The Effects of Enforcement on Illegal Markets: Evidence from Migrant Smuggling along the Southwestern Border

Christina Gathmann*

Stanford University

Abstract

Since 1986, enforcement along the Southwestern border has more than tripled. Using a unique dataset, the paper analyzes the effects of this dramatic increase on the illegal border crossing market. Controlling for endogeneity, increased enforcement has reduced illegal migration by only 10 percent, while increasing the prices charged by migrant smugglers ('coyotes') by 30 percent. Few migrants have switched to border smugglers, but the demand for coyotes is more price elastic than the demand for illegal drugs. Further evidence shows that illegal migrants have substituted away from heavily patrolled to more remote crossing routes. The resulting additional migration costs are roughly three times the direct effect of enforcement on smuggling prices.

*I thank Steve Levitt, Gary Becker and Michael Greenstone for helpful discussions and suggestions as well as Gordon H. Hanson for graciously supplying the sector-level enforcement data. Barry Chiswick, Libor Dusek, Henning Hillmann, Ali Hortacsu, Jenny Hunt, Guillermina Jasso, Sherrie Kossoudji, Costas Meghir, Derek Neal, Daniele Paserman, Sher Verick and participants at the European Economic Association, LACEA, the University of Chicago and the IZA Migration Meeting provided many useful comments. Financial support from the Margaret Reid Memorial Fund at the University of Chicago and the Hayek Fund for Scholars is gratefully acknowledged. All remaining errors are mine.

1 Introduction

Governments spend a sizeable fraction of their budget to deter and punish illegal activities. In the United States, federal expenditures to fight illegal drugs alone exceeded $6 billion in 2003. A primary motivation for the 'war on drugs' is the belief that stricter enforcement lowers drug supply and deters consumption.

To evaluate the effectiveness of this and other policies requires reliable estimates of how behavior in illegal markets responds to enforcement. For robbery, assault or murder, a number of studies have shown that criminals do respond to enforcement.[1] Evidence from other illegal markets, where conditions and incentives often differ substantially from the standard crime case, is in contrast limited.[2] Very little is known about how enforcement affects prices of illegal commodities, mostly because reliable data are difficult to come by.[3] Price adjustments however help to determine how enforcement affects the riskiness of supplying illegal commodities. Virtually nothing is known about this side of illegal markets. Deterrence of illegal behavior is also affected by the presence of other legal or illegal alternatives. Good illegal substitutes could render a narrowly targeted policy completely ineffective. A thorough understanding of the mechanisms and incentives in illegal markets are therefore required to design optimal enforcement policies and allocate public resources accordingly.[4]

This paper provides new evidence on the diverse effects of enforcement from the market for

[1] See for example, Ehrlich (1977), Levitt (1997), Tauchen, Witte and Griesinger (1994), Viscusi (1986), Witte (1980).

[2] In the case of illegal drugs for example, deterrence depends on two parameters: the effect of enforcement on drug prices and the price elasticity of demand. Several studies show that illegal drug use responds to market prices but that demand is typically inelastic. Estimates for drug participation range between -0.3 and -0.5 for cocaine or opium and -0.8 to -0.9 for heroin (Saffer and Chaloupka, 1995; Van Ours, 1995). In contrast, DiNardo (1993) finds a price elasticity close to zero.

[3] For illegal drugs, the existing estimates differ widely. Miron (2003) calculates that the gap between retail and farmgate prices for heroin and cocaine are between 2 and 80 times of legal goods. DiNardo (1993) finds a zero effect of drug seizures, while Kuziemko and Levitt (2001) show that enforcement and punishment raised cocaine prices by 10-15 percent.

[4] Becker, Grossman and Murphy (2005) for example show that costs of enforcement for society vary greatly depending on whether enforcement targets supply or demand in illegal drug markets.

illegal migration. An estimated 600,000 illegal migrants enter the United States each year, the vast majority along the border to Mexico. Efforts to seal the Southwestern border have increased dramatically over the last two decades. Figure 1 shows that since 1986, the budget of the border patrol increased sixfold while the hours federal agents spend patrolling the border tripled. This made the border patrol the fastest growing federal agency in the 1990s and increased its budget relative to the Drug Enforcement Agency from 45 percent in 1986 to 107 percent in 1998.

Stricter enforcement, by raising the probability of apprehension, increases the costs of crossing the border. The unique feature in this market is that illegal migrants can adjust their behavior along at least two margins: first, they can refrain from migrating illegally similar to the deterrence effect in the crime model. Alternatively, they can make an investment to lower their apprehension probability by hiring a smuggler. Smugglers are experts and have better information about where and when to cross the border without getting detected by the border patrol. Among migrants, they are known as 'coyotes' because, like their animal counterparts, they leave no trace behind - or so illegal migrants hope.

Extending the models of crime (Becker, 1968) and illegal migration (Ethier, 1986), the paper develops a simple framework to study the effects of enforcement on illegal behavior and derives its empirical implications. The deterrence effect in the model depends crucially on how enforcement affects prices and demand in the border smuggling market. Tighter enforcement increases the demand for smugglers. This works against a large deterrence effect as migrants can substitute to experts instead. The model also shows that the response of coyote prices can be used to calculate the effect of enforcement on the supply of smuggling services. Higher prices for coyotes increase costs for illegal migrants and thus lower migration propensities. The more smuggling prices increase and the smaller the substitution of migrants toward coyotes, the more effective is enforcement.

A second innovation of the paper is the use of a unique matched dataset for the empirical

analysis. The data contain the border crossing histories of over 2,000 illegal Mexican migrants, which provides information about where a migrant crossed the Southwestern border, whether a smuggler was used and how much was paid for the service. These individual data are linked to aggregate enforcement statistics from the Immigration and Naturalization Service and data on the punishments of illegal migrants and smugglers from the US Sentencing Commission.

Previous studies on illegal migration focused mostly on the direct deterrence of illegal migrants. Espenshade (1994; 1995) for example finds that tighter border enforcement did increase the probability of apprehension, but had no effect on the number of illegal migrants entering the United States. Similar results are reported by Kossoudji (1992), Donato, Durand and Massey (1992) and Massey and Singer (1995).[5] Equipped with the matched data and the theoretical predictions, this paper provides a more comprehensive investigation of how enforcement affects the demand for illegal migration and border smugglers and market prices for coyotes.

The empirical analysis first analyzes whether the small deterrence effect in the previous literature could be explained by endogeneity bias. If border enforcement responds to illegal migration flows, the deterrence effect estimated in the previous literature is biased toward zero.[6] To break the simultaneity between migration and enforcement, the drug budget of the Drug Enforcement Agency is used as an instrument for border enforcement.[7] The drug budget affects enforcement since the border patrol also fights drug trafficking along the Southwestern border. It has however no direct effect on migration except through border enforcement since drug and migrant smuggling have traditionally been separate businesses. Comparing the estimates from least squares and instrumental variables show that endogeneity bias is important. Even after accounting for endogeneity of border enforcement, the deterrence effect of border enforcement remains small. The instrumental variable

[5] Hanson and Spilimbergo (1999) find an elasticity of apprehensions with respect to border enforcement between 0.5 and 1.2. Since apprehensions are a noisy measure of the number of border crossers, it is difficult to compare.

[6] Some descriptive evidence on changes in prices and smuggler demand is provided by Donato, Durand and Massey (1995), Massey, Durand and Marone (2002), and Orrenius (2001).

[7] The instrument was first proposed by Angelucci (2004).

estimates suggest that the dramatic border build-up after 1986 has reduced the propensity to migrate illegally by only 10 percent. This translates into a decline in the annual inflow of temporary migrants by around 130,000.

One explanation for the small deterrence effect is that smuggling prices respond surprisingly little to enforcement. Smuggling prices increase by only 17 to 31 percent though enforcement more than tripled. This implies that the price elasticity of enforcement lies between 0.24 and 0.48. Under perfect competition, the price change provides information about the increase in the risk of supplying smuggling services. A back-of-the envelope calculation suggests that the risk of capture for coyotes rose by at most 3 to 5 percent after 1986. This implies that coyotes have been largely unaffected by the large increase of border resources.

At the same time, the demand for coyotes increased little in response to enforcement. Estimates of the demand parameters show that only 7 percent of migrants switch from crossing on their own to the using coyotes keeping smuggling prices constant. Smuggler demand does however respond to market prices. The price elasticites are around minus one and thus slightly higher than in the illegal drug market. Since both enforcement and prices are potentially endogenous, estimation is by instrumental variables. In addition to the drug budget as instrument for enforcement, the punishment for smugglers is used as instrument for coyote prices. The punishment is a cost shifter of the supply of smugglers but has no direct effect on smuggling demand conditional on the other control variables. Overall, substitution in the expert market can only partially account for the small deterrence effect of border enforcement.

Further analysis shows that large numbers of illegal migrants have shifted to less guarded sectors outside the main border cities. This limits the overall deterrence effect of enforcement as migrants can avoid enforcement along the popular crossing routes. Geographic substitution can also explain why the direct effect of enforcement on smuggling prices is small because the market demand

for coyotes in popular border crossing sectors declines. Finally, switching border sectors is also consistent with a small increase in the demand for coyotes because smuggler use in remote areas, where crossing is made difficult by natural conditions, has traditionally been low.

Since crossing in these remote areas is more dangerous, migrants today however face a much higher risk of dying as reflected in the rising death toll along the border. In addition, crossing in remote areas requires more time and smuggler services more expensive. Simple calculations show that these higher time costs and coyote prices amount to an additional expenditure of $110-$130 for illegal migrants, which is more than three times the direct effect of border enforcement on smuggling prices.

The results are robust to additional controls, changes in specifications and alternative sample definitions. Exploiting the panel dimension, fixed effect estimates to control unobserved heterogeneity does not change the results. If there are shifts in the costs or benefits of migration unrelated to increases in enforcement, the estimates could be affected by selection bias. Using data on individuals never migrating to control for composition changes does however not affect the results. Finally, the effects for permanent illegal migrants are similar or even smaller than those for temporary migrants. This suggests that the effects found for temporary migrants are roughly representative for the whole population of illegal migrants.

The evidence in this paper demonstrates that the effect of enforcement on illegal behavior depends crucially on the illegal alternatives available to the individual. While border enforcement has affected illegal migrants, substitution to more remote areas has not deterred many from crossing the border. The costs of avoiding tighter enforcement along popular crossing routes are almost 3 times the direct estimated effect of enforcement. This shows that indirect effects have a substantial impact on the overall effectiveness of enforcement policies and cannot be ignored as done in the previous literature. Instead of the current enforcement strategy, the paper proposes to introduce a

temporary legal permit for migrants in return for a fee. The proposed policy has three advantages over the current practice: first, it reduces the health risk for illegal migrants and improves their job opportunities in the United States. Second, it could largely eliminate the illegal smuggling market, which has often been blamed for carelessness and cruelty against illegal migrants. Finally, it would also benefit the United States by bringing in revenues from the sale of the permit and tax payments from legal temporary migrants.

The structure of the paper is as follows. The next section provides some background about illegal migration and changes in enforcement policy over the past two decades. Section 3 outlines a simple model of the illegal border crossing market and derives its empirical predictions. The dataset is introduced in Section 4, while the empirical results are presented in Section 5. Section 6 reports additional specification tests to demonstrate the robustness of the estimates. Section 7 discusses the policy implications, while Section 8 concludes.

2 Illegal Border Crossing and Enforcement

2.1 Characteristics of the Border Crossing Market

Illegal migration from Mexico to the United States has a long tradition driven by geographic proximity, large differences in wealth and limited legal entry.[8] Estimates from census data suggest that 250 to 350 thousand permanent migrants from Mexico enter the United States illegally each year (Warren, 2000). An even larger number cross the border as temporary illegal migrants. Apprehension data suggest that around 1.3 million illegal border crossings occurred each year in

[8] The end of the *Bracero Program* and the *Immigration and Nationality Act Amendment* in 1965 limited legal opportunities for Mexican migrants. The Bracero program had supplied up to 400,000 Mexicans per year to U.S. agriculture as temporary workers. After 1965, immigration visa favored relatives of U.S. citizens or permanent residents and those with special occupational skills. Both policies increased the pool of potential illegal migrants, since the changes in laws were not accompanied by a change in migration incentives. Also, population growth was 3.5 percent until the 1970s decreasing to 2.5 percent only in the late 1980s. This further increased the pool of potential migrants well into the 1990s.

the 1980s (Espenshade, 1995; Angelucci, 2004).

On average three out of four illegal migrants rely on coyotes to help them enter the United States, which are usually hired in the Mexican border towns.[9] Coyotes contact illegal migrants at major bus and train stations or in hotels popular with illegal migrants. There or at a later meeting, the parties agree on the price and desired destination in the United States. At night, the coyote meets a group of migrants on the Mexican side and takes them across the border.[10] The smuggling price depends on whether the migrant is brought only across the border or to his final destination in the United States and how difficult the border crossing is. More walking or swimming means a lower price. Usually, migrants pay half the price up front and the remainder upon safe arrival in the United States. Before border enforcement tightened, the average fee of a smuggler was around US$ 300 in 1983 dollars. This is roughly equivalent to three weeks of paid work as an illegal migrant.

On the other side of the market, detection and apprehension of illegal migrants is the primary task of the border patrol. While immigration inspectors handle the border traffic at legal points of entry, the majority of the border patrol's resources (63 percent in 1994) is devoted to patrolling the border in search of illegal migrants. These "linewatch hours", the hours per mile agents spend watching the border, are the measure of enforcement used in the empirical analysis below.[11] Most illegal migrants captured (98 percent of the 1.2 million Mexicans apprehended in 1994) enter the country without proper documentation, that is with no legal or false documents. Those apprehended usually spend little time in custody. The vast majority agree to be deported voluntarily and is simply returned to Mexico (95.3 percent in 1994). The rest faces a formal deportation hearing and is later deported or prosecuted in court. Prison sentences or fines however remain the exception.

[9] In some cases, the smuggler, often an illegal migrant with substantial border crossing experience, takes people from the same town in Mexico with him across the border (Lopez Castro, 1999).

[10] Most coyotes cross outside the legal crossing points. A much less popular method is to cross at legal points of entry with false documents.

[11] Other activities include traffic and transportation checks (19 and 4 percent in 1994 respectively) to detect illegal migrants further inland. Overall, 95 percent of apprehensions are done by the border patrol, while the remaining 5 percent are captured by investigations into criminal activities or work site enforcement.

The 1,989 miles Southwestern border with Mexico is the main point of entry for illegal migrants into the United States and accounts for 97 percent (1998) of all apprehensions, around 96 percent of them Mexicans.[12] Illegal border crossings have traditionally been concentrated in a few urban areas, where migrants just needed to jump over a fence. In more rural areas in contrast, migrants have to walk for hours or even days to reach their destination. Before enforcement tightened, the most popular entry route was the city borderline between Tijuana and San Diego. Of all illegal migrants apprehended, 45 percent were arrested in this sector, followed by 21 percent in the El Paso sector, in particular between the border cities Ciudad Juarez and El Paso. An additional 17 percent was captured in the Laredo sector, especially between Nuevo Laredo and Laredo. Microdata on actual migration flows support this pattern and show that more than fifty percent of illegal crossings occurred in the San Diego sector.

