POLITICAL ECONOMY RESEARCH INSTITUTE
PERI
University of Massachusetts Amherst

Attracting Undocumented Immigrants: The Perverse Effects of U.S. Border Enforcement

Florian K. Kaufmann

November 2008

WORKINGPAPER SERIES

Number 187

POLITICAL ECONOMY RESEARCH INSTITUTE

Gordon Hall
418 North Pleasant Street
Amherst, MA 01002

Phone: 413.545.6355
Fax: 413.577.0261
peri@econs.umass.edu
www.peri.umass.edu

UMASS

Attracting Undocumented Immigrants:
The Perverse Effects of U.S. Border Enforcement

Florian K. Kaufmann[1]

November 2008

This paper examines how U.S. migration management techniques affect the flow of undocumented migrants from Mexico and Mexican migrants' degree of socio-economic reorientation. The findings support the hypothesis that stricter U.S. border enforcement increases migrants' detachment from their place of origin, and that this in turn leads to a *net increase* in the volume of illegal Mexican migration. Estimates suggest that the increase in border enforcement in the 1990s induced between 245,000 and 360,000 Mexicans per year to migrate illegally. The results also suggest that narrowing the U.S. – Mexican wage gap would reduce both the extent of illegal Mexican migration and the degree of migrants' detachment from their place of origin. In addition, the results indicate that guest-worker programs, which facilitate continuing attachment to the migrant's place of origin, might be a desirable option in the short-term.

Keywords: International Migration, Border Enforcement, Migration Strategies, Assimilation
JEL Classification: F22, F24, J61, J18

[1] The author may be reached at Florian.Kaufmann@gmail.com. I am grateful to James K. Boyce, Melissa Gonzalez-Brenes, and Peter Skott for their guidance and support. I thank participants of the 2005 and 2006 New School-UMass workshop for helpful comments. I am grateful to the Political Economy Research Institute at the University of Massachusetts for their financial support. Any remaining errors are my own.

A perverse consequence of draconian border enforcement is that it does not deter would-be migrants from trying to enter the country so much as it discourages those who are already here from returning home. The end result of a border buildup is typically longer trip durations, lower probabilities of return migration, and a shift toward permanent settlement. [Massey et al. 2002, pp. 128 – 129]

1. INTRODUCTION

The Department of Homeland Security (2007) estimated that in January 2006, 11.6 million undocumented migrants resided in the U.S., of whom 57 percent were Mexican. The net inflow of undocumented aliens in the new millennium alone was estimated to average 690,000 per year, an amount larger than the populations of Wyoming, Vermont, North Dakota or Alaska (for data, see Passel and Suro 2005). Given the apparent mass influx of undocumented migrants, neither the extent to which the U.S. society and politics have recently been captivated by the "immigration debate" nor the proposed concentration on enforcement activities to "get the border back under control" might seem surprising. Indeed, over the last two decades U.S. immigration authorities have already hired several thousand additional enforcement personnel; begun to install fencing, vehicle barriers, and automated biometric scanning devises at U.S. borders; and, recently, hired a private military contractor to install a "virtual fence" of high-tech surveillance facilities along the U.S. border.

Beyond their intuitive appeal, however, little scientific evidence exists to support the efficacy of costly enforcement activities. The few studies that have analyzed the impact of U.S. border enforcement on the volume of illegal Mexican migration have reported mixed results. Even more striking is the lack of studies that examine the impact of U.S. border enforcement on other aspects of Mexican migration behavior, such as

preferred migration strategies or migrants' degree of socio-economic reorientation from Mexico to the United States. This study attempts to shed light on these questions.

Using a summary index to measure migrants' degree of socio-economic reorientation, and controlling for individual heterogeneity and the potential endogeneity of border enforcement, I find that U.S. border enforcement significantly increases Mexican migrants' detachment from their country of origin. Furthermore, I find that greater U.S. border enforcement increases Mexicans' propensity to migrate illegally. I attribute this perverse effect to the enforcement-induced increase in migrants' detachment, which reduces migrants' remittances and economic activity at home, thereby prompting other community members to out-migrate to the United States. I estimate that the tripling of U.S. border enforcement in the 1990s, as measured by "line-watch hours" of U.S. border patrol agents, encouraged between 245,000 and 360,000 Mexicans per year to migrate illegally. It also induced Mexican migrants' to move one-forth of their family dependents to the. U.S., elevated their total U.S. time by 17.6 percent, reinforced their efforts to obtain long-term visas by 23 percent, and increased their likelihood of acquiring a U.S. house by 6 percent.

The paper is structured as follows. The next section describes the setting and reviews the relevant literature. The third section presents a simple model of international migration behavior. The fourth section discusses the data, and the fifth section develops an econometric model. The following three sections present the results of econometric estimations: section six examines the net impact of border enforcement on Mexicans' propensity to migrate illegally; section seven examines the effect of border enforcement on Mexican migrants' degree of socio-economic reorientation; and section eight re-

evaluates border enforcement's impact on Mexicans' propensity to migrate illegally when accounting for its indirect stimulation channel. Section nine discusses policy implications and the final section provides a summary.

2. BACKGROUND

The Recent History of Mexico – U.S. Migration and U.S. Migration Management

The U.S. - Mexican farm labor program of 1942, known as "Bracero Program," marks a milestone in the history of Mexico – U.S. migration: the beginning of Mexican mass migration. At its height in the late 1950s, between 400,000 and 450,000 Mexican farm workers legally entered the U.S. every year (Massey et al. 2002). When the Bracero Program concluded in 1964 without a successor, many Mexican villages and rural towns, particularly in the central-western region, began to develop a tradition of undocumented migration to the U.S. (Massey et. al 1987). However, the typical migrant – a young, male blue-collar worker laboring in California – still remained strongly connected to his community of origin. He normally chose a seasonal or temporary migration strategy, with his spouse, children, and assets remaining in Mexico, which motivated frequent return trips and generous remittances (Massey et al. 1987).

