w_u) - U'(w_s))$. We know $EU'(W)$ will increase as the concavity of $U(w)$ increases. A very concave $U(w)$ means that as wealth increases, an extra unit of money gives marginally much less utility to the individual. Intuitively, individuals would become satiated faster with the money that they make. On the contrary, if $U(w)$ is less concave, individuals can be thought to be more “greedy” –they satiate their utility at a slower pace.

It can be shown that:

$$\frac{dEU'(W)}{dp} = U'(w_u) > 0$$

$$\frac{dEU'(W)}{dF} = -p(t_i)U''(w_u) > 0$$

Intuitively, when the probability of conviction or the fine increases, the value of $EU'(W)$ becomes bigger (or less negative). Note that if $\frac{1}{p(t_i)} > -\frac{U''(w_u)}{U'(w_u)}$ is true, increasing the probability of capture is a more efficient deterrent for crime than increasing the fines ⁶

This result is simple but powerful. Increasing the capacity of the state to capture criminals may be more efficient than increasing the fines because for risk-averse individuals becoming a criminal is less attractive when capture is highly possible. Yet, the threshold at which capture is a deterrent depends on how much individuals value money. Greedy individuals will have much more tolerance to risk.

Empirically, this seems to be the case. As Zetas normally state, they “prefer to live three years as kings than always as beggars. (Corchado 2009c)” They know that three years is the average life expectancy of a drug trafficker. Actually, some Zetas buy their own coffin with their very first paycheck (Rios 2009a).

Proposition 4: The distribution of ability into each occupation will be biased because of endogenous selection of occupations. In particular:

1. Higher ability entrepreneurs prefer to work as drug traffickers
2. Individuals with higher tastes for violence prefer to work as drug traffickers
3. Those who remain in the legal labor market (a) are lower ability entrepreneurs or (b) dislike violence.

⁶Normally, $U''(w_u)$ would be interpreted as a measure of risk aversion. Yet, I have some concerns about the validity of this interpretation under my setting. See Appendix for a more detailed discussion.

In a world where $0 > t_i^* > 1$, and given that both w_i and w_l are determined partially by an stochastic distribution of ability (see equations (1) y (2)), in equilibrium, w_i^* and w_l^* will be endogenously determined. Using equation (5) and (6), it we can shown that:

$$E(w_i|w_i > w_l) = m_i + \frac{\sigma_l \sigma_i}{\sigma_l^2 + \sigma_i^2} \left(\frac{\sigma_i}{\sigma_l} - \rho \right) \lambda \quad (7)$$

$$E(w_l|w_i > w_l) = m_l + \frac{\sigma_l \sigma_i}{\sigma_l^2 + \sigma_i^2} \left(\rho - \frac{\sigma_l}{\sigma_i} \right) \lambda \quad (8)$$

where

$$\lambda = \frac{\Phi(m_l - m_i)}{1 - \Phi(m_l - m_i)}$$

The second terms in (7) and (8) define the kinds of selection biases generated by individuals' income-maximizing behavior. Equation (7) shows that the average wage of new criminals may be better or worse than the average criminal wage before occupational change according to whether $\rho > \frac{\sigma_i}{\sigma_l}$ or not. Similarly, equation (8) shows that the average wage of a legal employee, once criminals have left the legal labor market, may be higher or lower than the average legal wage before occupational changes depending on $\rho > \frac{\sigma_l}{\sigma_i}$.

Define $Q_i = E(w_i|w_i > w_l) - E(w_i)$ and $Q_l = E(w_l|w_i > w_l) - E(w_l)$.

From equation (7) and (8) know that, when only considering ξ , $Q_i > 0$ and $Q_l < 0$ because

$$\frac{\sigma_l}{\sigma_i} < \rho < \frac{\sigma_i}{\sigma_l}$$

When only considering ν , $Q_i < 0$ and $Q_l > 0$ because

$$\frac{\sigma_l}{\sigma_i} > \rho > \frac{\sigma_i}{\sigma_l}$$

This is perhaps the most important result of the model. High ability, low-risk averse entrepreneurs prefer to work as criminals. In such a market they will have access to a farther right tale wage. Furthermore, those who select criminal jobs will outperform original criminals. Empirically, we would expect that criminals that got into illegal markets in P_{pan} are more violent and more entrepreneurial than those that were criminals in P_{pri} . As my discussion in section 1 showed, this is certainly the case. Negros and Zetas are known for their unprecedented violence and their ability to take part of several more entrepreneurial criminal businesses. They have created organizations of extortion and kidnapping in several towns around the border. Nuevo Laredo and Ciudad Juárez have been particularly targeted.