2.2 Changes in Immigration and Enforcement Policy

The *Immigration and Control Act* (IRCA) of 1986 marked a major shift how the U.S. government approached illegal migration. First, almost 3 million undocumented residents became legalized.[13] Further, the resources spent on border enforcement, especially along the Southwestern border, were increased substantially.[14] The border patrol budget more than doubled between 1986 and 1992. The main expansion began however in 1993, when several regional initiatives were launched to seal popular illegal crossing routes. In 1993, *Operation Hold-the-Line* in the El Paso sector focused its efforts on a 20-mile stretch of the border in the El Paso metropolitan area. The second big initiative, *Operation Gatekeeper* started in San Diego in October 1994. Within four years, enforcement staff

[12] See Figure 2 for a map of the nine border sectors.

[13] Illegal migrants, who had lived in the United States since January 1, 1982, were given permanent resident status. 1.8 million undocumented workers qualified for legalization and 1.6 million (of which 71 percent were from Mexico) obtained the residence permit. Temporary agricultural workers were granted permanent residence, if they had worked for at least 90 days in the agricultural sector in 1984, 1985 and 1986. 1.3 million farm workers were legalized through this Special Agricultural Workers (SAW) program, of which 81 percent were Mexicans.

[14] A third provision of IRCA required employers to verify their employees' eligibility of work. In reality, worksite enforcement has however remained very limited.

in San Diego increased by 150 percent. Initially, the additional resources were deployed along a 14 mile from the Pacific Ocean eastward into San Diego. It was later extended all the way to Yuma, Arizona. Big fences were constructed that covered 42.2 miles in 1998 compared to only 19 miles in 1994.[15] By 1998, the border patrol budget was six times its 1986 level. In addition, capital equipment expenditures rose by 45 percent between 1988 and 1996. Large numbers of motion detectors, infrared night scopes and "thermal imaging devices" were installed to track down migrants through their movements or body heat.

The *Illegal Immigration Reform and Immigrant Responsibility Act* of 1996 further increased enforcement. While in 1975, there was one border patrol officer for every 1.1 miles, today, there is one for every 1,000 feet or 0.2 miles. Along the border with Canada for comparison, there is one border patrol agent for every sixteen miles. Automated control systems were installed to facilitate detection of illegal repeat offenders and migrant smugglers. For the first time, prosecution and punishment of apprehened illegal migrants was increased. The median prison term of those convicted increased from 2 months in 1992 to 15 months in 2000. The caseload of immigration violations rose by 50 percent from 13,068 in 1994 to 22,071 in 2000, of which 70.25 percent (9,180) in 1994 and 90.65 percent (20,007) were convicted. These numbers remain however small relative to the more than one million border apprehensions each year.

3 Theoretical Framework

Building on the standard model of crime (Becker, 1968) and illegal migration (Ethier, 1986), this section outlines the incentives in the illegal migration market and how they respond to enforcement.

[15] Other operations included *Operation Safeguard* in Arizona (1995, extended 1999) and *Operation Rio Grande* in the southern Rio Grande Valley (1997).

3.1 Border Enforcement

Law enforcement, by raising the probability of apprehension and punishment, decreases the net benefit from illegal migration. Denoting enforcement efforts of the border patrol by L, the probabilities of apprehension for migrants ($prob$) and smugglers ($prob^E$) can be written as $prob = prob(L)$ and $prob^E = prob^E(L)$. The model assumes that $prob_L > 0$, $prob_{LL} < 0$ and $prob^E_L > 0$, $prob^E_{LL} < 0$, so there are decreasing returns to enforcement. With the border patrol's resources, a supply function for tolerated illegal border crossings can be derived. As a first approximation, enforcement is assumed to be determined exogenously.[16]

3.2 Supply of Expert Services

The decision to provide smuggling services is similar to the supply decision of a criminal. Potential smugglers have to evaluate the tradeoff between rewards and opportunity costs and expected punishments in the case of apprehension. For an income maximizing coyote, the expected net benefit is

$$P^E(L) - w^{alt} - prob^E(L)F^E - C(L)$$

where $P^E(L)$ is the price paid to the expert.[17] F^E denotes the punishment in case of apprehension. and w^{alt} the opportunity wagein a legal occupation. For simplicity, smugglers are assumed to provide homogenous smuggling services and face the same legal opportunities. C denotes all other cost components, which might be fixed or changing with enforcement, $C'(L) \geq 0$. This includes direct costs of smuggling people across the border like transportation or acquiring information about smuggling routes, as well as psychic costs of engaging in an illegal activity, i.e a "distaste for

[16] Optimal border enforcement levels with and without the presence of experts are derived in Appendix C. Since punishment levels play only a minor role and did not change much over the sample period, they are taken as given.

[17] The fact that migrants pay up to 50 percent up front complicates the calculation somewhat, but does not alter the basic result. Since a coyote takes several persons per trip, group size also matters for total earnings.

crime".[18] The supply of expert services is increasing in $P^E(L)$ and nonincreasing in the probability of apprehension ($prob^E(L)$), punishment upon apprehension (F^E) and the opportunity cost of working in the legal sector (w^{alt}).

Anecdotal evidence suggests that the supply side of smuggling services has been competitive over the sample period. Most coyotes had been illegal migrants themselves who later switched occupations or tried to earn extra money by smuggling. Since there are many illegal migrants with long border crossing histories, the pool of potential suppliers is large. Under perfect competition, the equilibrium price is

$$P^E(L) = w^{alt} + prob^E(L)F^E + C'(L) \tag{1}$$

In addition to the opportunity costs he incurs (first term), the smuggler also has to be compensated for the risk of being detected and punished (second term) as well as any additional inrease in marginal costs (third term).[19]

3.3 Decision Problem of Illegal Migrants

An individual has to make two decisions: whether to migrate illegally or stay and whether to use an expert to cross the border. Migration decisions are driven by the present value of migration net of total migration costs. Following the literature, migrants are risk neutral and maximize expected income. The benefit from migration is the real earnings differential between a job in the United States and Mexico ($\triangle w = w^{US} - w^{MX}$).[20] Migration costs are determined by the difficulty of

[18] The cost components could be individual-specific, if coyotes differ in smuggling ability, legal labor market skills or distaste for crime. For simplicity, the model abstracts from potential heterogeneities.

[19] The decision to become a smuggler is taken as given. One could include the accumulation of border crossing experience, for example by learning from other smugglers. This leads to heterogeneity in $prob^E$, as learning decreases the probability of apprehension and thus smuggling prices.

[20] This assumes that smugglers affect border crossing costs, not the benefit from migration. Less than 5 percent of migrants in the data report that smugglers helped finding a job.

crossing the border. Since these migrants engage in an illegal activity, the propensity to migrate decreases in the probability of getting caught, $prob(L)$, and the punishment upon apprehension, F. For simplicity, it is assumed that illegal migrants attempt to cross the border only once.

Potential illegal migrants differ in border crossing ability and the benefit from working in the United States. Individuals with high θ are less likely to be caught at the border, i.e. $prob\,(\theta, L)$ with $prob_\theta\,(\theta, L) < 0$. High-ability illegal migrants also have a larger benefit from migrating, because they can get better jobs in the United States. Thus, $\triangle w = \triangle w(\theta)$ with $\triangle w_\theta(\theta) \geq 0$.[21] θ is distributed according to a continuous and differentiable cumulative distribution function $G(\theta)$ with support $[\theta_{\min}; \theta^{\max}]$.

The unique feature in this market is that migrants can make an investment to lower their probability of apprehension. If hiring an expert, he pays the price P^E and purchases the smuggler's probability of apprehension, $prob^E(L)$. Since coyotes have better information about smuggling routes, easier access to false documents and other border crossing technology, their probability of apprehension is lower than for migrants crossing by themselves ($prob^E(L) \leq prob\,(\theta, L)$ for all θ). The illegal migrant hires a coyote as long as the expected benefit from doing so is higher than crossing by himself. Thus,

$$(2) \qquad (1 - prob^E(L))\left(\triangle w(\theta) - P^E(L)\right) - prob^E(L)F \geq (1 - prob(\theta, L)) \triangle w(\theta) - prob\,(\theta, L)\,F$$

Rearranging (2) yields that a migrant hires an expert as long as

$$(3) \qquad P^E(L) \leq \left(\frac{prob\,(\theta, L) - prob^E(L)}{1 - prob^E(L)}\right)(\triangle w(\theta) + F)$$

[21] The model could be generalized so that migrants differ along two dimensions. Net benefits from migration and costs are then driven by two different parameters. The setup here is a special case of this general model, where the two parameters are perfectly correlated.

The right-hand side is the expected benefit from hiring an expert, whereas the left-hand side measures the cost. The willingness to pay for a coyote increases in the wage differential, the expected punishment and the migrant's probability of apprehension.[22] The larger the difference in the apprehension probabilities of expert and migrant ($prob\,(\theta, L) - prob^E(L)$), the higher the benefit from hiring an expert. If the difference is small, expert and migrant are close substitutes. (3) defines a threshold θ^{**} where the equation holds with equality.[23] Migrants with $\theta > \theta^{**}$ try to cross the border alone whereas those with $\theta < \theta^{**}$ hire an expert.

In turn, the decision to migrate illegally ($D^M = 1$) depends on its full costs and benefits

$$\begin{aligned} (4) \qquad & \triangle w - (1 - D^E) prob(\theta, L)(\triangle w + F) - \\ & -D^E \left[prob^E(L)\,(\triangle w + F) + (1 - prob^E(L)) P^E(L) \right] \geq FC \end{aligned}$$

where FC are fixed costs to cross the border, for example transport costs, and $D^E = 1$ if the migrant hires an expert and zero otherwise. Appendix B shows that the two choices divide the suppport of the ability parameter θ into three subsets: individuals with $\theta < \theta^*$ remain at home, those with $\theta^* \leq \theta \leq \theta^{**}$ migrate and hire an expert and individuals with ability $\theta > \theta^{**}$ migrate and cross the border alone.

Market demand for experts is then given by aggregating over all those willing to pay for a coyote

$$D^E = \int_{\theta^*}^{\theta^{**}} g(u)du = G(\theta^{**}) - G(\theta^*)$$

[22] The derivative with respect to migrant ability θ is negative for high-ability and potentially positive for low-ability migrants. The term in brackets can go to zero at very high or low enforcement levels but is strictly positive in between. This captures the fact that the value experts is zero if there is no or prohibitive enforcement.

[23] See Appendix B for a derivation. To ensure the expert market is covered requires that

$$P^E \leq \left(\frac{prob\,(\theta_{\min}) - prob^E}{1 - prob^E} \right) (\triangle w(\theta_{\min}) + F)$$

The condition says that the individual with lowest ability always prefers to hire an expert (though he might choose not to migrate). Since the smartest person never hires an expert, this implies that the threshold exists. If coyote prices are very high, the condition might not hold.

whereas total demand for illegal migration is

$$D^M = \int_{\theta^*}^{\theta^{\max}} g(u)du = 1 - G(\theta^*)$$

3.4 Comparative Statics

Stricter enforcement L raises the probability of apprehension for self-crossers and coyotes. Because coyotes are experts and can adapt more easily to changing conditions, they are less affected by increased enforcement, so $prob^{E\,\prime}(L) < prob'(\theta, L)$. A higher probability of apprehension raises marginal costs and thus expert prices to compensate for higher risk or effort, for example by crossing in more dangerous areas. Formally, the derivative of smuggling price with respect to enforcement is

$$\frac{\partial P^E}{\partial L} = \frac{w^{alt} + F^E}{(1 - prob^E(L))^2} \left(\frac{\partial prob^E}{\partial L} \right) > 0 \tag{5}$$

The effect on smuggler prices is larger the more enforcement increases the expert's probability of apprehension. The derivative is also increasing in the punishment upon apprehension and the opportunity wage. The relationship between price and coyote punishment is exploited below to derive an instrumental variable for smuggling prices.

Since $prob^{E\prime}(L) < prob'(\theta, L)$, tighter enforcement also increases the effectiveness of experts relative to self-crossing migrants. This raises the value of smuggling services (see (3)) and induces some self crossers to switch to experts. The substitution effect is given by the derivative of smuggler use with respect to enforcement keeping smuggling prices constant

$$\frac{\partial D^E}{\partial L} = -g(\theta^{**}) \frac{P^E \frac{\partial prob^E}{\partial L} + (\triangle w + F) \left(\frac{\partial prob(\theta^{**})}{\partial L} - \frac{\partial prob^E}{\partial L} \right)}{-\left(prob^E - prob\left(\theta^{**}\right)\right) \frac{\partial \triangle w}{\partial \theta^{**}} + \left(\triangle w(\theta^{**}) + F\right) \frac{\partial prob}{\partial \theta^{**}}} \tag{6}$$

where the dependence on enforcement is kept implicit. Substitution to coyotes is larger the more their effectiveness increases relative to migrants $\left(\frac{\partial prob(\theta^{**})}{\partial L} - \frac{\partial prob^E}{\partial L}\right)$ and the higher the difference between migrant and expert probability of apprehension $\left(prob\left(\theta^{**}\right) - prob^E\right)$. Since substitution and price effect work in opposite directions, the net effect of enforcemet on smuggler demand is ambiguous. If the price increase is small, the substitution effect might dominate and the demand for experts goes up. In contrast, if the price increase is large because enforcement is very effective in raising the expert's apprehension probability, but smuggler demand increases little with enforcement (the substitution effect is small), the overall demand for experts declines.

Finally, by increasing the threshold for illegal migration, some individuals refrain from migrating illegaly. The deterrence effect of enforcement for illegal migration is given by

$$\frac{\partial D^M}{\partial L} = -g(\theta^*)\left(\frac{\triangle w(\theta^*) + F + F^E}{(1 - prob^E(L))\,\frac{\partial \triangle w}{\partial \theta^*}}\right)\left(\frac{\partial prob^E}{\partial L}\right)$$

The size of the deterrence effect depends on how much enforcement increases the probability of apprehension for coyotes. It is also increasing in the punishment for migrants and experts.

4 Data and Descriptive Evidence

The dataset comes from the Mexican Migration Project, which has interviewed a random sample of 200 households in two to five Mexican communities each year since 1982.[24] A unique feature is that detailed information about the household head's illegal migration history including the year, location of border crossing, number of apprehensions and the price paid for a coyote are available. The survey also records wages earned in the United States, on the last job in Mexico and demographic information on the individual migrant, household and family in the United States.

[24] See the data appendix for details on the construction of the dataset. The communities represent a wide range of regions, ethnic compositions and economic conditions. All have a long tradition of sending migrants to the United States (see also Mexican Migration Project, 2001).

The individual-level data is matched to enforcement records from the Immigration and Naturalization Service and punishment statistics of the United States Sentencing Commission. Border enforcement is measured by the hours border patrol agents spend patrolling the border per border mile ("linewatch hours") in each of the nine border sectors. Punishment is measured as the mean prison terms in days for immigration violations and migrant smuggling for each year and five district courts along the Southwestern border.

Of the 9,184 household heads in the sample, two-thirds have never migrated to the United States. Roughly 3,000 household heads had some migration experience, of which 74 percent entered illegally at least once.[25] On average, 77 percent of illegal migrants in the data use an expert to cross the border. Table 1 compares the characteristics of coyote users and self crossers over the sample period. Self crossers are somewhat older and slightly more educated than coyote users. They also have accumulated more border crossing expertise. Self crossers live in households with more migration experience, are more likely to cross the border alone and have more extended family members in the United States.[26] Coyote users in contrast are much more likely to be on their first illegal trip, originate from smaller communities where a larger fraction of men had migration experience and thus access to border smugglers.