Hoping to manage rising illegal migration, the bipartisan Immigration Reform and Control Act (IRCA) of 1986 offered both carrots and sticks. On the one hand, it legalized about 2 million undocumented Mexican migrants with prior U.S. work experience. On the other hand, it also paved the way for an escalation of U.S. border enforcement in the 1990s. Yet apprehending undocumented migrants at the U.S. border proved ineffective in stemming the inflow, as undocumented migrants became accustomed to contracting

smuggling experts and multiple entry trials, enabled by a U.S. "catch-and-release" policy. Hence, U.S. migration management shifted to a "prevention-through-deterrence" strategy (Cornelius 2007). Rather than trying to apprehend undocumented migrants at the U.S. border, this strategy intended to dissuade potential migrants from attempting to cross the border. Visible enforcement resources were concentrated at the main illegal border crossing points. Illegal Mexican mass migration did not cease (Passel and Suro 2005), but migrants appear to have become more permanent and diversified (Massey et al. 2002): female and dependent migration rose, trip duration increased, and migrants' destinations diversified (Reyes et al. 2002).

U.S. Border Enforcement and the Volume of Illegal Migration

Hanson and Spilimbergo (1999) examine how U.S. border enforcement affects the number of migrants apprehended at U.S. borders. Controlling for possible endogeneity of border enforcement, they find that stricter controls result in more border apprehensions. Yet in a later study, the same authors find that border enforcement does not "Granger-cause" border apprehension (Hanson and Spilimbergo, 2001). Orrenius and Zavodny (2003) report mixed results. Moreover, the implication of a rise or fall in the number of border apprehensions for the volume of undocumented migration is unclear. While Hanson and Spilimbergo (1999) take an increase in border apprehensions as an indication of deterrence, Espenshade (1995), Orrenius and Zavodny (2003), and others argue that border apprehensions are a proxy for the inflow of illegal migration.[2]

[2] These diametrically opposed interpretations seem to stem from a disagreement about the consequences of being apprehended. While Hanson and Spilimbergo (1999) *assume* that apprehended migrants are deterred from entering into the U.S., Espenshade (1995) draws

Angelucci (2005) examines Mexicans' decisions whether or not to migrate. She finds that U.S. border enforcement significantly reduces Mexicans' propensity to migrate illegally. Yet in a similar specification and data set, Gathmann (2004) finds no statistically significant effect.[3] Kossoudji (1992) reports that being apprehended *increases* migrants' hazard of making another U.S. trip (see also Carrion and Sorensen 2006; Reyes et al. 2002; Richter at al 2005). Summarizing the relevant econometric studies, Table C.1 in Appendix C highlights the disagreement in the literature regarding border enforcement's impact on the volume of illegal migration: about one-third of the studies find a significant deterrence effect, one-third find a significant stimulation effect, and one-third find no statistically significant effect.

Border Enforcement's Impact on Migration Strategies

When policy makers propose to "tighten borders," they appear unaware of the fact that this may provoke other unwanted changes in migration behavior. Kossoudji (1992) seems to have been the first to note that Mexican migrants change their migration patterns in response to heightened U.S. border enforcement. She finds that migrants who are apprehended stay a longer period in the U.S. on their next successful trip, attributing this to lost income and additional migration costs. Reyes et al. (2002) link Mexicans' falling probability to return home in the 1990s to increased border vigilance. While they

---

on field researchers' observation that many apprehended migrants simply try again (see also Donato et al. 1992; Cornelius 2005).

[3] Gathmann further reports that Mexican migrants' demand for smuggling services and the smuggling price have very low elasticities with respect to border enforcement, around 0.4 and 0.12, respectively.

fail to confirm this hypothesis econometrically, possibly due to the low statistical power of their specification, Angelucci (2005) reports supporting regression results.

There are indications that U.S. border enforcement has changed Mexicans' migration behavior in other ways, as well. Migrants' degree of socio-economic reorientation towards the U.S. appears to have risen: dependent migration has increased, settlement in the U.S. has become more common, and more migrants have successfully legalized (Cornelius 2007; Reyes et al. 2002).[4] Massey et al. (2002) have related this reorientation to the concurrent tightening of U.S. border controls. However, no study has yet examined this link econometrically, possibly because it has been difficult to quantify migrants' degree of socio-economic reorientation.

In another study (Kaufmann 2008a) I have argued that choices that reflect migrants' latent degree of socio-economic reorientation (or *migration intensity)*, such as investments into localized assets, remittance sending, and migration patterns (return and repeat migration behavior), are likely to be complementary. Finding empirical evidence that in the U.S. - Mexican case these choices are strongly correlated, I derive an Index of Migration Intensity (IMI) that summarizes migrants' degree of socio-economic reorientation. In the present paper, I use the IMI to examine the impact of U.S. migration policy on migrants' degree of socio-economic reorientation.

[4] Another reaction appears to be a shifting of Mexicans' crossing routes away from the traditional Tijuana-San Diego region to border segments further east (see Eschbach et al. 2003). Since these new crossing routes are often more remote and dangerous, Eschbach et al. identify this development as one of the reasons for the increase in border-crossing-related deaths from 180 in 1990 to 490 (GAO 2006) in 2005.