The model also predicts that individuals who dislike violence will remain in the legal indus-

try because their abilities cannot be sold into the criminal industry. This is certainly the case. As a Zeta stated: “I like to kill, that is why I have this job (Rios 2009b).”

Proposition 5: Patterns of talent drain can also be predicted:

1. Entrepreneurial talent drain from the legal to the illegal labor markets decreases as salaries in the legal labor market increases.

Consider what happens to Q_i when m_l changes:

$$\frac{Q_i}{m_l} = \frac{\sigma_l \sigma_i}{\sigma_l^2 + \sigma_i^2} \left(\frac{\sigma_i}{\sigma_l} - \rho \right) \frac{\delta \lambda}{\delta u}$$

We know that $\frac{d\lambda}{d(m_l - m_i)} > 0$, Thus, the sign of $\frac{Q_i}{m_l}$ will be determined by the sign of ρ . When $\rho > 0$ and sufficiently large –as is the case for ξ – $\frac{Q_i}{m_l} < 0$. A larger Q_i can be interpreted as larger entrepreneurial drain from the legal to the illegal labor market. Thus, as m_l increases, the rate of individuals that become criminals is going to be reduced.

This result is pretty intuitive. Individuals can sell their non-observable abilities either in the legal or in the illegal industry. As salaries increase in the legal market, individuals will remain less attracted to becoming drug traffickers.

2. Entrepreneurial talent drain from the legal to the illegal labor markets decreases as legal labor markets become more unequal.

Consider what happens to Q_i when σ_l changes:

$$\frac{Q_i}{\sigma_l} = \frac{\sigma_l \sigma_i^2}{(\sigma_l^2 + \sigma_i^2)^3} (\rho^2 - 1) \lambda - \frac{\sigma_i \sigma_l^2}{(\sigma_l^2 + \sigma_i^2)^3} \left(\frac{\sigma_i}{\sigma_l} - \rho \right) \left(1 - \frac{\sigma_i}{\sigma_l} \rho \right) \frac{d\lambda}{d(m_l - m_i)} (m_l - m_i)$$

Because $|\rho| \leq 1$, the first term is always going to be non-positive. The sign of $\frac{Q_i}{\sigma_l}$ will be determined by the signs of $\left(\frac{\sigma_i}{\sigma_l} - \rho \right) \left(1 - \frac{\sigma_i}{\sigma_l} \rho \right)$ and u . For simplicity, let's assume that $t_i^* \geq 0$ such that $(m_l - m_i) > 0$. Then, we know that $(\rho_\xi > 0)$, $\left(\frac{\sigma_i}{\sigma_l} - \rho_\xi \right) < 0$, $\left(1 - \frac{\sigma_i}{\sigma_l} \rho_\xi \right) < 0$, and $\frac{Q_i}{\sigma_l} < 0$.

Labor market inequality may have some positive externalities. As legal wage inequality increases, higher ability entrepreneurs get access to more right-tale wages which reduces the relative attractiveness of drug traffic. Talent drain from the legal to the illegal industry is reduced.⁷

⁷Note that, in a market where $(m_l - m_i) < 0$ such that

$$\frac{\sigma_l \sigma_i^2}{(\sigma_l^2 + \sigma_i^2)^3} (\rho^2 - 1) \lambda < \frac{\sigma_i \sigma_l^2}{(\sigma_l^2 + \sigma_i^2)^3} \left(\frac{\sigma_i}{\sigma_l} - \rho \right) \left(1 - \frac{\sigma_i}{\sigma_l} \rho \right) \frac{\delta \lambda}{\delta(m_l - m_i)} (m_l - m_i)$$

Drug traffic offers relatively larger salaries to high ability individuals. Individuals who know their high ability would prefer to work as drug traffickers because such jobs offer better top-end salaries. As salaries at the top become even more distant from salaries at the top of the legal income distribution, individuals become more prone towards drug traffic. It is not only levels of salaries what matter. For people at the right tail of the ability distribution, what matters the most is the dispersion. They know they will be at the tail of the income distribution. Thus, they only care about how far they can make it into the salary distribution. Keeping average salaries constant and equal, high ability individuals will always prefer to work in the market with higher variance. In this case, that is the illegal market.