5 Empirical Results

5.1 Deterrence Effect of Illegal Migrants

The main goal of the massive expansion of border patrol resources has been to deter potential migrants from travelling to the border. The deterrence effect of enforcement is estimated using the

[25] In the data, 51 percent migrated to the United States 5 or more times. Another 33 percent went to the United States between 2 and 5 times, while the remaining 16 percent went only once. The median number of trips by illegal migrants is 4 and the median duration 12 months.

[26] If a migrant reports several attempts to cross the border, it is only observed whether he employed a smuggler in any of the attempts. If some migrants first try to cross the border alone and switch to experts after they are caught, the apprehension probability of expert users is biased upward.

following linear probability model

$$\Pr(D_{it}^M = 1) = \alpha^M + \beta^M L_t + \gamma^M X_{it} + u_{it}^M$$

where the dependent variable is the propensity that individual i begins a new illegal trip to the United States in year t. L_t denotes the number of linewatch hours the border patrol spends patrolling the border and X_{it} are control variables that affect the illegal migration decision.

If the border patrol responds to changes in the smuggling market, enforcement efforts are endogenous though likely to occur with a time lag. For example, a boom in the U.S. economy increases incentives to migrate illegally and could also increase enforcement. Least squares estimates of β^M are then biased toward zero. To account for this endogeneity, the above equation is estimated by two-stage least squares. Finding a good instrument for border enforcement is made even more difficult by two features of the migration market: first, border enforcement is a national policy and resources largely determined by the federal government. Even if one can find an instrument with time and geographic variation, it would not help in estimating the deterrence effect on illegal migrants because it is unknown where individuals that chose not to migrate would have crossed the border.

In the estimation, the budget of the Drug Enforcement Agency (DEA) is used as an instrument for border enforcement. According to the agency's estimates, a large fraction of drugs smuggled into the United States enter along the Southwestern border. With the *Anti-Drug Abuse Act* of 1988, the states along the Southwestern border were the first designated as High Intensity Drug Trafficking Areas. Substantial efforts were undertaken to coordinate and strengthen local, state, and federal law enforcement. The fight against drugs increases border enforcement against illegal migration. Accounts from illegal migrants as well as coyotes captured at the border and interviews with border

patrol personnel suggest that drug smuggling and coyotes are separate businesses. The main resons is that smuggling migrants together with drugs would spread information about successful drug routes. This would substantially increase the risk of capture for the highly profitable drug trade and of long imprisonment for drug smugglers. While the budget of the DEA affects the resources of the border patrol, the tasks of the DEA are spread over many activities and areas other than the Southwestern border. This makes it unlikely that changes in the illegal migration market affect the DEA budget leading to problems of reverse causality.

The first-stage reported in the first columns of Table 2 (1st Stage(1)-(3)) shows that the budget of the Drug Enforcement Agency has inded a positive and significant effect on border enforcement. Subsequent columns report the least-squares (odd columns) and instrumental variable estimates (even columns) of the migration propensity. The effect of enforcement on migration propensities is negative, but small for both least squares and instrumental variable estimates. The deterrence effect becomes more pronounced as controls for individual heterogeneity, the community and Mexican state of residence are included (column (4)). It drops sharply once aggregate controls like the US unemployment rate, the growth rate of the US economy, the number of Mexicans naturalized, Mexico's Gross Domestic Product and population are added (column (6)). Comparing least squares and instrumental variables shows that accounting for endogeneity increases the deterrence effect as expected. Other variables have the expected sign. Higher earnings prospects in the United States have a large positive, while potential earnings in Mexico a negative effect on the propensity to migrate. Older and more educated individuals are less likely to migrate illegally. Family in the US and migration experience in the household increase the likelihood, while owning a business or land in Mexico reduce it.[27] The deterrence elasticity in the last row show that illegal migration responds to enforcement but that demand is not very elastic.[28]

[27] Women are more likely to migrate conditional on other characteristics, though only 1.5 of all women migrate in the sample compared to 6.5 percent of men.

[28] Recent evidence also suggests that illegal migrants stay longer in the United States in response to increased

The estimates of the preferred specification in the last two columns suggest that the total border build-up has reduced the propensity to migrate by roughly 10 percent. Based on estimates of the annual inflow of temporary migrants, this translates into a reduction of the gross inflow by around 130,000 temporary migrants. These results are higher than previous estimates in the literature, which underlines that accounting for endogeneity is important.

5.2 The Response of Smuggling Prices

The model showed that deterrence depends crucially on how probabilities of apprehension respond to enforcement. As these are unobservable, price changes can be used to infer changes in the risk of smuggling services. Virtually nothing is known about how enforcement affects the supply side in this market. The response of market prices to enforcement is important in its own right as very little is known about supply effects in illegal markets. Figure 2 shows that as enforcement tightened after 1986, smuggling prices doubled from \$273 to \$550. Most of the increase is concentrated after 1993, when the border patrol began to seal popular crossing routes. To control for observable characteristics of illegal migrants and aggregate shocks, the following equation is estimated

$$P_{it}^{E} = \alpha_P + \beta_P L_t + \gamma_P X_{it} + u_{it}^{P}$$

where the dependent variable P_{it}^{E} is the smuggling price reported by migrant i using a coyote in year t. L_t denotes border enforcement in year t and X_{it} other variables affecting smuggling prices. The primary parameter of interest is β_P measuring how enforcement affects market prices. If the border patrol responds to changes in the smuggling market, β_P is biased upward. The price

enforcement (Angelucci, 2003; Reyes et al., 2002). Longer duration of illegal trips lowers the demand for illegal migration and therefore the size of the smuggling market. If there is positive selection into duration of stay, the more able migrants remain longer in the United States. Since these have higher border crossing ability than the average migrant, they are less likely to use an expert and would pay less. Longer duration then results in an upward bias in the enforcement effect on smuggling prices, while the substitution effect for smuggling demand is downward biased.

equation is therefore estimated by two-stage least squares with the Drug Enforcement Agency budget as instrument.

The results of both least-squares and instrumental variable estimates are reported in Table 3.[29] The first three columns (1st Stage) show the first-stage, where the dependent variable is the number of linewatch hours in a given year. The instrument has a strong positive and significant effect on the number of linewatch hours across all specifications. The right part of the table shows the instrumental variable (even columns) and ordinary least-squares estimates (odd columns). Enforcement has a positive effect on smuggling prices but the effect is small. As expected, the instrumental variable estimates are smaller than least squares. The first specification includes migrants' and community characteristics to control for heterogeneity in access to coyotes and smuggling costs. They include the individual's age, gender, education, whether he is a first-time migrant and whether he crosses alone. State dummies are included to control for transport costs to the border. Columns (3) and (4) include a linear time trend to control for aggregate shocks shifting enforcement and smuggling prices. Least squares remains small and significant, while the instrumental variable estimate turns negative and is not statistically significant.[30] Instead of a linear time trend, columns (5) and (6) use Mexico's population and Gross Domestic Product, the number of Mexicans naturalized in the United States and the U.S. unemployment rate. Least squares and instrumental variable estimates become even smaller. Other variables have largely the expected sign. Migrants crossing the border without their family pay lower smuggling prices. Older migrant, women and those with more education pay higher prices, while first-time migrants pay less. Finally, migrants from households with a lot of migration experience pay lower prices, potentially because they have better information about coyotes.

[29] The pricing equation could also be estimated in logs. This puts more weight on changes in sectors with traditionally low enforcement. The effects on prices were overall somewhat weaker and standard errors higher.

[30] If a quadratic trend is added, the standard error increases sharply but the enforcement estimate remains negative. This suggests that the quadratic trend absorbs most of the variation in the instrumented variable.

The estimates from the preferred third specification imply that the direct effect of the post-IRCA border build-up on smuggling prices is a mere \$25 (IV) to \$45 (OLS). Tighter enforcement can thus only explain between 10 and 16 percent of the overall price increase. The corresponding elasticities reported in the last row are small. In a perfectly competitive market, changes in the smuggling price just compensate the coyote for the higher risk facing smugglers.[31] From the model, prices change according to $\triangle P^E = \triangle prob^E * F$. The median prison term F in the early 1990s was 2 months, which translates into \$840 of potential earnings lost. The estimates then suggest that the apprehension probability for coyotes has changed by only 3 to 5.4 percent.[32]

The estimates above relied on time series variation in border enforcement. There is however substantial variation in enforcement and prices across the nine sectors of the Southwestern border. Enforcement in the urban areas like San Diego is more difficult, while border crossing much easier than in the desert or mountains further inland. To exploit this cross-sectional variation, Table 4 reports least-squares estimates, where the enforcement variable is now the number of linewatch hours per border mile in each sector. Column (1) shows that enforcement levels are positively correlated with smuggling prices, but the correlation is again weak. In column (2), dummies for the border crossing sector and year of migration as well as migrant characteristics are added. Sector fixed effects, by absorbing all time-constant sectoral differences, control for the fact that natural conditions make crossing in some sectors more difficult and dangerous. Year fixed effects in turn control for all aggregate shocks that affect both smuggling prices and enforcement. Both sets of fixed effects are jointly highly significant. Though the enforcement effect increases substantially, it

[31] If smugglers have market power and smuggler demand becomes less elastic after 1986, this could also explain the price increase. Empirical estimates however did not show that demand became less elastic over time.

[32] This calculation is an upper bound as punishment also increased during the 1990s. If smugglers invest in lowering their apprehension probability, prices would rise but the probability would remain constant or even decrease. There is some evidence that smuggling has become more sophisticated after the border build-up. As one smuggler remarked: "It's a game between cat and mouse. We adjust and they [the border patrol] adapt; they adjust and we adapt". Cell phones to warn smugglers of current locations of border patrol agents have replaced the traditional flashlight. The business has also become more specialized often consisting of a recruiter in the Mexican border town, a guide across the border and a delivery person that drives migrants to their U.S. destination if desired. This decreases the risk of apprehension for each individual smuggler and allows use of low-wage individuals for less demanding tasks.

remains statistically insignificant.

If migrants switch border crossing sectors to avoid enforcement along popular crossing routes, this induces a negative correlation between enforcement and smuggling prices. In fact, if migrants are perfectly mobile, an increase in enforcement in one sector leaves prices unchanged as this is just offset by migrants switching to less guarded sectors. Column (3) therefore includes the mean linewatch hours of the two neighboring sectors. The coefficient on enforcement increases substantially and is now statistically significant. Finally, column (4) uses aggregate control variables instead of year dummies. The enforcement effect further increases. The price effect of enforcement from neighboring sector is actually larger than the direct effect suggesting that border switching is indeed important. A comparison of changes in raw price within and across sectors confirms this. For example, coyote prices in a popular crossing point like Tijuana increase by 24 percent from US$240 before 1986 to US$300 thereafter. This is much less than the increase in overall prices.

The estimates in column (3) and (4) imply that an increase in enforcement of one standard deviation or 4,850 hours per border mile would increase smuggling prices in that sector by $31 to $35. An increase in enforcement in the neighboring sectors by one standard deviation or 1,740 hours raises prices by an additional $30 to $42. Their contribution to changes in average smuggling prices depends on the numbers of migrants crossing in the different sectors. Translated into elasticities, a 10 percent increase in overall enforcement therefore raises overall smuggling prices by 3 percent. While enforcement has an effect on market prices, the main effect is indirect through migrants switching sectors to avoid enforcement. Note that the elasticities in Table 4 are not directly comparable to those in Table 3, because in the latter enforcement at neighboring sectors is held constant. Elasticities based on time series variation are about twice as large as the direct enforcement effect, but similar once the indirect effect from neighboring sectors is taken into account.[33]

[33] The fact that standard errors from sector-specific enforcement are higher than those based on time series variation suggests that measurement error is an issue. This could arise if migrants falsely report their border crossing place

5.3 The Demand for Smuggling Services

A second explanation for the small deterrence effect found above could be that migrants substitute toward expert smugglers in order to avoid enforcement. To estimate how the demand for coyotes responds to enforcement and prices, the following linear probability model is specified

$$\Pr\left(D^E = 1\right) = \alpha_E + \beta_E P_{jt}^E + \gamma_E L_{jt} + \delta_E' X_{it}^E + u_{it}^E$$

where the dependent variable is whether a migrant uses a coyote in year t. P_{jt}^E and L_{jt} denote the smuggling price and enforcement in sector j and year t respectively, while X_{it}^E represents other variables affecting smuggler demand. The parameters of interest are the price elasticity of the demand for coyotes derived from β_E, which should be negative, and the substitution effect between self crossing and coyote use (γ_E), which is expected to be positive. If experts can price discriminate between migrants based on characteristics unobservable to the econometrician, the expert price is correlated with the error term. This understates the price elasticity of demand. Similarly, if enforcement is increased more in sectors where coyote use is high, the substiution effect is overstated. Two-stage least squares are used to address the endogeneity issues with the budget of the Drug Enforcement Agency as an instrument for border enforcement. For the expert price, the theoretical model suggests one candidate instrument: the punishment for experts in the case of apprehension (F^E). The expected punishment shifts the cost of providing smuggling services. As punishment for experts increases, the price of smuggling increases or the supply of experts decreases because of deterrence and incapacitation effects. The punishment for experts however has no direct influence on the demand for smugglers conditional on other variables except through prices.[34]

and are matched to the wrong enforcement variable. Measurement error in enforcement would bias the least-squares estimates, but the direction of the bias is unclear.

[34] The estimation below controls for the punishment of illegal migrants upon apprehension. A potential concern with the instrument is that punishment levels are determined by the district courts. If courts adjust their sentencing practice to changes in migration flows or a third factor affects both enforcement and sentencing, the instrument is

The left hand side of Table 5 reports the first-stage of the instrumental variable estimates. As expected, tougher punishment for smugglers increases coyote prices, while a higher drug budget raises enforcement. The least squares (columns (1) and (3)) and two-stage least squares (columns (2) and (4)) estimates are shown on the right. The instrumental variable estimate of the price effect is negative across all specifications. As expected, it is larger in absolute value than least squares. The partial effect of enforcement on smuggling demand is in contrast small for both specifications. To control for individual heterogeneity in the demand for experts, education, age, gender, marital status, whether the migrant crosses alone, and the potential benefit from migration are included. Since people with more border crossing experience are less likely to use expert, controls for whether the migrant is on his first trip, the total number of prior trips to the United States and the migration experience of the household in Mexico are used. Also included are variables for wealth and prior migration experience in the migrants' community, state dummies to proxy for transportation costs and controls for macroeconomics changes like the unemployment rate, the number of Mexicans naturalized, Mexico's Gross Domestic Product and population. The second specification (columns (3) and (4)) uses a linear time trend instead to control for aggregate shocks to smuggling demand. The control variables have the expected sign though few are statistically significant. For example, married and female migrants are more likely, more educated individuals and those with prior migration experience less likely to use a coyote.

The implied elasticities shown at the bottom of Table V suggest that the substitution effect toward experts is small. The enforcement build-up after 1986 increased smuggling demand by only 7 percent keeping prices constant.[35] In contrast, the demand for coyotes is price elastic and

invalid. The instrumental variable estimate is then a lower bound and the true price effect lies between least squares and instrumental variables. Finally, the instrument is only available from 1991 onward. Least squares result suggest that the effect of enforcement and prices on smuggler demand becomes somewhat stronger in the 1990s. The time period can therefore not explain the small effects.