3. A SIMPLE MODEL OF INTERNATIONAL MIGRATION BEHAVIOR

In modeling international migration behavior I will distinguish two types of migration-related choices: first, agents' decisions whether to become a migrant or not ("extensive migration behavior") and, secondly, migrants' decisions about how strongly to reorient themselves from the place of origin to the destination ("intensive migration behavior"). The latter is reflected in choices regarding return and repeat migration, remittance sending, and investment into localized assets. I construct a two-stage model, in which the first stage is a traditional Harris-Todaro (1970) model of the "go-no-go" decision, and the second considers intensive migration behavior.[5]

Assume that individuals value two commodities: consumption of goods (C) and spending time at home ("home-time consumption").[6] By home-time consumption (HT), I refer to migrants' desire to return home to spend time with family and friends or to be in their homeland (e.g., Massey et al. 1987). Individuals can choose between migrating to a foreign country called "U.S.," where they earn a real wage rate w^*, or staying in their home country called "Mexico," where they earn w. In addition to this "go-no-go" decision, migrants can also decide whether to return home and whether to make additional trips. This is represented by the number of return trips to Mexico (n), with values n_1 larger than one indicating that migrants make a total of n_1 round trips. Each time a migrant enters the foreign country he incurs migration costs (M), which include traveling costs, border crossing expenses (e.g., smuggler fees) and job search costs.

[5] This section is a shortened version of Chapter four in Kaufmann (2008b). While I do not model localized investment behavior here, due to simplicity, the interested reader may refer to the longer version.

[6] My model is related to Hill (1987), who assumes that agents value consumption, total time at home, and traveling.

Let the average trip lengths in the U.S. and Mexico be t^* and t, respectively. Each individual may then select his preferred number of trips and his preferred average trip lengths, as long as his budget constraint holds and the joint trip lengths do not surpass his time endowment T, or $\max\{n,1\}(t+t^*)=T$. For example, for an emigrant (n,t=0) t^* equals T, while $t + t^* = T$ holds in the case of a single-visit "target earner" (n=1).

Let agents' home-time consumption be $HT(n,t)=nt^{\alpha}$, with $0<\alpha<1$. This specification has two desirable properties. First, utility increases as total time at home (nt) rises and, secondly, it allows for smoothing over time (see Hill 1987); that is, migrants experience home-sickness and therefore value several short trips more than one long trip of equal length. Non-migrants enjoy maximal HT, which I define as L. Furthermore, I assume that migrants' home-time consumption is complementary to the amount of remittances they send (R).[7] For simplicity, I take HT and R to be perfect complements, bundling both into the composite good $Z(HT, R) = \min\{R, HT\}$; thus for non-migrants, Z = L holds. Finally, I assume that both migrants and non-migrants have identical Cobb-Douglas utility functions: $U(C,Z)=C^{\delta}Z^{(1-\delta)}$.

The solution of the first stage of the model, the "go-no-go" decision, involves a comparison between the utility of non-migration, $U^{NM}=(Tw)^{\delta}L^{(1-\delta)}$, and the utility derived

[7] The remittance literature offers three main motives for remitting - altruism, reciprocal exchanges, and self-regarding behavior (see Rapoport and Docquier 2007). Each of these rationales is linked to the migrant's intention to return home. If a migrant were to remit to increase his "status" at home or improve his chances to inherit land (Lucas and Stark 1985) he would generally have to return home to claim these localized goods or services. Similarly, in the case of reciprocal exchanges, such as paying somebody to supervise one's assets at home, the migrant benefits only if he returns. Indeed Rapoport and Docquier (2005, p. 13) state, "[s]uch [exchange] motivations are generally the sign of a temporary migration, and signal the migrants' intention to return." Remitting out of altruism may also depend on return in order to maintain the relationship with the beneficiary. At the same time, remitting makes home-time consumption more valuable because of the acquired local services or goods, or continuing affection.

from the optimal migration strategy, U^M. The latter can be determined by solving the second stage of the model:

$$
\begin{aligned}
&\max_{\{C,R,n,t\}} \; C^{\delta} Z\left(R, HT(n,t)\right)^{(1-\delta)} \\
&\text{subject to} \\
&\text{-Budget constaint:} \quad C + M + \max\{n-1,0\}M + R \le Tw^* - nt(w^* - w) \\
&\text{-Time constaint:} \quad \max\{n,1\}(t + t^*) = T \\
&\text{-Remittances/ HT:} \quad Z = A + \min\left\{R, HT\right\};\; HT(n,t) = nt^{\alpha} \\
&\text{-Ranges:} \quad A, R, C, t, t^* \ge 0;\; n \in \{0,1,2,...\};\; \alpha,\; \delta \in (0,1)
\end{aligned}
\tag{1}
$$

where, to recapitulate, C refers to consumption of goods, HT refers to home-time consumption, R refers to remittances, n is the return trip frequency, t refers to average trip duration in Mexico, w is the real wage rate in Mexico, M refers to migration costs, T is the total time endowment, A is a technical parameter,[8] and the asterisk indicates U.S. variables.

Solution and Comparative Statics

It is now possible to calculate the first order conditions (FOCs) of maximization problem (1) and search for interior solutions; that is, solutions that satisfy the FOCs, and imply t, $t^*>0$ and $n>1$.[9] Transforming the Cobb-Douglas function into logs and facilitating, two FOCs describe the model's second stage:

[8] A is included to prevent the marginal utility of Z from going to infinity as HT or R approach zero – a peculiarity of the Cobb-Douglas utility function – which would rule out emigration strategies. A may be interpreted as indicating migrants' "relative comfort of living abroad."