Note however that this is not the case for tastes for violence. Those individuals who like violence are going to be well paid as drug traffickers but badly paid as legal employees. There will be a clear sort by taste. All those with high violence taste will go to the illegal industry and the opposite will be true for those who dislike violence. Unlike in the entrepreneurial ability case, in this case the legal and the illegal markets are not competing for individuals with the same characteristics.

3. Entrepreneurial talent drain from the legal to the illegal labor markets increases as the legal and illegal sectors become more similar (i.e. demand the same abilities in their employees).

Consider what happens to Q_i when ρ_l changes:

$$\frac{Q_i}{\rho} = \frac{\sigma_i \sigma_l^3}{(\sigma_l^2 + \sigma_i^2)^3} \left(1 - \frac{\sigma_i}{\sigma_l} \rho\right) \lambda + \frac{\sigma_i^2 \sigma_l^2}{(\sigma_l^2 + \sigma_i^2)^3} \left(\frac{\sigma_i}{\sigma_l} - \rho\right) \frac{\delta \lambda}{\delta u} u$$

For the case of entrepreneurs ($\rho > 0$) with $u > 0$, $\frac{Q_i}{\rho} < 0$. In words, as the abilities required by the drug industry became more correlated with the abilities required in the legal industry, entrepreneurs find more attractive to become criminals.

This result is particularly interesting because it shows a potential positive effect of Calderón's drug war. By increasing the difficulty of the drug business, the Mexican government is fostering that drug traffickers increase their demand for labor qualifications that are not valuable in the legal markets (i.e. tastes for violence). Indeed, as the drug business becomes less similar to the legal markets, it "compete" less with it. Talent sorts more

increases in wage inequality will generate larger (not smaller) entrepreneurial talent drains from the legal to the illegal industry.

adequately, leading those whose talents are valuable for the legal industries to remain there.

4 Conclusion

The results of my theoretical model, summarized in Figure 6, shows the reasons behind the changes in levels/scope/forms of violence that Mexico has experimented in recent years. As explained in section 2, even though Mexico has always been a major player in the illicit drug industry, recently drug-related violence has reached unprecedented levels. The type and scope of violence have also changed. Since 2003, violence is not only more common (measured as number of violent deaths) but also more intense. Criminals have become particularly bloody and cruel. Furthermore, other forms of organized crime, such as kidnappings and extortion, have also spiked.

Over the course of this paper I argued that the reasons behind these changes are to be found in the interaction between legal and illegal labor markets. A new generation of drug dealers has emerged in Mexico. They are more violent and more keen on criminal diversification. When the illegal labor market opened to outsiders in 2003 –and because of the larger variance in salaries in the illegal versus the legal industry– highly talented entrepreneurs and individuals with higher tastes of violence sorted into illegal occupations. These new drug traffickers have levels of entrepreneurial ability and violence that are much higher than those of the traditional drug traffickers. Furthermore, entrepreneurial talent is draining into the illegal labor markets.

Self-selection and talent run-off have been contained by recent efforts of the Mexican government. Felipe Calderón’s war against drug traffic has increased the probability of capture and fines for drug dealers. He has also reduced the profits of the drug industry which has in turn diminished salaries within illegality. Lower criminal salaries are indeed one of the major disincentives for people to devote time to illegality.

Yet, this strategy has not been efficient to deter very greedy individuals, or those who are less risk averse. Individuals that have very high tastes for violence may also not be deterred. Their abilities are much valuable in the drug industry than in any legal job. My model predicts that changing Mexico’s security policy towards capturing all types of drug traffickers (not just drug lords as has been the case) would create further disincentives for people to become drug traffickers. This is inferred from the fact that drug traffickers are more deterred by general changes in salaries than by truncating their wage distribution.

Finally, my model predicts that wage inequality may in fact have some positive externalities. Increasing the variance of wages in legal markets will reduce the attractiveness of illegal markets for highly able individuals. Talent drain is a negative function of inequality. Indeed, this result should be taken carefully. Inequality may be generated in several different forms and not all

of them will have as a result a decrease in the number of drug traffickers. Only increases in upper-tail inequality as payoffs to entrepreneur ability (or other abilities highly rewarded in both legal and illegal labor markets) will have as a result a reduction in criminal rates.