[35] Sectoral switching can explain why the substitution effect is so small. The raw data shows that before the border build-up migrants crossing in high enforcement sectors are much more likely to use a smuggler than those in less patrolled areas. This suggests that smuggler services are primarily valuable for avoiding apprehension by the

elasticities are somewhat higher than in the illegal drug market. As the price effect dominates, the propensity to use an expert decreases after enforcement tightens. Since in addition, some people refrain from migrating, the overall number of people smuggled by coyotes declines.

5.4 Substitution to More Remote Border Sectors

What then can explain that coyote prices have responded little to enforcement and that few migrants have switched to coyotes after the border build-up? This section provides evidence that enforcement shifted migrants to more remote areas in Arizona or New Mexico and analyzes its effect on illegal migration costs. Before enforcement tightened, two-thirds of illegal migrants in the dataset entered the United States along the San Diego or El Paso sector, in particular in the cities of Tijuana and Nuevo Laredo. Between 1986 and 1998, the fraction of migrants entering through sectors other than California increased from 39 percent to 58 percent. Migrants also substituted within each sector from crossing in cities to more rural and desolated areas. Before 1993, almost 90 percent of migrants crossing in the San Diego sector did so in Tijuana. The fraction decreases to 70 percent in the late 1990s. Aggregate apprehension data, though a noisy measure of migration flows, support this pattern.[36] Table 6 shows that apprehensions in the two most popular crossing sectors, San Diego and El Paso, decline dramatically over the 1990s in absolute number and as a fraction of total apprehensions. Whereas in 1993, 68 percent of apprehensions occurred in San Diego and El Paso, by 2000 the number had dropped to 16 percent. In contrast, apprehensions in Arizona, where migrants need to pass through long stretches of desert, have more than quadrupled, from 10 percent in 1993 to 44 percent in 2000.

border patrol. In sectors with low enforcement like Arizona, crossing is made difficult by natural conditions. If many migrants switch from popular to remote sectors, enforcement and coyote use are negatively correlated. Indeed, coyote use declines in the data between 1986 and 1992.

[36] Aggregate apprehension data are noisy measures of the number of illegal border crossings for two reasons. First, most illegal migrants are never caught or if apprehended cross at some later point. Apprehensions then underestimate the number of attempts in the former case or overestimate it in the latter. Second, though more enforcement increases the probability of apprehension, it also deters people from migrating illegally to the United States. The net effect on the number of apprehensions is therefore ambiguous.

Tighter enforcement, if effective, increases the probability of apprehension and thus the number of border crossing attempts. However, if migrants substitute toward less patrolled areas, this reduces the impact of enforcement. In the data, the overall number of attempts actually decreased from 1.6 before 1986 to 1.35 after 1986 (T-statistic: 4.71), a reduction of more than 15 percent. For those reporting at least one apprehension, the number of attempts went down from 2.41 to 1.97 after 1986 (T-statistic: 2.31). The number of border crossing attempts also decreases for the same migrant over time. This rules out that the observed decrease is driven by selection along the migration margin.[37] Everything else constant, one would expect that migrants adjust their crossing behavior to keep the apprehension probability constant. The decline in border crossing attempts however makes sense if the new crossing routes are more dangerous. This is indeed the case as reflected in the rising death toll along the Southwestern border. Between 1994 and 2000, the number of deaths reported by the border patrol have risen almost sixfold (Reyes et al, 2002). Today, around 500 illegal migrants die each year during their attempt to cross the border.[38] The causes of border deaths confirm that the rising toll is related to changing migration patterns and not driven by other forces. In the late 1990s, more people die from hypothermia, heat stroke or drowning. For example, 67 persons died along the Californian border due to hypothermia or heat stroke in 1998 compared to only 2 in 1994. Similarly, 53 people drowned in 1998 whereas only 9 did so in 1994 (Eschbach et al, 2001). In contrast, other causes like accidents or homicides have declined or remained constant over the same period.

Substitution away from well guarded crossing routes has decreased the risk of getting caught by the border patrol but increased a migrant's time costs and health risks. As one illegal migrant puts it: "When you arrive at the border and there they ask you, "Where are you going?" and there are

[37] The same pattern emerges conditional on migrant demographics, year and sector dummies.

[38] These numbers are still conservative, as they only include bodies detected by the U.S. border patrol or the Mexican police. Higher punishments could also explain the phenomenon. Since the fraction of migrants punished remains small and goes up only after 1996, this cannot explain why crossing attempts decline after 1986.

many dishonest people, many who rob, many who attack you just to take the little money you have, and since you can no longer cross the line in Tijuana, you have to go through the desert, where you have to walk three or four or six days and sometimes even more.... And in the desert, you run out of water, of food, of everything, because you can't carry much, because of the distance. The safer routes are longer, you have to walk longer and although it's safer it's uglier, with more desert. And the heat is intense, and the water runs out" (Reyes et al., 2002). Anecdotal evidence suggests that crossing the border can take between 3 to 6 days in remote areas even without apprehension. If crossing the border now requires four days instead of one, the additional time cost would be US $40 to $60 in foregone earnings. Using a coyote to cross in remote areas is also more expensive. The mean difference between high and low enforcement sectors after 1993 is used as measure, which adds another US$ 70. Without considering the costs from health risks, substitution to remote sectors could increase migrants' crossing costs by US $110 to $130. This is about three times the direct effect of enforcement on smuggling prices. Note that this is consistent with the estimates reported in Table 4, where the indirect of enforcement in neighboring sectors on smuggling prices was roughly three times the direct effect. While enforcement has affected the risk of apprehension, it imposed much larger additional costs as illegal migrants substituted away from heavily patrolled crossing routes.

6 Robustness Analysis

6.1 Unobserved Heterogeneity among Migrants

If the price or demand for smuggling services depends on unobserved characteristics of migrants that are correlated with the regressors, the estimates above suffer from omitted variable bias.[39]

[39] Even if enforcement efforts are uncorrelated with the average ability of illegal migrants, the coefficient on the enforcement variable is still biased, if enforcement is correlated with another regressor that is itself correlated with the unobservable.

Exploiting the panel structure, a fixed effects model is estimated to control for unobserved heterogeneity in migrant's border crossing ability. The results, which are based on observations from repeat migrants with illegal trips in subsequent years, are reported in Panel A of Table 6. The estimates for smuggling prices (columns (1)-(3)).are similar to those reported above and the enforcement elasticity remains very inelastic. Columns (4)-(5) on the right hand-side report the fixed effects estimates of the demand for smugglers. The enforcement effect becomes actually negative and the price effect is very small and even positive for least squares. The estimates controlling for unobserved heterogeneity of migrants are even smaller than the results reported in Section 5. This suggests that unobserved heterogeneity among migrants cannot explain why enforcement has only a small effect on the smuggling market.[40]

6.2 Composition Effects

The effects of enforcement on smuggling prices and demand reported above were estimated conditional on making an illegal trip. While enforcement deters people from migrating, the high-growth years in the United States during the 1990s increase the propensity to migrate illegally. If those leaving or entering the market in response to enforcement and aggregate shocks are not a random sample of all potential illegal migrants, the estimates above could be affected by selection bias.[41] To control for composition effects, the following selection model for the smuggling price is estimated

[40] A second source of bias in the price equation arises if coyotes differ in smuggling ability and quality differences are priced out. If tighter enforcement drives low-ability smugglers out of the market, enforcement is positively correlated with coyote quality. This however leads to an upward bias in the enforcement effect and cannot explain the small effect found. To control for unobserved coyote quality, the price equation was reestimated using an indicator of whether a coyote user was caught as a proxy for coyote quality. The estimate of the enforcement effect is smaller than in Section 5 as expected (see Gathmann, 2004 for the results). The coefficient on the quality proxy suggests that expert users caught at least once pay between US$11-14 less than those crossing without delay.

[41] As mean expert use remains almost constant, the analysis focuses on selection along the migration margin. Illegal temporary migrants are negatively selected in terms of characteristics and income. Stayers in Mexico are better educated, more likely to own a business and live in larger, wealthier towns with higher educational attainment.

$$P_{it}^{E} = \alpha_P + \beta_P L_{jt} + \gamma_P X_{it}^{P} + K(D_{it}^{M*}) + \varepsilon_{it}^{P}$$

$$D_{it}^{M*} = P(D_{it}^{M} = 1) = \alpha_M + \beta_M L_{jt} + \gamma_M X_{it}^{M} + \varepsilon_{it}^{M}$$

where β_M measures the deterrence effect and X_{it}^{M} are other variables affecting the demand for illegal migration. $K(D_{it}^{M*})$ denotes the control function in the price equation while D_{it}^{M*} is an indicator equal to one if the individual made an illegal trip to the United States in period t and zero otherwise. A fourth-order polynomial in the predicted propensity of illegal migration is used to approximate the control function. An indexof vegetable prices in U.S. agriculture is used as exclusion restriction. Since agriculture is still the dominant sector of employment for temporary migrants from Mexico, changes in the prices of agricultural products affect the demand for illegal migrants and thus incentives to migrate illegally to the United States. The results are shown in Panel B of Table 6. The first column reports the estimates of the corresponding selection equation while subsequent columns show the results for the corrected price equation using sectoral (Price (1)) and time series variation (Price (2)). In both cases, the polynomials of the propensity score are jointly highly significant. The are quite similar to the one reported in Tables 3 and 4. While the selection-corrected estimate using cross-sectional variation is roughly half the one reported in Table 4, the least-squares estimate using time series variation is close to the one ignoring composition changes.

Selection along the migration margin could also bias the demand function. In the model, those deterred have the lowest border crossing ability, which would lead to a downward bias in the substitution effect, while the bias of the price effect is ambiguous. With a slight abuse of notation, the model estimated is now

$$\Pr\left(D_{it}^{E}=1 \mid D_{it}^{M}=1\right)=\alpha_E+\beta_E P_{jt}^{E}+\gamma_E L_{jt}+\delta_E' X_{it}^{E}+K(D_{it}^{M*})+\varepsilon_{it}^{E}$$

$$D_{it}^{M*}=\Pr\left(D_{it}^{M}=1\right)=\alpha_M+\beta_M L_{jt}+\gamma_M' X_{it}^{M}+\varepsilon_{it}^{M}$$

where $K(D_{it}^{M*})$ is the control function for the market size effect and X_{it}^{M} and D_{it}^{M*} are defined as before. The demand for illegal migration is again estimated using a linear probability model with the vegetable price index as exclusion restrictions and a fourth-order polynomial to approximate the control function. The results for both the selection (illegal migration) and outcome (expert use) equations are shown on the right side of the Panel B. As expected, correcting for selection increases the substitution effect and the price sensitivity of demand. This suggests that those dropping out of the market pay above average prices for smugglers. Overall, the results show that the small effects of enforcement on prices and demand for coyotes are not driven by selection effects though it affects the estimates in the expected direction.

6.3 Legalization or Enforcement?

The Immigration and Control Act of 1986 also implemented one of the largest legalization programs in U.S. history between 1986 and 1989. Legalization could affect the results in two ways: first, it reduces the size of the market for illegal migration. Anecdotal evidence suggests that those eligible for legalization refrained from illegal migrations until they obtained their legal documents. If the propensity to migrate remains unchanged among those ineligible for the program, the total number and propensity to cross illegally declines. If Mexicans however expect future legalizations, this works in the opposite direction. The propensity to migrate illegally could thus raise or fall though the latter effect is likely to dominate the former. Note that this effect is independent of

enforcement efforts by the border patrol and should not be counted as a deterrence effect. In addition, legalization reduces the number of people using an expert. Since those legalized are all repeat migrants and thus less likely to use an expert, the demand for smugglers among illegal migrants is likely to increase. If stayers start migrating in expectation of future legalizations, this would further increase the demand. Thus, legalization and enforcement work in the same direction: they are likely to lower the demand for illegal migration and increase the demand for experts among illegal migrants. However, the policies have different predictions with respect to the expert price. Whereas enforcement increases the price for experts, legalization might increase or decrease smuggling prices. The estimated enforcement effect on smuggling prices could thus be an upper or lower bound on the true effect.

To distinguish the effects of enforcement from those of legalization, the price and demand function were reestimated using only first-time migrants. First-time migrants are strongly affected by stricter enforcement but their composition should not be affected by legalization, since only repeat migrants were eligible for legalization.[42] The results based on the subsample of first-time migrants are shown in Panel A of Table 8. The demand for smugglers by first-time migrants is less price elastic (column (4) and (5)) compared to the whole sample. This is to be expected since border crossing experience allows repeat migrants to substitute to self service in case smuggler prices increase. The estimates and implied elasticities are very similar to the main results in Section 5. Thus, legalization cannot explain the small enforcement effects reported above.

6.4 Temporary and Permanent Migrants

The estimates in the last section are based on a sample of temporary migrants. Many illegal border crossers however settle permanently in the United States. Since they have larger gains and

[42] Anecdotal evidence suggests that an informal market existed to purchase false documents for the Special Agricultural Worker program. In that case, first-time migrants would be affected by the legalization program from 1986 to 1989. Using the same specification but excluding first-time migrants in that period, the results were very similar.

less experience in crossing the border than temporary migrants, permanent migrants should be more likely to use experts and less easily deterred by stricter enforcement. The deterrence effect from temporary migrants above would thus overstate the true deterrence effect and the impact of enforcement. To test these predictions, smuggling price and demand were reestimated using the nonrandom sample of permanent migrants to the United States in the Mexican Migration Project.[43] The results in Panel B of Table 8 confirm the theoretical predictions. Enforcement has a smaller effect on smuggling prices for the OLS estimates (column (1) and (2)) and even turns negative for the IV estimate (column (3)). For smuggling demand, the substitution effect is larger, which implies that more permanent migrants switch from being a self crosser to using a coyote holding prices constant. As expected, the demand for smugglers among permanent migrants is also less price elastic. Overall, the results from the permanent sample are close to those for temporary migrants and suggest that the estimates reported in this paper could be representative for the whole population of illegal migrants.

7 Policy Implications: Temporary Legal Permits

The results in this paper raise the question whether there is better way of regulating the illegal crossing market. Most additional resources have been invested to raise the probability of apprehension, which is costly to society. The current policy of high enforcement and low punishment is potentially dominated by two alternatives. First, the government could impose fines on illegal migrants instead of stricter border enforcement. Fines are costless to society and generate government revenue. However, imposing a fine would not eliminate the smuggling market and society would still have to bear the costs of border enforcement. A second alternative policy instrument

[43] The permanent sample is on average younger, better educated and more likely to have family in the United States (Gathmann, 2004). In the data, permanent migrants are more likely to use coyotes and pay higher prices than temporary migrants.

is to charge a fee in return for allowing legal entry for a limited period.[44] Suppose the fee was chosen such that the number entering the United States remains the same as under the current enforcement policy. Denote the number of migrants who choose to come with a temporary legal permit as M^{leg}. The number of legal migrants decreases in the fee and border enforcement levels, in both cases at a decreasing rate: $M_L < 0$, $M_{fee} < 0$ and $M_{LL} > 0$, $M_{feefee} > 0$.Define the cost to society from additional migrants as $C\left(M^{leg}\left(fee, L\right)\right)$ where $C_M > 0$ and $C_{MM} > 0$. The social cost thus increases with the number of migrants at an increasing rate.