[9] Allowing any interior solution (n*, t*) to be non-integer with respect to n is an approximation that reduces mathematical costs considerably while the comparative

$$(1a) \qquad \frac{1-\delta}{\delta}\frac{\alpha n t^{\alpha-1}}{Z} = \frac{n(w^* - w) + \alpha n t^{\alpha-1}}{C}$$

$$(1b) \qquad \frac{1-\delta}{\delta}\frac{t^{\alpha}}{Z} = \frac{t(w^* - w) + t^{\alpha} + M}{C}$$

Equations (1a) and (1b) show that migrants need to balance the marginal benefits of more home-time consumption due to longer average stays in Mexico (1a) or more frequent returns (1b) against the opportunity cost of lost consumption due to missed U.S. income, increased remittances, and (in the case of 1b) additional migration costs. Equations (1a) and (1b) uniquely determine the optimal interior solution (see Table A.1 in Appendix A).[10]

Comparative Statics: We may now examine how marginal changes in parameters affect migrants' intensive migration behavior.[11] Higher migration costs – arising, for example, from stricter border enforcement – raise the opportunity cost of home-time consumption for migrants. This reduces the equilibrium values of home time-consumption and complementary remittances, while increasing the optimal consumption of goods. Furthermore, in trying to reduce the "price shock" to traveling, migrants make

---

statics of (n*, t*) should approximate average effects well. To find exact solutions, the utility at the two integer values closest to n* (and associated t values) would need to be compared.

[10] It should be noted that a second migration strategy exists - the boundary where migrants make exactly one return trip (n=1). This strategy is optimal under certain conditions. However, due to simplicity and similar marginal effects, I concentrate on the migration strategy as defined in table 1 (for additional results, see Kaufmann 2008b).

[11] The mathematical details behind the cited results are given in Appendix A. The simulation results cited here can be found in Kaufmann (2008b).

fewer trips but stay longer; simulations suggest that total U.S. time is likely to rise. In sum, if migration costs increase migrants' reorient more to the U.S. A rise in the real U.S. wage rate has, c*eteris paribus*, the opposite effect on migrants' intensive migration behavior. Migrants choose to reorient less to the U.S.: as a higher U.S. wage rate enlarges migrants' total income, migrants consume more goods but also remit more and travel more frequently; according to simulations, total U.S. time is likely to fall.

The direct effects of marginal parameter changes on the first stage of the model are quite intuitive: *ceteris paribus,* if the U.S. - Mexican wage gap shrinks, or if tighter border controls raise migration costs, agents' likelihood to remain in Mexico increases, as the net benefit of migration falls. However, it should be noted that the deterrence effect of border enforcement depends on the assumption that non-migrants' income is unaffected by changes in border enforcement. In labor-exporting regions, such as the central highlands of Mexico, this assumed independence may not hold. Non-migrants benefit from other migrants' transfers, due to both direct income transfers and indirect multiplier effects.[12] Recalling that remittances fall if migration costs rise ($dR/dM<0$), we note that non-migrants' income shrinks if migration costs increase. This indirect effect weakens border enforcement's direct deterrence effect. Indeed, the indirect effect may outstrip the direct one, in which case border enforcement would stimulate more migration.

Hypotheses for Empirical Testing

The model presented above generates the following hypotheses:

H1: The direct impact of elevated border controls is to reduce Mexicans'

[12] Adelman et al. (1988) found that every remitted U.S. dollar increased the Mexican GNP by about three.

propensity to migrate illegally.

H2: Elevated border enforcement also leads to a further detachment of Mexicans who succeed in migrating or have already migrated, resulting in a reduction in remittances.

H3: The latter effect is expected to stimulate more illegal migration. Depending on whether the direct deterrence effect or the indirect stimulation impact carries more weight in Mexicans' decision whether or not to migrate, the net effect of heightened U.S. border enforcement on migration inflows could be negative or positive.

H4: A growing U.S. - Mexican wage gap, due to either rising U.S. earnings or falling Mexican earnings, motivates more Mexicans to migrate.

H5: Wage increases on either side of the border reduce migrants' detachment from their place of origin, as the relaxation of the budget constraint allows for more return trips and remittances. (It is possible, however, that migrants interpret higher U.S. earnings as a sign of "being welcome," which would make the net effect of U.S. wages on home detachment indeterminate, *a priori*.)

In addition, migration networks are expected to facilitate illegal migration (see Palloni et al. 2001; Munshi 2005). Having more family members in the U.S. could also induce detachment from Mexico. An increase in available legal employment opportunities, in particular long-term visas, could also lead to higher detachment, but since visas ease cross-border travel, their net impact is uncertain, *a priori*, and might vary depending on the type of visa.

These hypotheses are tested against empirical evidence in the remainder of this paper.

4. DATA

This study uses panel data from the Mexican Migration Project (MMP), a collaborative research project based at Princeton University and the University of Guadalajara.[13] Since 1982, the MMP has surveyed both migrants and non-migrants in Mexican communities during the winter months to take advantage of the regular return visits of migrants. Each community is visited once, and about five communities are surveyed in a given year. The MMP database for the years 1982 to 2006 includes data from a total of 114 communities, in each of which roughly 170 randomly chosen households were interviewed. This sample gives a total of 19,003 surveyed household heads, of whom 6,759 migrated at some point.[14] Using household heads' retrospective accounts, I construct two panels covering the period from 1972 to 2004.[15] The "ME panel" includes both non-migrant and migrant household heads in order to examine extensive migration behavior. The "MI panel" includes only migrant household heads in order to examine intensive migration behavior.