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Appendix

Further ideas to explore and main concerns

- General set up and order of the paper. A better organization of it may make the puzzle more attractive. I want the model to contribute to the understanding of a puzzle that otherwise would be intuitively difficult to grasp. Is this the case? How to do it better?
- Equations 1 and 2 may need to be formulated in a different way. I was thinking on instead of having two parameters for ability (e_l and e_i), just have one $e \sim N(0, \Sigma)$ where

$$\Sigma = \begin{vmatrix} \sigma_i & X \\ X & \sigma_l \end{vmatrix}$$

$$\sigma_i = \begin{vmatrix} \sigma_\xi & P & R \\ P & \sigma_\nu & R \\ R & R & \sigma_\tau \end{vmatrix}$$

$$\sigma_l = \begin{vmatrix} \sigma_\xi & N & R \\ N & \sigma_\nu & R \\ R & R & \sigma_\tau \end{vmatrix}$$

$0 > X > 1$, $0 > R > 1$, $P > 0$, $N < 0$. What I want is to express that (a) wages are determined by an stochastic distribution of abilities (normally distributed), (b) there are three abilities (entrepreneurial ability ξ , tastes for violence ν and others τ), (c) ξ contributes positively to wages in the illegal/legal labor markets, (d) ν contributes positively(negatively) to wages in the illegal(legal) labor markets, and (e) τ may contribute positively or negatively to legal/illegal labor markets. In addition, I do not know how to think about X intuitively.

- This model is about individuals but yields results that can be interpreted as aggregate. For example, my model predicts the share of the time that an individual would use to perform criminal activities. In the aggregate, this could be interpreted as the share of the population that is full time criminal. This would be more interesting. Yet, I do not know if this is a good idea or can be done with the model as it is now.
- Another interesting result, related to discussion in proposition 2, would be to think in terms of likelihood ratios. As in the classical results of a moral hazard problem, the likelihood ratio would tell us how important are abilities in determining final wages ⁸.

⁸In a moral hazard problem, the likelihood ratio determines how strong is the incentive scheme going to be according to how much information the output gives about the action

Likelihood would be defined as:

$$\begin{aligned} L &= \frac{\Phi'(m_l - m_i)}{\Phi(m_l - m_i)} \\ &= \frac{m_l - m_i}{\sigma_l^2 + \sigma_i^2} \end{aligned}$$

A low L would mean that abilities ($e_i - e_l$) give us few information about what the final wage ($m_l - m_i$) is going to look like. Some comparative statics could be done. For example, abilities are more informative when m_l is low, m_i is high and labor market inequality (σ_l^2 or σ_i^2) is higher.

Am I getting this right?

- In proposition 3, normally, $U''(w_u)$ would be interpreted as a measure of risk aversion. Three ideas/problems come to my mind:
 - First, in my setting, individuals are maximizing their utility with respect to t_i , not with respect to w . Risk aversion thus –I think– would be determined by $\frac{d^2U(w_u)}{dt_i^2} = U''(w_u)\left(\frac{\partial w_u}{\partial t_i}\right)^2 + U'(w_u)\left(\frac{\partial^2 w_u}{\partial t_i^2}\right)$, not by $U''(w_u)$. The confusion comes from the fact that w_u is a function of t_i . Furthermore, following convention I assumed that $U'(w) > 0$ and $U''(w) < 0$ which means that individuals cannot be risk lovers with respect to wealth (right?). The only idea that I come to joint all results/interpretations is that (a) individuals are not risk lovers with respect to wealth, (b) $U''(w_u)$ is not a measure of risk aversion, (c) $\frac{d^2U(w_u)}{dt_i^2}$ is a measure of risk aversion, (c) individuals can be risk lovers/averse/neutral with respect to t_i . Am I getting it right?
 - Second, if $U''(w_u)$ would be interpreted as a measure for risk aversion, what would be the interpretation of $U''(w_s)$ given that we know that $w_u = w_s - F(t_i)$?
 - Third, perhaps the best way to interpret $\frac{U''(w_u)}{U'(w_u)}$ is as “first order” likelihood ratio. A likelihood ratio (hazard rate) is defined as $\frac{f'(x)}{f(x)}$. The exact meaning of this idea, as well as the role of t_i and $F(t_i)$ would have to be determined.
- If risk aversion is defined as $\frac{d^2U(w_u)}{dt_i^2}$, the sign of the second order condition is partially determined by it.