The total cost to the US society under the temporary permit would then be $C(M^{leg}(fee, L)) + w^{BP}L - (fee + \tau w^{Mig})M^{leg}$, where w^{BP} denotes the wage of border patrol officers, w^{Mig} the wage rate of legal temporary migrants and τ the tax rate on labor earnings. The second term represents the costs of enforcement, while the third term reflect government revenues from permit sales and taxes paid by temporary migrants. In contrast, with the current policy of enforcement and punishment, the cost is $C(M^{ill}(L)) + w^{BP}L$, where $M^{ill} = M^{leg}$ by assumption. Unless the cost of temporary legal migrants is much higher than for illegal migrants, for example because they have better access to welfare benefits, the costs to the US society with the temporary permit are lower than under the current policy for two reasons: first, under the permit policy, the government receives additional revenues from selling the permits and taxes on migrant's labor earnings. Second, as shown formally in Appendix C, the government chooses a lower enforcement level L and thus faces lower enforcement costs under the new policy.

To calculate the potential revenues from temporary permits, the mean wage differential between the United States and Mexico is multiplied with the average duration of the permit, taken as the mean duration in the temporary migrant sample, and subtracts the average monthly living expenses for food and lodging in the data. The resulting \$2,200 for a permit in 1983 prices should

[44] This is preferrable only if the United States wants to limit illegal migration and not low-skill migration in general.

be considered an upper bound as it represents the maximum amount the average migrant is willing to pay.[45] Alternatively, the government could simply charge the average smuggling price of $300 before 1986. The calculated fee per migrant is then multiplied with the number of users assuming that the annual inflow of temporary migrants remains at the current level of 1 to 1.3 million. This yield additional annual revenues between $300 million and 2.86 billion, which is equivalent to 15 to 100 percent of the budget of the Immigration and Naturalization Service in 1998. These numbers are still conservative, since potential tax revenues from temporary legal migrants and savings from reduced enforcement are not included in the calculation.

8 Conclusion

Enforcement efforts of the border patrol more than tripled between 1986 and 1998. Using a unique dataset on illegal Mexican migrants, the paper analyzes the effects of this dramatic shift in policy. The results suggest that the deterrence effect is limited even after accounting for endogeneity in enforcemnt. Further, the effect on smuggling prices and demand for border smugglers is small. Enforcement has however pushed migrants to more remote and dangerous routes. Additional migration costs due to higher time costs, prices for coyotes and health risk add up to more than three times the direct effect of enforcement on smuggling prices. The observed increase in smuggling prices by US$270 after 1986 can thus be decomposed into a direct enforcement effect (around 15 percent), the indirect substitution effect from sector switching (roughly 45 percent) and a residual component. These findings highlight that enforcement can have large indirect effects on illegal markets. These cannot be ignored, when evaluating enforcement policies as often done in the literature.

Though enforcement has raised migration costs, the deterrence effect of the current enforcement

[45] The calculation ignores that legal migrants can get better jobs and thus have higher migration gains.

strategy is likely to remain small. First, the costs associated with apprehension remain low. Of the 1,600,000 apprehensions made in 1998, only about 20,000 or 1.25 percent are prosecuted in court. Since most migrants apprehended can attempt to cross the border the next night, the cost of apprehension is simply the value of a day lost working in the United States, which is about $20. Second, the benefits from migration are high. Earnings prospects north of the border are more than three times those in Mexico in the data. As one illegal Mexican migrant puts it: "I tell you something, with that you make here in a day, you can eat the entire week. There [in Mexico], they pay you 70 pesos a day, on a good day. Seventy pesos are about $7. A kilogram of meat, which is equivalent to two pounds, costs 47 pesos; so if you buy one kilogram of meat and tortillas, with what are you going to buy a pair of pants? Here if you make $50 in a day, you can buy five pounds of meat for about $10. You can still go to a second-hand store and buy a pair of pants for two quarters" (Reyes, Johnson and Von Swearningen, 2002).[46] Instead of the current enforcement policy, the paper proposes a temporary legal permit as alternative policy instrument. This not only yields additional revenues to the government and allows further savings from lower enforcement levels but also diminishes, if not eliminates, migrant smuggling.

References

[1] Angelucci, Manuela (2004), "U.S. Border Enforcement and the Inflow-Outflow of Mexican Illegal Migration," mimeo, University College London.

[2] Becker, Gary S. (1968), "Crime and Punishment: An Economic Approach," *Journal of Political Economy*, 78, 169-217.

[3] Becker, Gary S., Michael Grossman and Kevin M. Murphy (2005), "The Economic Theory of Illegal Goods: The Case of Drugs," National Bureau Economic Research, working paper 10976.

[46] More resources have also been employed for fighting the drug war as the 1986 Anti-Drug Abuse Act extended the duties of the border patrol to fight drug smuggling. The number of legal border crossing has also more than doubled since the late 1970s (Massey et al, 2002). Since legal border traffic is handled by immigration officers, this should have however little effect on the border patrol's effectiveness.

[4] Conover, Ted (1987), *Coyotes : A Journey through the Secret World of America's Illegal Aliens,* New York City, NY: Vintage Books.

[5] DiNardo, John (1993), "Law Enforcement, the Price of Cocaine and Cocaine Use," *Mathematical and Computer Modeling,* 17, 53-64.

[6] Donato, K., John Durand, and Douglas S. Massey (1992), "Stemming the Tide? Assessing the Deterrent Effects of the Immigration Reform and Control Act," *Demography*, 29, 139-157.

[7] Ehrlich, Isaac (1977), "Capital Punishment and Deterrence: Some Further Thoughts and Additional Evidence," *Journal of Political Economy*, 85, 741-788.

[8] Eschbach, Karl, J. Hagan, and N. Rodriguez (2001), "Causes and Trends in Migrant Deaths along the U.S.-Mexico Border, 1985-1998," Center for Immigration Research at the University of Houston, working paper No. 01-4.

[9] Espenshade, Thomas (1994), "Does the Threat of Border Apprehension Deter Undocumented US Immigration?," *Population and Development Review*, 20, 871-892.

[10] Espenshade, Thomas (1995), "Using INS Border Apprehension Data to Measure the Flow of Undocumented Migrants Crossing the U.S.-Mexico Border," *International Migration Review*, 29, 545-565.

[11] Ethier, William J., "Illegal Immigration: the Host-Country Problem", *American Economic Review*, LXXVI (1986), 56-71.

[12] Federal Judicial Center, *Federal Court Cases: Integrated data base, 1970-2000* [Parts 1-14, 29-33, 58-60, 67-69, 76-81, 109-113: Criminal data, 1970-2000] [Computer file] (ICPSR version, Washington, DC: Federal Judicial Center [producer], 1992, 1995, 2000, Ann Arbor, MI: Inter-university Consortium for Political and Social Research [distributor], 1997, 1997, 2002).

[13] Gathmann, Christina, "The Effect of Enforcement on Illegal Markets: Evidence from Migrant Smuggling Along the Southwestern Border," Institute for the Study of Labor dicussion paper No. 1004, 2004.

[14] Hanson, Gordon H., and Antonio Spilimbergo (1999), "Illegal Immigration, Border Enforcement and Relative Wages: Evidence from Apprehensions at the U.S.- Mexico Border," *American Economic Review*, 89, 1337-1357.

[15] Kossoudji, Sherrie A. (1992), "Playing Cat and Mouse at the U.S.-Mexican Border," *Demography*, 29, 159-180.

[16] Kuziemko, Ilyana, and Steven D. Levitt (2004), "An Empirical Analysis of Imprisoning Drug Offenders," *Journal of Public Economics,* 88, 2043-2066.

[17] Levitt, Steven D. (1997), "Using Electoral Cycles in Police Hiring to Estimate the Effect of Police on Crime," *American Economic Review*, 87, 270-290.

[18] Lopez Castro, Gustavo (1998), "Coyotes and Alien Smuggling", in Mexico-United States Binational Migration Study, *Migration between Mexico and the United States,* Vol I-III, Austin, TX: Morgan Printing.

[19] Massey, Douglas S., Jorge Durand, and Nolan J. Marone (2002), *Beyond Smoke and Mirror. Mexican Immigration in an Era of Economic Integration,* New York City, NY: Russell Sage Foundation.

[20] Massey, Douglas S., and Audrey Singer (1995), "New Estimates of Undocumented Mexican Migration and the Probability of Apprehension," *Demography*, 32, 203-213.

[21] Mexican Migration Project (2001), *MMP71 data files.* Population Studies Center, University of Pennsylvania. Philadelphia.

[22] Miron, Jeffrey A. (2003), "The Effect of Drug Prohibition on Drug Prices: Evidence from the Markets for Cocaine and Heroin," *Review of Economics and Statistics,* 85, 522-530.

[23] Orrenius, Pia M.(2001), "Illegal Immigration and Enforcement along the U.S.-Mexico Border: An Overview", Federal Reserve Bank of Dallas.

[24] Reyes, Belinda I., Hans P. Johnson, and Richard Van Swearingen (2002), *Holding the Line? The Effect of Recent Border Build-Up on Unauthorized Migration* (San Francisco, CA: Public Policy Institute of California.

[25] Saffer, Henry, and Frank Chaloupka (1995), "The Demand for Illicit Drugs," National Bureau of Economic Research, working paper No. 5238.

[26] Tauchen, Helen, Ann D. Witte, and Harriet Griesinger (1994), "Criminal Deterrence: Revisiting the Issue with a Birth Cohort," *Review of Economics and Statistics,* 86, 399-412.

[27] U.S. Immigration and Naturalization Service (various years), *Statistical Yearbook of the Immigration and Naturalization Service*, Washington, DC: Government Printing Office.

[28] Van Ours, Jan (1995), "The Price Elasticity of Hard Drugs: The Case of Opium in the Dutch East Indies 1923-38," *Journal of Political Economy*, 103, 261-279.

[29] Viscusi, Kip W.(1986), "The Risks and Rewards of Criminal Activity: A Comprehensive Test of Criminal Deterrence," *Journal of Labor Economics*, 4, 317-340.

[30] Warren, Robert (2000), "Annual Estimates of the Unauthorized Immigrant Population Residing in the United States and Components of Change: 1987 to 1997," United States Immigration and Naturalization Service, mimeo.

[31] Witte, Ann D. (1980), "Estimating the Economic Model of Crime with Individual Data," *Quarterly Journal of Economics*, 94, 57-84.

A Data

The Mexican Migration Project is a repeated cross-sectional survey conducted since 1982 except 1984 to 1986. The sampled communities cover isolated rural towns and large farming communities

as well as big metropolitan areas. The survey oversamples temporary migrants, who are more likely to return to Mexico during the winter months. The data includes information on migration experience, wages earned in the United States and on the last formal job in Mexico, detailed demographic information and land and business holdings in Mexico. For household heads, a history of illegal migration to the United States, including the price for a coyote if used, the border crossing sector and number of apprehensions at the border is compiled. While less than 10 percent of illegal migrants report missing values on coyote use or do not remember where they crossed the border, almost 30 percent do not recall the price paid. The sample is restricted to household heads between age 16 and age 55 with valid information on age, education, Mexican wage and workers with positive earnings in the United States if a migrant. To avoid recall error, only information ten years prior to the survey date is kept for analysis. The Consumer Price Index (base year 1982-1984) is used to deflate wage and price data. Variables denoted in Mexican Pesos are adjusted by the exchange rate taken from the International Financial Statistics.

Enforcement is measured as the number of linewatch hours the border patrol spends patrolling in each of the nine border sectors from 1976 to 1998. The punishment data is taken from the Federal Court Cases Data Base (1970-2000). Mean prison terms in days for immigration violations (illegal entry and reentry) for each year and each of the five district courts at the Southwestern border (California South (CS), New Mexico (NM), Arizona (AZ), Texas South (TS), Texas West (TW)) were constructed. The punishment for smugglers is the mean prison term for smuggling aliens and constructed from the United States Sentencing Commission (1991-1998). Both are matched to the border patrol sectors (San Diego and El Centro (CS), El Paso (NM), Tucson and Yuma (AZ), McAllen and Laredo (TS), Del Rio and Marfa (TW)). Only wages of the last job in Mexico are reported. Wages earned in previous jobs are predicted for each person and year from a standard Mincer regression with education, experience, experience squared, dummies for the year and state of residence, marital status, gender and occupational dummies as regressors. The same procedure is used to predict wages in the United States for individuals migrating in that year, since only wages for the first and last trip are observed in the data. To construct potential U.S. wages for those not migrating, a standard selection model is used. The participation equations include the number of members, children and minors in the household and whether the father and mother ever migrated, the migrant's education, age and state of residence as regressors. The existence of family members in the United States, which raises migration propensities, is used as an exclusion restriction. If family members assist in finding higher paying jobs, the restriction is not valid. Alternatively, an indicator of business ownership in Mexico is used, which decreases the propensity to migrate. Both specifications yielded similar estimates. The results in the paper are based on results from the demographic variable.

B Derivation of Model Thresholds

The demand for illegal migration (4) is defined as

$$\triangle w(\theta) - (1 - D^E)prob(\theta) \triangle w(\theta) + F - D^E prob^E (\triangle w(\theta) + F) - D^E(1 - prob^E)P^E - FC \geq 0$$

while for those hiring an expert ($D^E = 1$), the threshold for migrating illegally is

$$\theta^* : (1 - prob^E)(\triangle w(\theta^*) - P^E) - prob^E F - FC = 0 \tag{7}$$

Individuals with $\theta < \theta^*$ will choose not to migrate whereas those with $\theta \geq \theta^*$ migrate. For demand for experts to be positive, it is required that $\theta^* < \theta^{**}$. The threshold for hiring an expert versus crossing alone is

$$\theta^{**} : \left(prob\left(\theta^{**}\right) - prob^E\right)\left(\triangle w(\theta^{**}) + F\right) - \left(1 - prob^E\right) P^E = 0$$

Solving for the price yields

$$\theta^{**} : P^E = \frac{prob\left(\theta^{**}\right) - prob^E}{1 - prob^E}\left(\triangle w(\theta^{**}) + F\right) \tag{8}$$

Rewrite (7) using the fact that for $\theta^* < \theta^{**}$, $\triangle w(\theta^*) \leq \triangle w(\theta^{**})$:

$$(1 - prob^E)(\triangle w(\theta^{**}) - P^E) - prob^E F - FC \geq 0$$

Substituting for the price from (8) and simplifying gives the condition

$$\left(1 - prob\left(\theta^{**}\right)\right) \triangle w(\theta^{**}) - prob\left(\theta^{**}\right) F - FC \geq 0 \tag{9}$$

This is the condition that self crossers ($D^E = 0$) find it optimal to migrate. It is shown below that (9) is indeed satisfied for $\theta \geq \theta^{**}$.Thus, all individuals who are self-crossers also choose to migrate. Substituting in (9) for $prob(\theta^{**})\left(\triangle w(\theta^{**}) + F\right)$ from (8) and rearranging yields

$$(1 - prob^E) \triangle w(\theta^{**}) - prob^E F - FC(1 - prob^E)P^E \geq 0$$

Since the equation holds for θ^* with equality and $\triangle w(\theta^{**}) \geq \triangle w(\theta^*)$, this is always satisfied. Finally, to ensure that all self crossers find it optimal to cross alone, the following single crossing property for all $\theta \geq \theta^{**}$ needs to hold:

$$\frac{\partial \triangle w(\theta)}{\partial \theta}(prob(\theta) - prob^E) > \left(-\frac{\partial prob(\theta)}{\partial \theta}\right)(\triangle w(\theta) + F)$$

The condition says that the value of more able illegal migrants from a larger wage differential exceeds the additional value from a lower probability of apprehension.