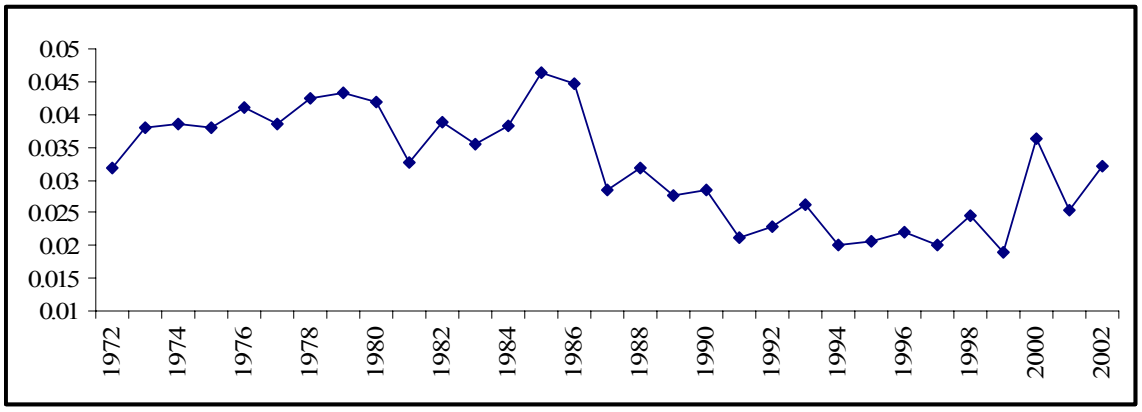
Extensive Migration Behavior: The Decision Whether or Not to Migrate

The ME panel includes 362,160 individual-year observations of potential undocumented migrants. Potential undocumented migrants are working-age Mexicans who do not possess legal U.S. immigration documents and are currently not residing in the U.S. on an ongoing trip. The dummy variable $ME_{i,t}$ equals one if individual i starts a

[13] The data set is publicly available at http://mmp.opr.princeton.edu.
[14] I use household heads, since their dataset contains all the necessary information.
[15] I exclude earlier observations as some of my variables start to be observed in 1972. I choose 2004 as end point as the MMP dataset includes too few observations thereafter.

new trip to the U.S. in year t, and zero if he stays in Mexico that year.[16] There are many more "non-trip" observations (351,024) than trip observations (11,136), and about two-thirds of the household heads never migrate. Figure 1 depicts year averages of individual ME values, sometimes referred to as the average "propensity to migrate illegally." Mexicans' propensity to migrate illegally averaged 0.031 in the sample period. It rose steadily throughout the 1970s as Mexicans were looking for alternative migration opportunities after the conclusion of the Bracero Program. The marked drop in 1987 is due to the IRCA, which enabled around 2 million undocumented Mexican migrants to legalize and thus shrank the pool of potential undocumented migrants.

Figure 1: Mexicans' Propensity to Migrate Illegally



Notes: Graph shows annual likelihood of new U.S trip of Mexicans without U.S. visa.

[16] I drop individual-year observations of continued residence in the U.S.; that is, the second, third, and higher years of a multi-year U.S. trip (see also Angelucci 2005).

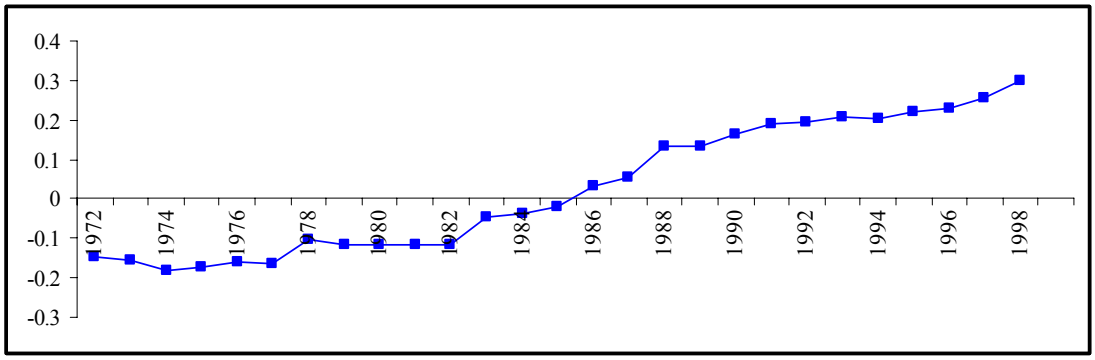
Intensive Migration Behavior: Migrants' Degree of Socio-Economic Reorientation

The MI panel includes 24,948 individual-year observations of working-age migrant household heads.[17] Starting with a set of observable indicators that reflect the relevant aspects of migrants' degree of socio-economic reorientation, I use principal component analysis to combine the indicators' information into an Index of Migration Intensity (IMI) (see Kaufmann 2008a). The four indicators are the proportion of total time that the migrant spends abroad; a house index indicating whether, and if so, in which country, the migrant owns a house; the proportion of the migrant's dependents who currently reside in the U.S.; and a dummy variable indicating if the migrant has long-term U.S. immigration documentation (see Table C.2 in Appendix C). Principal component analysis indicates that these indicators are highly correlated and can be well summarized by a unidimensional Index of Migration Intensity (IMI).[18] Figure 2 shows the annual progression of the IMI, averaged across individuals and purged of a linear time trend. Mexican migration intensity started to rise strongly in the aftermath of the 1986 IRCA. The increase in the IMI was particularly steep in the mid-1990s, a time of burgeoning U.S. border enforcement (see Figure 3).

[17] In the MI panel observations of individual migrants are included once every five years, in accordance with the sampling frequency of the Index of Migration Intensity (for more details, see Kaufmann 2008a).