Differentiating utility with respect to t_i yields the following results:

$$\begin{aligned}
\frac{dU(w_s)}{dt_i} &= \frac{dU(w_s)}{dw_s} \frac{\partial w_s}{\partial t_i} \\
&= U'(w_s)(w_i - w_l) \\
\frac{dU(w_u)}{dt_i} &= \frac{dU(w_u)}{dw_u} \frac{\partial w_u}{\partial t_i} \\
&= U'(w_u)((w_i - w_l) - F') \\
\frac{d^2U(w_s)}{Dt_i^2} &= \frac{d^2U(w_s)}{dw_s^2} \frac{\partial w_s}{\partial t_i} \frac{\partial w_s}{\partial t_i} \\
&= U''(w_s)(w_i - w_l)^2 \\
\frac{d^2U(w_u)}{dt_i^2} &= \frac{d^2U(w_u)}{dw_u^2} \frac{\text{partial}w_u}{\text{partial}t_i} \frac{\text{partial}w_u}{dt_i} + \frac{dU(w_u)}{dw_u} \frac{\text{partial}^2w_u}{\text{partial}t_i^2} \\
&= U''(w_u)((w_i - w_l) - F')^2 - U'(w_u)(F'')
\end{aligned}$$

Second order condition is given by:

$$\begin{aligned}
p'' [U(w_u) - U(w_s)] + 2p'[U'(w_u)((w_i - w_l) - F') - U'(w_s)(w_i - w_l)] + [p \frac{d^2U(w_u)}{dt_i^2} + (1 - p) \frac{d^2U(w_s)}{dt_i^2}] \\
= \alpha + 2\gamma + E[\frac{d^2U(w)}{dt_i^2}]
\end{aligned}$$

where

$$\begin{aligned}
\alpha &= p''[U(w_u) - U(w_s)] \\
\gamma &= p'[U'(w_u)((w_i - w_l) - F') - U'(w_s)(w_i - w_l)] \\
E[\frac{d^2U(w)}{dt_i^2}] &= p[U''(w_u)((w_i - w_l) - F')^2 - U'(w_u)(F'')] + (1 - p)[U''(w_s)(w_i - w_l)^2]
\end{aligned}$$

We can think on $E[\frac{d^2U(w)}{dt_i^2}]$ as the expected risk aversion of the individual once the probability of each realization of w has been taken into account. If $\frac{d^2U(w_u)}{dt_i^2} > 0$ individuals are risk prone; if $\frac{d^2U(w_u)}{dt_i^2} < 0$ individuals are risk averse, and if $\frac{d^2U(w_u)}{dt_i^2} = 0$ individuals are risk neutral. The same can logic can be applied to $\frac{d^2U(w_s)}{dt_i^2}$.

We know that $\alpha < 0$. The sign of γ depends on $((w_i - w_l) - F')$. γ will always be non positive unless $(w_i - w_l) > F'$. The most important variation comes from $\frac{d^2U(w_u)}{dt_i^2}$ and $\frac{d^2U(w_s)}{dt_i^2}$. The second term of $E[\frac{d^2U(w)}{dt_i^2}]$ is always negative. This means individual is always

risk averse with respect to income when crime is successful ⁹. The sign of the first term of $E[\frac{d^2U(w)}{dt_i^2}]$ depends on F'' . If

$$F'' < 0 \tag{9}$$

$$|F''| > \left| \frac{U''(w_u)((w_i - w_l) - F')^2}{U'(w_u)} \right| \tag{10}$$

individual is risk averse (with respect to w_u).

SOC would be negative (which means we would find corner solutions of the form $t_i^* = 1$ or $t_i^* = 0$ only if individual is sufficiently risk prone, equation (9) and (10) are fulfilled and $(w_i - w_l) > F'$. These are pretty restrictive conditions. Among other things, it means average wages in the criminal industry have to be larger than wages in the legal industry, expected salary when crime is unsuccessful has to be a positive function of t_i and penalties should be marginally increasing in t_i .

- I would like to improve the model by adding a condition in which after a certain threshold $t_i^* \geq c$, t_l becomes zero. This is, people spend part of their time in both legal and illegal activities, but once the size of their illegal activities becomes larger than c , they have to give up on any legal activity. Ideas on how to do this would be helpful.
- Finally, I would also like to calculate $\frac{\partial t_i^*}{\partial p}$ and $\frac{\partial t_i^*}{\partial F}$. In order to do this I need to use implicit differentiation. I do not know how to proceed mathematically on this endeavor but I thought on a way to cheat. If in equilibrium, $U(w_u^*) = U(w_s^*)$, mathematics are simplified significantly. Yet, I do not know how far interpretations would go with this cheat.

⁹I am not sure on whether this result is right. Should this be interpreted as risk propensity? In previous bullet I addressed this issue