C Optimal Enforcement

This section shows that optimal enforcement levels are lower in a market without experts. A social planner chooses enforcement (L or $prob$) to maximize the welfare of the U.S. population. Migration imposes a cost on society denoted by $C(M(L))$ where $M(L)$ is the number of migrants entering each year with $C_M > 0$ and $C_{MM} > 0$. The marginal cost from illegal migrants increases with their number either because the benefits from having migrants go down or the marginal costs go up. It is also assumed that $M_L < 0$ and $M_{LL} \geq 0$. Increasing enforcement decreases the number of illegal entries either because of a deterrence or enforcement effect but at a decreasing scale. The costs from enforcement in the absence of capital expenditures are simply

$$C^{BP} = w^{BP} * L$$

where w^{BP} is the wage of a border patrol agent. The decision problem of the social planner is then to choose enforcement levels to minimize the sum of costs to society and enforcement. The first-order condition for this problem is

$$-C'(M(L))\frac{\partial M(L)}{\partial L} = w^{BP} \tag{10}$$

and the second-order condition is

$$-C''(M)\frac{\partial M}{\partial L} - C'(M)\frac{\partial^2 M}{\partial L^2} > 0 \tag{11}$$

(10) and (11) define two enforcement levels: $\widetilde{L}$ (without experts) and L^* (with experts). To show that $\widetilde{L} < L^*$ is equivalent to showing that

$$\left|\frac{\partial M}{\partial L}\right|_{\widetilde{L}} > \left|\frac{\partial M}{\partial L}\right|_{L^*} \tag{12}$$

To simplify the derivation, the following assumptions functional form assumptions are made:

$$\begin{aligned} prob^E &= (1-\theta^E)prob \quad \text{where } \theta \in [\theta^*; 1] \\ prob(\theta) &= (1-\theta)prob \quad \text{where } \theta \in [0; 1] \\ \triangle & \quad w(\theta) = \theta \triangle w \end{aligned} \tag{13}$$

where $\triangle w$ is the benefit from migration for the smartest person ($\theta = 1$) and $prob$ is determined by the resources of the border patrol (L). Given that migrants can try to cross the border only once, the number of successful illegal entrants in the absence of experts is

$$M_{NoExp} = \int_{\widetilde{\theta}(L)}^{\theta^{\max}} (1 - prob\,(u, L))g(u)du$$

which given (13) is equivalent to

$$M_{NoExp} = (1 - prob(L)) \left(1 - G\left(\widetilde{\theta}(L)\right)\right) + prob(L) \int_{\widetilde{\theta}(L)}^{\theta^{\max}} ug(u)du \tag{14}$$

where

$$\widetilde{\theta} : \triangle w(\widetilde{\theta}) - prob(\widetilde{\theta}) \left(\triangle w(\widetilde{\theta}) + F\right) = FC$$

is the threshold in the absence of experts such that individuals with $\theta \geq \widetilde{\theta}$ choose to migrate illegally. With fixed L, the threshold satisfies $\theta^* \leq \widetilde{\theta} \leq \theta^{**}$. That is, all individuals that cross alone will still choose to migrate in a world without experts ($\widetilde{\theta} \leq \theta^{**}$). Some individuals who would be deterred from migrating alone do so with the help of an expert ($\theta^* \leq \widetilde{\theta}$). Note that the last term in (14) is simply the average ability of migrants

$$\int_{\widetilde{\theta}(L)}^{\theta^{\max}} ug(u)du = E\left[\theta \mid \theta \geq \widetilde{\theta}\right]$$

In the presence of experts, the number of illegal migrants is instead

$$M_{Exp} = \int_{\theta^*(L)}^{\theta^{**}(L)} (1 - prob^E) g(u)du + \int_{\theta^{**}(L)}^{\theta^{\max}} (1 - prob\,(u, L)) g(u)du$$

Using (13), this can be simplified to

$$\begin{aligned} M_{Exp} &= \left(1 - prob^E\right) \left[G(\theta^{**}(L)) - G(\theta^*(L))\right] + \\ &\quad + (1 - prob(L)) \left(1 - G(\theta^{**}(L))\right) + \\ &\quad + prob(L) E\left[\theta \mid \theta \geq \theta^{**}\right] \end{aligned}$$

Taking the derivative with respect to enforcement level L yields for the market without experts

$$\begin{aligned} \frac{\partial M_{NoExp}}{\partial L} &= -(1 - prob(L)) g(\widetilde{\theta}) \left(\frac{\partial \widetilde{\theta}}{\partial prob}\right) \left(\frac{\partial prob(\widetilde{L})}{\partial L}\right) - \\ &\quad - \left(1 - G(\widetilde{\theta}) - E\left[\theta \mid \theta \geq \widetilde{\theta}\right]\right) \left(\frac{\partial prob(\widetilde{L})}{\partial L}\right) \\ &\quad + prob(L) \frac{\partial E\left[\theta \mid \theta \geq \widetilde{\theta}\right]}{\partial L} \end{aligned}$$

Substituting for the derivative of the conditional expectation yields

$$\begin{aligned} \frac{\partial M_{NoExp}}{\partial L} &= -\left[1 - G(\widetilde{\theta}) - E\left[\theta \mid \theta \geq \widetilde{\theta}\right] + (1 - prob(\widetilde{\theta}, L)) g(\widetilde{\theta}) \frac{\partial \widetilde{\theta}}{\partial prob}\right] \\ &\quad \times \left(\frac{\partial prob(\widetilde{L})}{\partial L}\right) \end{aligned}$$

Similarly, with experts, the derivative is

$$\begin{aligned}\frac{\partial M_{Exp}}{\partial L} &= -(1-prob^E(L))g(\theta^*)\left(\frac{\partial\theta^*}{\partial prob^E}\right)\left(\frac{\partial prob^E}{\partial L}\right)+\\ &+(prob(\theta^{**},L)-prob^E(L))g(\theta^{**})\left(\frac{\partial\theta^{**}}{\partial prob}\right)\left(\frac{\partial prob(L^*)}{\partial L}\right)-\\ &-\left(1-G(\theta^{**})-E\left[\theta\mid\theta\geq\widetilde{\theta}\right]\right)\left(\frac{\partial prob(L^*)}{\partial L}\right)-\\ &-(G(\theta^{**})-G(\theta^*))\left(\frac{\partial prob^E}{\partial L}\right)+prob(L)\frac{\partial E\left[\theta\mid\theta\geq\theta^{**}\right]}{\partial L}\end{aligned}$$

and substituting for the derivative of conditional expectation and simplifying yields

$$\begin{aligned}\frac{\partial M_{Exp}}{\partial L} &= -\left[(1-G(\theta^{**})-E\left[\theta\mid\theta\geq\theta^{**}\right])-(prob(\theta^{**},L)-prob^E(L))g(\theta^{**})\left(\frac{\partial\theta^{**}}{\partial prob}\right)\right]\times\\ &\times\left(\frac{\partial prob(L^*)}{\partial L}\right)-\\ &-\left[(1-prob^E(L))g(\theta^*)\left(\frac{\partial\theta^*}{\partial prob^E}\right)+G(\theta^{**})-G(\theta^*)\right]\left(\frac{\partial prob^E}{\partial L}\right)\end{aligned}$$

The second term is nonnegative. A sufficient condition for (12) to hold is then

$$\begin{aligned}&\left[1-G(\widetilde{\theta})-E\left[\theta\mid\theta\geq\widetilde{\theta}\right]+(1-prob(\widetilde{\theta},L))g(\widetilde{\theta})\frac{\partial\widetilde{\theta}}{\partial prob}\right]\left(\frac{\partial prob(\widetilde{L})}{\partial L}\right)\\ >\ &\left[1-G(\theta^{**})-E\left[\theta\mid\theta\geq\theta^{**}\right]-(prob(\theta^{**},L)-prob^E(L))g(\theta^{**})\frac{\partial\theta^{**}}{\partial prob}\right]\left(\frac{\partial prob(L^*)}{\partial L}\right)\end{aligned}$$

If there are decreasing returns to enforcement such that $\frac{\partial^2 prob(L)}{\partial prob^2}<0$,then $\widetilde{L}<L^*$ implies $\frac{\partial prob(\widetilde{L})}{\partial L}>\frac{\partial prob(L^*)}{\partial L}$. All that is left is to compare the terms in square brackets. Assume that $\widetilde{\theta}<\theta^{**}$ such that the threshold for self crossers at the higher enforcement level L^* is still above the threshold for migrants at the lower enforcement level $\widetilde{L}$. Then, $G(\theta^{**})>G(\widetilde{\theta})$ and $E\left[\theta\mid\theta\geq\theta^{**}\right]>E\left[\theta\mid\theta\geq\widetilde{\theta}\right]$. Rearranging the terms in square brackets yields

$$\begin{gathered}G(\theta^{**})-G(\widetilde{\theta})+E\left[\theta\mid\theta\geq\theta^{**}\right]-E\left[\theta\mid\theta\geq\widetilde{\theta}\right]+\\ +(1-prob(\widetilde{\theta},L))g(\widetilde{\theta})\frac{\partial\widetilde{\theta}}{\partial prob}+(prob(\theta^{**},L)-prob^E(L))g(\theta^{**})\frac{\partial\theta^{**}}{\partial prob}>0\end{gathered}$$

The first three terms are all positive. The change in thresholds in the fourth term is

$$\frac{\partial\theta^{**}}{\partial prob}=\left(\frac{\triangle w(\theta^{**})+F+F^E}{(prob(\theta^{**},L)-prob^E)\frac{\partial\triangle w(\theta^{**})}{\partial\theta^{**}}+\left(\triangle w(\widetilde{\theta})+F\right)\frac{\partial prob(\theta^{**},L)}{\partial\theta}}\right)\left(\frac{\partial prob^E}{\partial prob}\right)$$

The denominator is positive as long as experts are better border smugglers than the person just indifferent between self crossing and using an expert, that is $prob^E(L) \leq prob(\theta^{**}, L)$. Thus, $\frac{\partial \theta^{**}}{\partial prob} > 0$ which in turn implies $(prob(\theta^{**}, L) - prob^E(L))g(\theta^{**})\frac{\partial \theta^{**}}{\partial prob} > 0$.

Table 1: Characteristics of Expert Users and Self Crossers

Variable	Self Crosser Mean	Self Crosser Std. Dev	Coyote User Mean	Coyote User Std. Dev	T Statistic Difference
Age	37.07	8.40	36.06	8.28	2.6
Married	0.94	0.23	0.97	0.18	-2.7
Female	0.01	0.11	0.02	0.13	-1.2
Education	5.00	3.19	4.81	3.19	1.3
No years of formal education	0.08	0.27	0.08	0.28	-0.6
Some primary education	0.46	0.50	0.47	0.50	-0.8
Primary education (6 years)	0.24	0.43	0.26	0.44	-0.8
More than primary education	0.23	0.42	0.18	0.39	2.3
Mexican Occupation in Agriculture	0.54	0.50	0.44	0.50	4.5
Mexican Occupation in Manufacturing	0.34	0.48	0.36	0.48	-0.9
Members in the Household	5.55	2.29	5.65	2.27	-0.9
Number of Children	3.15	2.85	3.09	2.80	0.5
Total US Experience Household	8.94	7.15	6.99	6.57	6.3
Total Domestic Experience Household	1.78	3.46	1.23	2.55	4.2
Community Size	41804	126941	22201	84102	4.4
_Metropolitan	0.10	0.30	0.04	0.20	5.5
_Small Urban	0.24	0.43	0.27	0.44	-1.1
_Small Town	0.33	0.47	0.34	0.47	-0.1
_Rancho	0.33	0.47	0.36	0.48	-1.5
Males with Migration Experience	0.53	0.23	0.57	0.23	-3.6
Whether Family in the United States	0.75	0.02	0.71	0.01	2.1
Father Ever Migrated?	0.33	0.47	0.30	0.46	1.5
Mother Ever Migrated?	0.05	0.22	0.04	0.19	1.9
On First Trip?	0.22	0.02	0.30	0.01	-3.7
Total Number of Trips	8.07	5.83	6.65	5.67	5.4
Mean Trip Duration	25.85	1.99	26.87	0.98	-0.5
Total Months of US Experience	76.55	2.58	68.30	1.24	3.0
Domestic Migrations?	0.52	0.50	0.40	0.49	5.3
Fraction Crossing Alone	0.50	0.50	0.45	0.50	2.3
Fraction Crossing With Family	0.19	0.39	0.16	0.37	1.6
Fraction Deported at Least Once	0.18	0.38	0.23	0.42	-2.7
Fraction Working in Agriculture	0.60	0.49	0.47	0.50	5.6
Fraction Working in Manufacturing	0.31	0.46	0.34	0.47	-1.3
Wage Earned in the United States	2.59	0.04	2.67	0.02	-1.6
Observations	604		2114		

Notes: The descriptive statistics are reported for household heads that have migrated illegally to the United States and were interviewed in Mexico. Classification into subgroups is based on whether the individual started a new trip in a given year. An individual can therefore be in both categories if he uses a coyote in one year but crosses by himself in another. Community characteristics are interpolations between decennial observations from the Mexican Census. T-Statistics in the last column test for mean differences between coyote users and self crossers.