[18] The construction of the IMI is also robust to the inclusion of additional variables, such as indicators for remittance sending, language capability (both of which are not used here, as they are available only as time-invariant variables in the MMP), and business ownership. For details, see Kaufmann (2008a).

Figure 2: Annual Progression of the Index of Migration Intensity (De-Trended)



Notes: Graph shows annual average of IMI after purging a linear time trend and smoothing over five years; Graph includes only migrants interviewed after 1997 to improve comparability across time (n=10,550).

U.S. Border Enforcement and Instruments

To measure U.S. border enforcement, I use an updated version of Hanson and Spilimbergo's (1999) time-series on the number of hours that U.S. border patrol agents at the southern U.S. border use for "line-watch activities" ("line-watch hours"). As Figure 3 shows, line-watch hours rose sluggishly until the early 1990s. Then they grew rapidly, tripling in less than one decade to peak at 9.8 million hours in 2001. Simultaneously, the real budget of the border patrol agency quadrupled, reaching $1.2 billion in 2001 (in dollars of 1995).[19]

Hanson and Spilimbergo (1999) argue that U.S. border enforcement might be endogenous if unobservable or uncontrollable shocks change the behavior of both migrants and U.S. immigration authorities. To address this potential problem, the authors

[19] I also construct a "regional border enforcement" series which varies across time and Mexican states. For this purpose I use Hanson and Spilimbergo's second time series ("total enforcement hours"), which has a spatial breakdown (for more details, see Appendix A-II). Due to the series' shorter time span and highly collinear progression across regions, I use it only for additional robustness tests.

propose the use of instrumental variables (IV) estimation.[20] I test three different sets of instruments for border enforcement. First, I use the real budget of the U.S. Drug Enforcement Agency (DEA), as Angelucci (2005) has proposed.[21] Second, I use Carrion and Sorensen's (2006) indicators for the "political clout" of U.S. border states. Third, I construct dummy variables which indicate the party affiliation of the U.S. president and the majorities in U.S. Congress ("political majority instruments"), the idea being that under Republican rule border enforcement tends to be tougher (see Table C.2 in Appendix C).[22]

Wages and Other Independent Variables

As income measures, I include predicted monthly wages in the U.S. and Mexico. These are predicted for each individual, year and country, and deflated into real terms (for details, see Appendix A-II). The use of predicted wages is preferable to the use of observed wages due to possible sample selection bias (Taylor 1987). Furthermore, predicted wages are less prone to be collinear with other macro-level variables than person-invariant wage indexes. To measure migration networks, I create a variable for

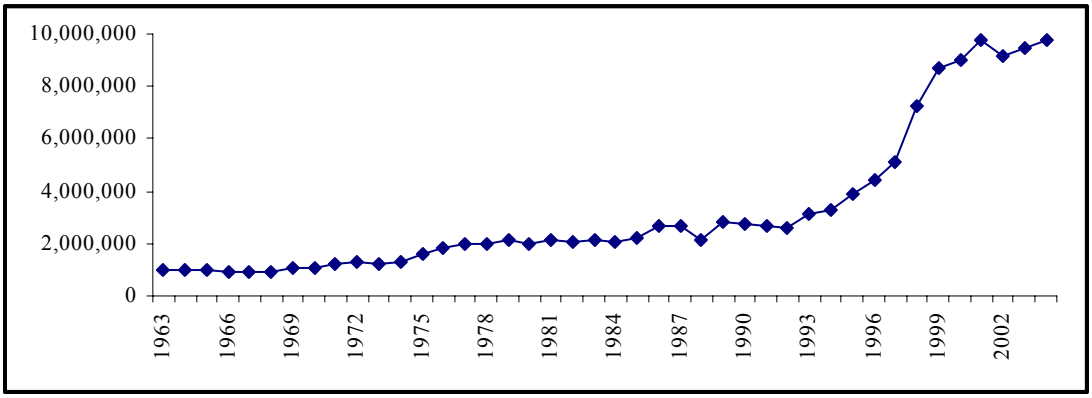
[20] I found that Hanson and Spilimbergo's proposed instruments – several election dummies, the U.S. defense budget, and lags in border enforcement and border apprehensions – performed poorly with my data set. In my first stage results, the election dummies were not statistically significantly related to line-watch hours and the defense budget was negatively correlated to line-watch hours, which seems unreasonable. Hence I use alternative instruments.

[21] Using the DEA budget as an instrument for border enforcement might not solve potential endogeneity problems, as the U.S. border patrol is also involved in drug control activities, according to Massey and Singer (1998).

[22] The "political majority instruments" should be uncorrelated to shocks to the Mexican economy as well as to shocks operating at the U.S. local or regional level, such as changes to local employment conditions or housing or enforcement regulations.

how many of the migrant's two parents ever migrated to the U.S. prior to the current period.[23] To measure the availability of long-term legal employment opportunities, I include the annual number of green cards granted to Mexicans.[24] I further include two types of short-term visas in additional specification tests. I use the yearly change in the Mexican consumer price index (CPI) to control for Mexican economic crises, and add additional macroeconomic variables in robustness tests. Descriptive statistics of all variables are provided in Table C.2 in Appendix C.

Figure 3: Line-Watch Hours of U.S. Border Patrol Agents at the Southern U.S. Border



Source: Hanson and Spilimbergo (1999), updated.

Data Issues

Since the MMP selects communities non-randomly, strictly speaking it is representative only for the populations of the 114 surveyed communities. Fortunately, the selected communities reflect a broad range of sizes and socio-economic conditions.

[23] In alternative specifications I also included the number of siblings who ever migrated to the U.S. previous to the current period. This produced no significant changes.

[24] The use of individuals' observed immigration status would be inappropriate, as applying for U.S. immigration documentation is an endogenous choice.