Table 2: The Deterrence of Illegal Migrants

Variable	1st Stage(2)	1st Stage(4)	1st Stage(6)	(1)	(2)	(3)	(4)	(5)	(6)
Border Enforcement (in 100,000 hours)				-0.0017	-0.0053	-0.0012	-0.0084	-0.0021	-0.0024
				(0.00054)**	(0.0048)	(0.0009)	(0.0108)	(0.0020)	(0.0047)
Budget of Drug Enforcement Agency	0.0470	0.0180	0.0225						
(in million $)	(0.0001)**	(0.0004)**	(0.0002)**						
Age	-0.0080	0.0011	0.0008	-0.0043	-0.0044	-0.0045	-0.0045	-0.0045	-0.0045
	(0.0022)**	(0.0018)	(0.0014)	(0.00017)**	(0.00020)**	(0.00018)**	(0.00020)**	(0.00017)**	(0.00017)**
Female	0.2577	0.3936	0.3192	0.0872	0.0888	0.0992	0.1028	0.0999	0.1000
	(0.1030)*	(0.0862)**	(0.0666)**	(0.00711)**	(0.00692)**	(0.00844)**	(0.00818)**	(0.00738)**	(0.00687)**
Some Primary School	-0.1555	-0.1914	-0.0387	-0.0156	-0.0169	-0.0179	-0.0196	-0.0170	-0.0170
	(0.0558)**	(0.0455)**	(0.0351)	(0.00265)**	(0.00286)**	(0.00230)**	(0.00285)**	(0.00249)**	(0.00249)**
Finished Primary School	-0.2962	-0.2491	-0.0925	-0.0341	-0.0361	-0.0368	-0.0390	-0.0355	-0.0355
	(0.0615)**	(0.0507)**	(0.0391)*	(0.00333)**	(0.00333)**	(0.00342)**	(0.00342)**	(0.00377)**	(0.00379)**
More than Primary Education	-0.6479	-0.4590	-0.1313	-0.1105	-0.1143	-0.1146	-0.1186	-0.1126	-0.1126
	(0.0648)**	(0.0544)**	(0.0420)*	(0.00699)**	(0.00734)**	(0.00752)**	(0.00770)**	(0.00747)**	(0.00748)**
Family in the United States	-0.0586	-0.0049	0.0252	0.0153	0.0146	0.0113	0.0111	0.0118	0.0119
	(0.0352)	(0.0304)	(0.0235)	(0.00185)**	(0.00190)**	(0.00163)**	(0.00168)**	(0.00179)**	(0.00176)**
US Experience Household Members	0.0151	0.0186	0.0131	0.0300	0.0300	0.0292	0.0293	0.0292	0.0292
	(0.0048)**	(0.0040)**	(0.0031)**	(0.00119)**	(0.00119)**	(0.00121)**	(0.00123)**	(0.00122)**	(0.00121)**
Number Domestic Migrations	-0.0127	-0.0129	0.0000	-0.0020	-0.0021	-0.0018	-0.0019	-0.0017	-0.0017
	(0.0065)	(0.0054)*	(0.0041)	(0.00040)**	(0.00039)**	(0.00034)**	(0.00034)**	(0.00034)**	(0.00034)**
Business Owned in Mexico	0.0796	0.0226	-0.0258	-0.0233	-0.0230	-0.0213	-0.0210	-0.0212	-0.0212
	(0.0440)	(0.0363)	(0.0281)	(0.00162)**	(0.00152)**	(0.00175)**	(0.00159)**	(0.00173)**	(0.00164)**
Hectar of Land Owned in Mexico	-0.0007	0.0007	0.0002	-0.0001	-0.0001	-0.0002	-0.0002	-0.0002	-0.0002
	(0.0010)	(0.0010)	(0.0006)	(0.00002)**	(0.00002)**	(0.00003)**	(0.00003)**	(0.00003)**	(0.00003)**
Potential U.S. Wage	1.0337	0.7284	0.5943	0.2057	0.2114	0.2239	0.2303	0.2249	0.2251
	(0.0472)**	(0.0402)**	(0.0310)**	(0.01025)**	(0.01063)**	(0.01287)**	(0.01292)**	(0.01074)**	(0.01013)**
Potential Wage in Mexico	-0.0718	-0.1246	-0.2795	-0.0107	-0.0116	-0.0123	-0.0136	-0.0154	-0.0157
	(0.0220)**	(0.0183)**	(0.0147)**	(0.0075)	(0.0101)	(0.0089)	(0.0130)	(0.00658)*	(0.00657)*
Other Individual Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Community Characteristics	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes
State Dummies	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Linear Time Trend	No	Yes	No	No	No	Yes	Yes	No	No
Aggregate Migration Incentives	No	No	Yes	No	No	No	No	Yes	Yes
Observations	73495	71060	71060	73495	73495	71060	71060	71060	71060
R-squared	0.67	0.69	0.82	0.3		0.31		0.31	
Elasticity of Deterrence				-0.66	-2.01	-0.43	-3.05	-0.75	-0.87

Notes: The table shows the enforcement effect on illegal migration from a linear probability model, where the dependent variable is one if a person migrated illegally in a given year. In even columns, enforcement is instrumented. The first-stage results are shown in 1stStage, where the dependent variable is border enforcement (in 100,000 hours) and the instrument is the budget of the Drug Enforcement Agency. The omitted education category is no formal education. Columns (1)-(6) report the estimates of the deterrence effect. Columns (3) and (4) add individual characteristics like number of prior trips, wages earned in Mexico and the United States and community characteristics (fraction of males with migration experience, more than 6 years of education, earning below and more than twice the minimum wage), Mexican state of resident dummies and aggregate controls (U.S. growth and unemployment rate, Mexicans naturalized, Mexico's Gross Domestic Product and population. Columns (5) and (6) include a linear time trend instead to control for aggregate shocks to the demand for illegal migration. Coefficients with * are significant at the 5 percent level, those with * at the 1 percent level. Standard errors are corrected for clustering. Elasticities are evaluated at the mean.

Table 3: Annual Border Enforcement and Smuggling Prices

	1st Stage (2)	1st Stage (4)	1st Stage (6)	(1)	(2)	(3)	(4)	(5)	(6)
Enforcement (in 100,000 hours)				6.292	5.728	3.952	-2.94	3.119	1.161
				(0.925)**	(1.158)**	(1.076)**	(9.967)	(0.893)**	(4.256)
Budget of the DEA (in million US$)	0.043	0.022	0.026						
	(0.001)**	(0.003)**	(0.002)**						
Crossing the Border Alone	-0.403	0.031	-0.193	-51.162	-52.091	-33.315	-32.937	-34.623	-34.983
	(0.1974)*	(0.152)	(0.190)	(11.944)**	(12.065)**	(7.393)**	(7.791)**	(7.278)**	(7.116)**
Age	-0.007	-0.014	-0.010	1.448	1.447	0.783	0.749	0.809	0.737
	(0.013)	(0.010)	(0.013)	(0.854)	(0.853)	(0.566)	(0.568)	(0.585)	(0.594)
Female	-0.321	-0.410	0.311	-26.926	-27.821	5.364	4.892	7.816	10.218
	(0.963)	(0.726)	(0.908)	(46.288)	(46.316)	(51.872)	(52.017)	(51.581)	(51.055)
Married	0.690	-0.050	0.317	33.120	33.826	78.904	79.100	79.483	82.101
	(0.701)	(0.527)	(0.660)	(20.109)	(20.220)	(26.936)**	(26.987)**	(26.936)**	(26.161)**
Some Primary School	-0.621	0.003	-0.614	25.753	25.839	13.513	13.402	13.362	8.652
	(0.406)	(0.304)	(0.381)	(16.445)	(16.512)	(12.479)	(12.695)	(12.694)	(14.987)
Finished Primary School	-0.494	-0.033	-0.670	50.984	51.746	28.510	28.399	28.383	23.333
	(0.434)	(0.331)	(0.414)	(18.603)*	(18.656)*	(11.810)*	(12.033)*	(11.617)*	(13.272)
More than Primary Education	-0.422	0.001	-0.719	8.311	9.359	-7.517	-7.566	-6.763	-12.473
	(0.459)	(0.356)	(0.445)	(20.897)	(20.924)	(15.241)	(15.655)	(14.974)	(18.859)
First-Time Migrant	-0.457	-0.303	-0.533	-58.603	-59.778	-46.125	-47.125	-47.400	-50.875
	(0.2285065)*	(0.185)	(0.2321)*	(9.573)**	(9.497)**	(11.040)**	(11.603)**	(11.098)**	(13.439)**
Indicator Whether Family in the US	0.222	-0.089	0.125	-16.229	-16.452	-1.037	-1.163	-2.283	-1.214
	(0.232)	(0.178)	(0.222)	(8.040)	(8.100)	(8.707)	(8.670)	(8.707)	(9.020)
US Experience Household Members	-0.002	0.040	0.043	-3.559	-3.748	-3.452	-3.367	-3.295	-3.001
(in months)	0.019	(0.0154)**	(0.0193)*	(0.875)**	(0.838)**	(0.721)**	(0.778)**	(0.711)**	(0.706)**
Other Individual Characteristics	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Community Characteristics	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes
State Dummies	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Linear Time Trend	No	Yes	No	No	No	Yes	Yes	No	No
Aggregate Migration Incentives	No	No	Yes	No	No	No	No	Yes	Yes
Observations	1443	1434	1434	1443	1443	1434	1434	1434	1434
R-squared	0.71	0.84	0.84	0.14	0.14	0.33	0.32	0.34	0.34
Enforcement Elasticity				0.52	0.48	0.32	-0.16	0.24	0.13

Notes: The table reports least-squares and instrumental variables estimates of the enforcement effect on smuggling prices. In even columns, enforcement is instrumented. The first-stage results are reported in 1stStage, where the dependent variable is border enforcement and the instrument is the budget of the Drug Enforcement Agency. The dependent variable in columns (1)-(6) is the price paid by migrants to smugglers measured in 1983 US$. The omitted education category is no formal education. Column (3) and (4) add dummies for the state of origin and community characteristics in which the migrant lives (fraction of people with more than primary education, fraction of males working in agriculture and manufacturing, earning less than the Mexican minimum wage and more than twice the Mexican minimum wage) and a linear time trend. Column (5) and (6) adds controls for aggregate migration incentives (Mexico's Gross Domestic Product and population, number of Mexicans naturalized in the United States in a given year, the U.S. growth and unemployment rate) instead of the linear time trend. Coefficients with * are significant at the 5 percent level, those with ** at the 1 percent level. Standard errors are corrected for clustering by year. Elasticities are evaluated at the mean.

Table 4: Enforcement by Border Sector and Smuggling Prices

	(1)	(2)	(3)	(4)
Sectoral Enforcement (in 1,000 hours)	0.298	4.162	6.422	7.45
	(0.353)	(2.290)	(2.684)*	(2.526)*
Crossing the Border Alone		-34.386	-34.004	-34.204
		(6.778)**	(6.554)**	(6.761)**
Age		0.769	0.67	0.854
		(0.563)	(0.558)	(0.594)
Female		10.741	-1.235	9.377
		(59.389)	(62.722)	(59.509)
Married		81.697	74.371	82.881
		(33.193)*	(35.310)	(32.849)*
Some Primary School		14.539	13.17	11.917
		(17.932)	(18.095)	(17.691)
Finished Primary School		28.881	27.862	28.085
		(21.307)	(21.729)	(20.371)
More than Primary Education		-6.741	-7.388	-6.78
		(21.634)	(22.251)	(20.129)
First-Time Migrant		-49.213	-46.75	-48.979
		(17.751)*	(18.586)*	(16.745)*
Indicator Whether Family in the US		(0.009)	(0.331)	-0.084
		(13.543)	(13.595)	(13.053)
US Experience Household Members		-3.147	-3.379	-3.043
		(0.793)**	(0.812)**	(0.820)**
Mean Enforcement Neighboring Sectors			17.179	24.314
			(6.609)*	(10.143)
Other Individual Characteristics	No	Yes	Yes	Yes
Year Dummies	No	Yes	Yes	No
Sector Dummies	No	Yes	Yes	Yes
Community Characteristics	No	Yes	Yes	Yes
State Dummies	No	Yes	Yes	Yes
Aggregate Controls	No	No	No	Yes
Observations	1408	1385	1385	1397
R-squared	0.00	0.41	0.41	0.4
Direct Enforcement Elasticity	0.01	0.08	0.12	0.14
Indirect Enforcement Elasticity			0.18	0.15

Notes: The table reports least squares results where the dependent variable is the price for smuggling services paid by illegal migrants in a given year. The measure of enforcement is the number of linewatch hours (in 1,000 hours) of the border sector and year, in which the individual crossed the border. Standard errors are corrected for clustering at the sectoral level. Coefficients with * are significant at the 5 percent level, with ** at the 1 percent level. Column (2) includes sector, year dummies and individual characteristics of the migrant (see notes to previous tables for list of variables included). In addition, state dummies and characteristics of the migrant's community of origin are added to control for differences in geographic distance and access to border smugglers. Column (3) adds the mean enforcement of the two neighboring sectors. Finally, column (4) uses the US growth and unemployment rate, Mexico's GDP, its population and the number of Mexicans naturalized instead of year dummies to control for aggregate shocks. Elasticities are evaluated at the mean.

Table 5: The Demand for Smuggling Services

	1st P^E (2)	1st L (2)	1st P^E (4)	1st L (4)	(1)	(2)	(3)	(4)
Budget of the DEA (in million US$)	0.215	0.095	0.17	0.093				
	(0.087)*	(0.003)**	(0.0828)*	(0.0029)**				
Prison Term for Migrant Smugglers	0.125	0.0004	0.001	0.001				
(in days)	(0.023)**	(0.0008)	(0.0002)**	(0.001)				
Expert Price (in US$)					0.000	-0.004	-0.0002	-0.003
					(0.0000)	(0.001)*	(0.0003)	(0.001)*
Enforcement (in 100,000 hours)					0.000	0.002	-0.0004	0.008
					(0.003)	(0.005)	(0.003)	(0.006)
Crossing the Border Alone	3.326	-0.258	1.145	0.124	-0.038	-0.025	-0.051	-0.036
	(5.1198)	(0.178)	(4.919)	(0.124)	(0.050)	(0.054)	(0.050)	(0.050)
Age	-0.055	0.041	0.125	0.017	0.000	0.000	0.000	0.000
	(0.3455)	(0.012)**	(0.333)	(0.009)*	(0.001)	(0.002)	(0.002)	(0.001)
Female	57.649	0.296	49.249	0.579	0.271	0.464	0.279	0.277
	(29.398)	(1.027)	(28.145)	(0.707)	(0.046)**	(0.155)*	(0.043)**	(0.046)**
Married	31.181	1.134	33.948	0.545	0.153	0.254	0.151	0.148
	(15.196)	(0.531)*	(14.557)*	(0.366)	(0.113)	(0.154)	(0.115)	(0.114)
Some Primary School	3.337	-0.158	0.685	0.200	-0.066	-0.071	-0.053	-0.061
	(11.623)	(0.406)	(11.131)	(0.280)	(0.076)	(0.094)	(0.078)	(0.076)
Finished Primary School	3.680	0.284	2.611	0.670	-0.087	-0.083	-0.083	-0.083
	(12.436)	(0.434)	(11.905)	(0.299)*	(0.055)	(0.083)	(0.058)	(0.056)
More than Primary Education	-2.566	0.389	-3.433	0.553	-0.133	-0.148	-0.123	-0.131
	(12.824)	(0.448)	(12.258)	(0.308)	(0.054)*	(0.077)	(0.054)	(0.054)*
Trip Number	1.336	-0.005	1.018	-0.034	0.018	-0.040	0.005	0.019
	(1.341)	(0.047)	(1.285)	(0.032)	(0.039)	(0.045)	(0.031)	(0.039)
Domestic Migrations	-2.217	0.060	-1.997	0.013	-0.009	-0.005	-0.009	-0.010
	(1.456)	(0.051)	(1.394)	(0.035)	(0.006)	(0.010)	(0.007)	(0.007)
Predicted US Wage	-2.217	0.428	-1.596	0.169	-0.006	-0.011	-0.008	-0.006
	(1.456)	(0.086)**	(2.393)	(0.060)**	(0.006)	(0.012)	(0.005)	(0.006)
Predicted Mexican Wage	-4.073	-2.256	-20.307	-1.047	0.002	-0.011	0.002	0.001
	(2.449)	(0.223)**	(6.507)**	(0.164)**	(0.011)	(0.016)	(0.011)	(0.011)
Family in the United States	-9.347	-0.020	0.285	0.023	-0.038	-0.050	-0.025	-0.028
	(6.398)	(0.19)	(5.200)	(0.131)	(0.016)*	(0.028)	(0.010)*	(0.010)*
US Experience Household Members	-1.755	0.025	-1.998	0.014	0.011	0.011	0.004	0.011
	(5.4269)	(0.037)	(1.026)	(0.026)	(0.033)	(0.034)	(0.034)	(0.033)
Other Individual Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Community Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Linear Time Trend	Yes	Yes	No	No	Yes	Yes	No	No
Aggregate Migration Incentives	No	No	Yes	Yes	No	No	Yes	Yes
Observations	480	480	480	480	480	480	480	480
R-squared	0.45	0.95	0.50	0.98	0.26	0.08	0.26	0.14
Price Elasticity					-0.13	-1.09	-0.13	-0.94
Substitution Elasticity					0.00	0.07	-0.02	0.30

The table shows least squares and instrumental variable estimates of the demand for smugglers. The first-stage is shown in the first columns, where the dependent variables are the smuggling price (1st PE(2)-(4)) and enforcement (1st L(2)-(4)). The instruments are the drug budget of the Drug Enforcement Agency and the punishment for smugglers (in prison days). In column (1)-(4), the dependent variable is one if a coyotes was used and zero otherwise. In columns (2) and (4), both linewatch hours and expert price are instrumented. Individual characteristics included are prior trips, household migration experience, domestic migration, gender, education, age, Mexican and U.S. wages. Community characteristics (males with migration experience, more than 6 years of education, earning below and more than twice the minimum wage), state dummies and punishment for migrants upon prosecution (in prison days) are also included. Finally, a linear time trend to control for aggregate shocks to smuggling demand. Columns (3) and (4) use Mexican state of residence dummies, U.S. unemployment rate, U.S. growth rate, the number of Mexicans naturalized, Mexican Gross Domestic Product and population instead. Standard errors are corrected for clustering. See als

Table 6: Changes in the Geography of Border Crossings

Border Sector	1993 Apprehensions	1993 % of Total	2000 Apprehensions	2000 % of Total
San Diego, CA	531,689	44	151,681	9
El Paso, TX	285,781	24	115,696	7
Yuma, AZ	23,548	2	108,747	7
Tucson, AZ	92,639	8	616,346	37
El Centro, CA	30,058	2	238,126	14
Marfa, TX	15,486	1	13,689	1
Del Rio, TX	42,289	3	157,178	10
Laredo, TX	82,348	7	108,973	7
McAllen, TX	109,048	9	133,243	8
Total	1,212,886	100	1,643,679	100

The table reports the number and fraction of apprehended illegal migrants in a border sector per year.
Source: Immigration and Naturalization Service

Table 7: Accounting for Unobserved Heterogeneity and Composition Changes

A: Unobserved Heterogeneity	Smuggling Price			Coyote Demand	
	(1)	(2)	(3)	(4)	(5)
Sectoral Enforcement (in 1,000 hours)	3.921			-0.007	-0.024
	(2.754)			(0.004)*	(0.027)
Annual Enforcement (in 100,000 hours)		4.234	5.768		
		(1.332)**	(5.463)		
Smuggling Price (in US$)				0.000	0.001
				(0.000)	(0.007)
Enforcement Elasticity	0.07	0.35	0.47		
Price Elasticity				-0.01	0.16
Substitution Elasticity				-0.27	-0.89
Other Individual Characteristics	Yes	Yes	Yes	Yes	Yes
Community Characteristics	Yes	Yes	Yes	Yes	Yes
Sector Dummies	Yes	No	No	N/A	N/A
Year Dummies	Yes	No	No	N/A	N/A
Aggregate Controls	No	Yes	Yes	Yes	Yes
Enforcement Neighboring Sector	Yes	No	No	N/A	N/A
Observations	1397	1434	1434	660	483
R-squared	0.19	0.14	0.12	0.15	0.11

B: Selection Effects		Smuggling Price		Coyote Demand	
	Migrate	Price (1)	Price (2)	Migrate	Demand
Sectoral Enforcement (in 1,000 hours)		3.366			
		(2.4590)			
Annual Enforcement (in 100,000 hours)	-0.0048		3.450	-0.0057	0.0069
	(0.0027)		(1.105)**	(0.0032)	(0.0092)
Smuggling Price (in US$)					-0.0006
					(0.0002)*
Vegetable Price Index U.S. Agriculture	-0.0003			-0.0003	
	(0.0001)*			(0.0001)*	
Enforcement Elasticity		0.07	0.29		0.25
Price Elasticity					-0.16
F-Test of Polynomial Propensity Score		65.61	13.6		4.85
		(0.0000)	(0.0000)		(0.0778)
Other Individual Characteristics	Yes	Yes	Yes	Yes	Yes
Community Characteristics	Yes	Yes	Yes	Yes	Yes
District Dummies	No	No	No	No	Yes
Year Dummies	No	No	No	No	Yes
Aggregate Controls	Yes	Yes	Yes	Yes	Yes
Observations	61323	1168	1196	63401	630
R-Squared	0.24	0.45	0.38	0.31	0.27

Notes: Panel A reports fixed effects estimates. In columns (1)-(3), the dependent variable is the smuggling price. In (1), enforcement varies across year and sector, in (2) and (3) across time only. (3) instruments enforcement with the Drug Enforcement Agency budget. The specification is as in the last column of Table 3. In columns (4) and (5), the independent variable is whether an illegal migrant uses a smuggler. The specification is as in the last column of Table 5. In (5), the Drug Enforcement Agency budget instruments for enforcement and punishment of smugglers for prices. First-stage results are available from the author upon request. Panel B reports results from a selection model to control for changes in migration. The exclusion restriction is the lagged vegetable price index in U.S. agriculture. Migrates show the selection results, where the dependent variable is the migration propensity. Price(1) and Price(2) report the results with prices, Demand with the propensity to use smugglers as dependent variable. In Price(2), enforcement varies across time only. Standard errors are corrected for clustering. Elasticities are evaluated at the mean.

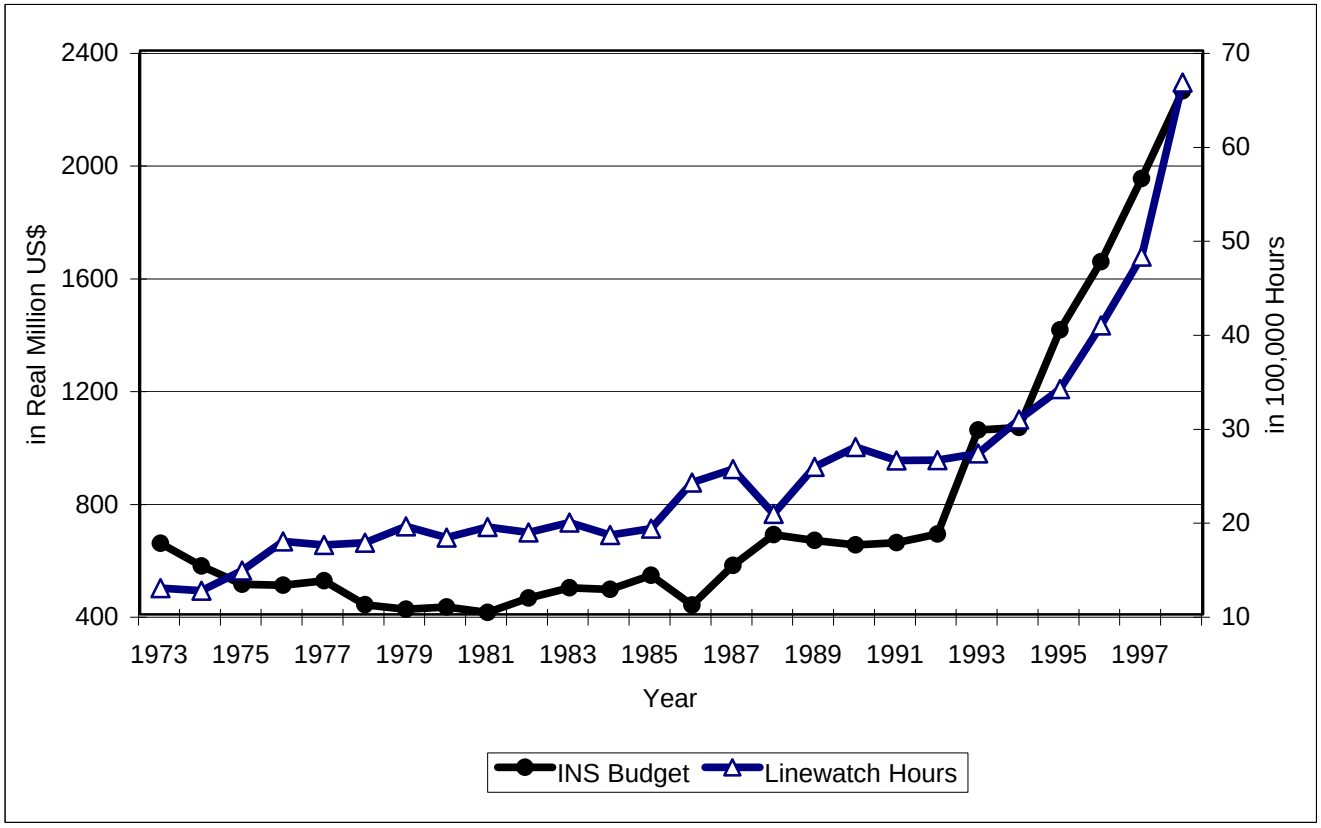
Table 8: Further Robustness Tests

Panel A: First-Time Migrants	Smuggling Price			Coyote Demand	
	(1)	(2)	(3)	(4)	(5)
Sectoral Enforcement (in 1,000 hours)	4.23			-0.013	-0.005
	3.544			(0.007)	(0.005)
Annual Enforcement (in 100,000 hours)		6.298	11.517		
		(2.678)*	(9.412)		
Smuggling Price (in US$)				0.000	-0.002
				(0.001)	(0.001)*
Enforcement Elasticity	0.11	0.58	1.06		
Price Elasticity				-0.01	-0.48
Substitution Elasticity				-0.44	-0.16
Other Individual Characteristics	Yes	Yes	Yes	Yes	Yes
Community Characteristics	Yes	Yes	Yes	Yes	Yes
Sector Dummies	Yes	No	No	No	No
Year Dummies	Yes	No	No	No	No
Aggregate Controls	No	Yes	Yes	Yes	Yes
Observations	433	453	453	218	143
R-squared	0.44	0.35	0.34	0.26	0.3

Panel B: Permanent Migrants	Smuggling Price			Coyote Demand	
	(1)	(2)	(3)	(4)	(5)
Sectoral Enforcement (in 1,000 hours)	5.493				
	(13.232)				
Annual Enforcement (in 100,000 hours)		1.461	-3.412	0.0029	0.0053
		(4.490)	(9.801)	(0.0118)	(0.0206)
Smuggling Price (in US$)				-0.0029	-0.0017
				(0.0007)**	(0.0039)
Individual Characteristics	Yes	Yes	Yes	Yes	Yes
Community Chcaracteristics	Yes	Yes	Yes	Yes	Yes
Sector Dummies	Yes	No	No	No	No
Year Dummies	Yes	No	No	No	No
Aggregate Controls	No	Yes	Yes	Yes	Yes
Observations	360	361	361	80	80
R-Squared	0.24	0.21	0.21	0.68	0.67

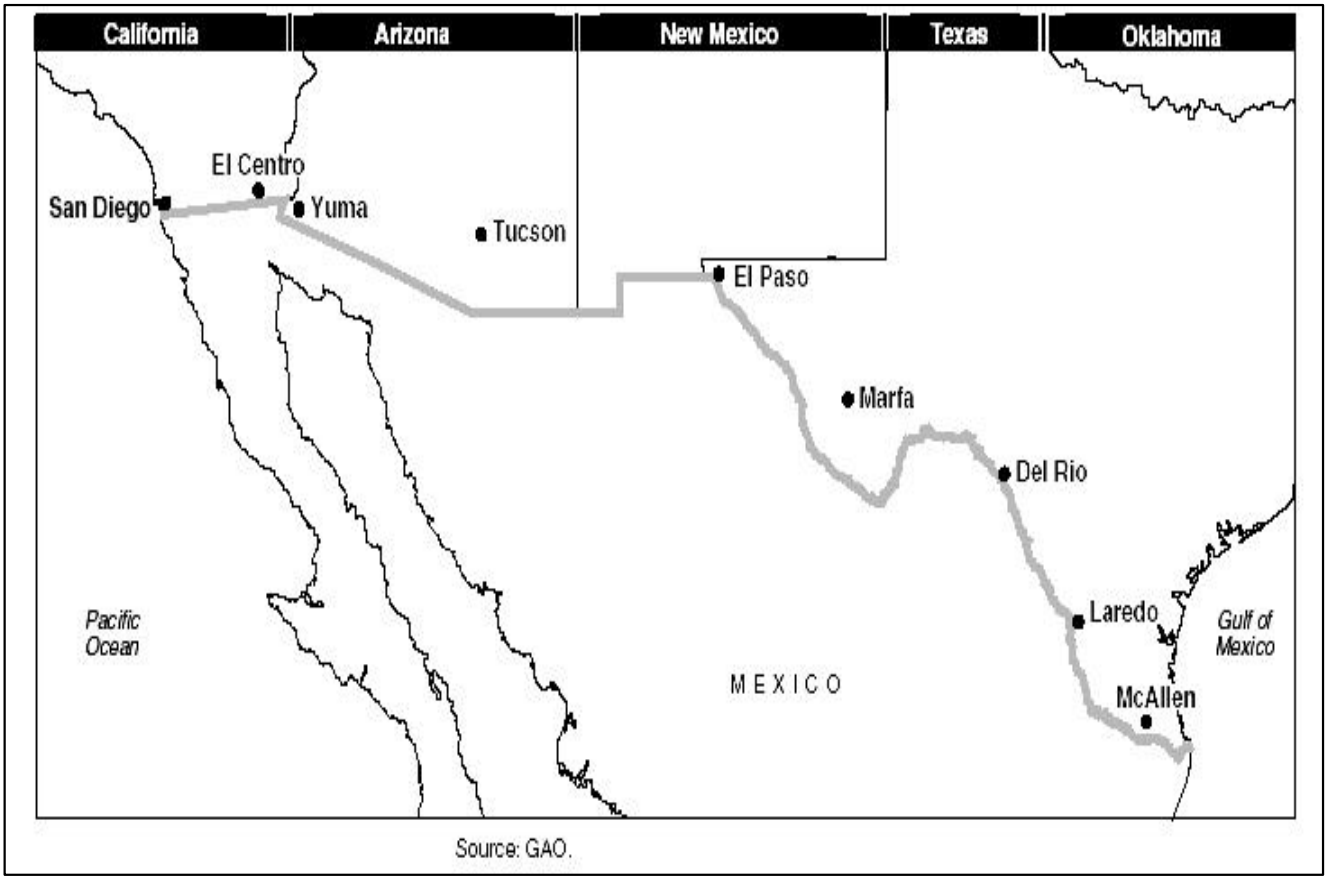
Notes: Panel A reports the estimates on the subsample of first-time migrants, whereas Panel B shows results for the nonrandom sample of permanent migrants in the United States. For both panels, the independent variable in the first three columns is the smuggling price paid by illegal migrants (1978-1998). In the last two columns, the independent variable is whether an illegal migrant uses a smuggler (1990-1998). The variables included are the same as in the models estimated on the whole sample. Column (1) reports least-squares estimates where the enforcement variable varies across sectors and years, while (2) and (4) report least-squares estimates where enforcement varies across time only. Column (3) and (5) show the second-stage instrumental variable results where the Drug Enforcement Agency budget is used as an instrument for enforcement and the punishment of coyotes as an instrument for smuggling prices in column (5). Standard errors are corrected for clustering. Coefficients with * are significant at the 5 percent, those with ** significant at the 1 percent level. The first-stage results are available from the author.

Figure 1: Border Patrol Resources



Source: Mexican Migration Project

Figure 2: Enforcement Districts along the Southwest Border



Source: GAO.