Comparison of the MMP to a nationally representative survey has shown a high degree of accordance (Massey and Durand 2005). The sole major bias seems to be its geographic focus, which has favored western Mexican states (other regions have been added more recently).

Representativeness within the communities themselves is often difficult to achieve when communities experience significant out-migration. The MMP takes various steps to deal with this problem: first, MMP staff conducts interviews in Mexico during the winter months when migrants traditionally return; second, spouses frequently remain in Mexico and are interviewed in the absence of the household head; and third, emigrated households are tracked by "snowball sampling" techniques and interviews with them are conducted in the U.S. In this respect, the MMP data are preferable to census or similar survey data that focus only on one location and hence either miss all current migrants or else miss all "stayers" and former migrants.

5. AN ECONOMETRIC MODEL OF MEXICAN MIGRATION BEHAVIOR

I use two reduced-form equations to examine econometrically Mexicans' migration behavior. Equation (2a) is a linear probability model that models decisions regarding whether or not to migrate (extensive migration behavior). Equation (2b) models the migrants' degree of socio-economic reorientation from Mexico to the U.S. (intensive migration behavior):

$$\text{(2a)} \quad \Pr(ME_{it}=1) = \alpha^{E} + \beta_1^{E} l_t + \beta_2^{E} w_{it}^{MX} + \beta_3^{E} w_{it}^{US} + \beta_4^{E} n_{it} + \beta_5^{E} g_t + \gamma^{E} X_t + u_{it}^{E}$$

$$\text{(2b)} \quad IMI_{it} = \alpha^{I} + \beta_1^{I} l_t + \beta_2^{I} w_{it}^{MX} + \beta_3^{I} w_{it}^{US} + \beta_4^{I} n_{it} + \beta_5^{I} g_t + \gamma^{I} X_t + u_{it}^{I},$$

where ME_{it} is a dummy variable that is equal to one if individual i starts a new undocumented U.S. trip in year t and zero otherwise, IMI_{it} measures individual i's migration intensity in year t, α is an intercept term, β_i are the parameters to be estimated, l_t is a measure of U.S. border enforcement, w_{it}^{MX} and w_{it}^{US} are predicted real wage rates in Mexico and the U.S., respectively, n_{it} is a measure of migration networks, g_t indicates the availability of visas, X_t is a vector of additional macroeconomic controls (for a description, see Table C.2 in Appendix C), and u_{it} is an error term.

To account for unobserved cross-person differences, such as deviating abilities or tastes, I include "individual fixed effects:"

$$(2c) \qquad u_{it} = \omega_i + \varepsilon_{it},$$

where ω_i is a constant term that captures time-invariant cross-person differences and ε_{it} is an independent and identically distributed error term. Ideally, I would also include year dummy variables to better control for unobserved changes over time, but the fact that the measure of U.S. border enforcement varies only across time precludes this. As a second-best alternative, I include several macroeconomic control variables and correct the error terms for clustering at the year level.

6. THE DETERMINANTS OF EXTENSIVE MIGRATION BEHAVIOR

Table 1 presents the results of different regressions that implement equation (2a), which models the choice as to whether or not to migrate illegally. Column one starts with an ordinary least square (OLS) regression that estimates the effect of U.S. border enforcement without controlling for the effects of other variables. Column two also controls for predicted earnings in both countries. Columns three and four further include migration networks, the number of green cards granted to Mexicans, the change in the Mexican CPI, and time-invariant individual control variables.[25] Columns five onward use individual fixed effects instead of the time-invariant individual control variables, and columns six through eight test different instruments for border enforcement.

The results indicate that increases in U.S. border enforcement do not deter Mexicans from migrating illegally. Only in the uncontrolled OLS specification (column one) does greater U.S. border enforcement (slightly) reduce Mexicans' propensity to migrate illegally. In all other specifications, including the IV estimations,[26] the estimated coefficient of border enforcement is positive, implying that stricter border controls have a perverse effect: they *stimulate* more illegal migration.

While highly statistically significant throughout, the estimated effect of border enforcement is rather small, with an estimated point elasticity at the sample mean of 0.19

[25] I include indicators for individuals' age, sex, educational attainment, marital status, and land and business ownership.

[26] All first stage results are reported in Table C.2 in Appendix C. I find that the political clout variables are the weakest instruments. Unlike other authors (Angelucci 2005; Carrion and Sorensen 2006; Hanson and Spilimbergo 1999), I do not find marked differences between OLS and IV estimation results. In particular there are no indications that OLS underestimates border enforcement's deterrence effect.

to 0.31 (see columns five to eight). Put differently, hiring 1,000 additional U.S. border patrol officers – that is, adding 904,000 line-watch hours[27] – increases a Mexican's probability to migrate illegally by 0.15 to 0.23 percent. Given the population of potential Mexican migrants, this translates into an estimated 34,000 to 50,000 increase in the annual volume of illegal Mexican migration.[28] As discussed in the following sections, the reason for this perverse effect is that Table 1 shows border enforcement's net impact: the reported coefficient of border enforcement is not purged of border enforcement's indirect stimulation effect, resulting from its impact on intensive migration behavior.

In accordance with expectations, predicted real U.S. wages exert a significant pull effect on Mexicans. The estimated point elasticity of undocumented migration with respect to U.S. wages, when controlling for individual heterogeneity, ranges from 0.6 to 1.25. An increase in predicted real Mexican wages deters undocumented migration, with a smaller point elasticity of -0.36. Given that Mexican wages are quite low compared to U.S. wages – in 2004, the Mexican minimum wage rate per *day* was less than the U.S. federal minimum wage rate per *hour* – the binational wage gap is relatively little affected by marginal changes in Mexican wages. Also in accordance with expectations, I find that migration networks significantly raise the likelihood of undocumented migration, supporting the hypothesis that assistance furnished by social networks facilitates migration. Mexicans' propensity to migrate illegally seems little affected by Mexico's inflation rate or by the number of available green cards.

---

[27] In 2004, 10,727 border patrol officers performed 9.7 million line-watch hours, giving an average of about 904 line-watch hours per officer and year. This is about half the figure used by Angelucci (2005), who does not correct for non-line watch activities.

[28] To approximate the population of potential migrants, I use the International Labor Organization's census-based estimate of the average size of Mexico's labor force during the sample period (22.17 million), available at http://laborsta.ilo.org/.

Table 1: The Determinants of Mexicans' Propensity to Migrate Illegally

	1	2	3	4	5	6	7	8
	OLS	**OLS**	**OLS**	**IV**	**OLS-IFE**	**IV-IFE**	**IV-IFE**	**IV-IFE**
Border Enforcement	-0.0015	0.0004	0.0034	0.0030	0.0020	0.0017	0.0019	0.0025
(millions of line-watch hours)	(0.0002)***	(0.0006)	(0.0006)***	(0.001)***	(0.0004)***	(0.0005)***	(0.0009)**	(0.0006)***
Predicted Mexican Wages		-0.0028	-0.0024	-0.0024	-0.0022	-0.0022	-0.0022	-0.0018
(const. 2000 Pesos, thousands)		(0.0010)**	(0.0009)**	(0.001)**	(0.0008)***	(0.0008)***	(0.0008)***	(0.0006)***
Predicted U.S. Wages		0.0506	0.0423	0.0415	0.0144	0.0134	0.0140	0.0297
(const. 2000 Dollars, thousands)		(0.0084)***	(0.0088)***	(0.010)***	(0.0047)***	(0.0054)**	(0.0062)**	(0.0087)***
Migration Networks			0.0542	0.0541	0.0323	0.0325	0.0324	0.0378
(# of parents ever in US)			(0.0032)***	(0.003)***	(0.0071)***	(0.0072)***	(0.0070)***	(0.0067)***
Green Cards			8.9867	8.6423	1.1784	0.7786	1.0096	3.4641
(millions granted to Mexicans)			(4.3516)**	(4.465)*	(2.8537)	(3.0817)	(3.1685)	(3.2383)
Mexican Inflation			0.1760	0.1687	0.0442	0.0374	0.0420	0.0364
(annual change in CPI * 10^3)			(0.0699)**	(0.070)**	(0.0374)	(0.0347)	(0.0517)	(0.0386)
LWH Instrumented				Pol. Majority		Pol. Majority	DEA Budget	Pol. Clout
Add. Individual Controls			YES	YES				
Individual Dummies					YES	YES	YES	YES
Observations	362160	354350	346545	346545	346545	346545	346545	290392
R-squared	0	0.01	0.03	0.03	0.28	0.28	0.28	0.31
Elasticity of Enforcement	-0.14	0.04	0.35	0.42	0.23	0.19	0.21	0.31
Elasticity of Mexican Wages		-0.43	-0.39	-0.38	-0.36	-0.36	-0.36	-0.29
Elasticity of U.S. Wages		2.22	1.90	1.97	0.66	0.61	0.64	1.25
Δ ME if +1,000 BP Officers	-0.0014	0.0004	0.0031	0.0028	0.0018	0.0015	0.0017	0.0023
Δ Migrants if +1,000 BPO	-30063	8017	68142	60969	40083	34071	38079	50104

Notes: "***," "**," and "*" significant at the 1%, 5% and 10% level, respectively. Standard errors in parentheses are robust to clustering at year level. All elasticities are predicted point elasticities at the sample mean. The last two rows estimate the effect of hiring 1,000 additional border patrol officers (904,000 line-watch hours) on probability to migrate illegally and on flow of illegal migration, respectively; WDI estimate of male Mexican working-age population was used to approximate population of potential migrants. For a description of the variables and the first stage results see Tables C.2 and C.3 in Appendix C, respectively.

Robustness Tests

Additional specifications to test the robustness of these results are reported in Table 2. I first check whether U.S. border enforcement might have a non-linear effect, by including squared line-watch hours. The estimated coefficient of the quadratic term is statistically significant, but the inflection point is beyond the sample range, indicating no reversal of the net stimulation effect (column one). Using a regional border enforcement measure as a substitute for line-watch hours causes the results to change very little (column two). Since previous studies generally have relied on wage or income indexes, I replace my predicted income variables with two commonly used indexes: a real index of earnings in Mexican manufacturing, from the Instituto Nacional de Estadística Geografía e Informática, and real earnings in U.S. manufacturing, from the U.S. Department of Labor. Border enforcement's coefficient remains unaffected (column three).

To test whether unobserved shocks affect the results, I include as additional macroeconomic control variables the U.S. and Mexican unemployment rates, the Mexican GDP growth rate, and a dummy variable indicating whether the IRCA was enacted. The estimated coefficients remain fairly stable, with slightly stronger positive effects of border enforcement and U.S. wages. Next, I include year dummies, dropping all person-invariant variables, using the regional border enforcement measure, and first differencing all independent variables to reduce multicollinearity (column five). None of the estimated coefficients changes sign, but border enforcement's coefficient loses statistical significance, presumably due to remaining multicollinearity.[29]

[29] In levels, regional border enforcement's variance inflation factor (VIF) is 20.67. Once I first difference the VIF drops to 12.95.

Table 2: The Determinants of Mexicans' Propensity to Migrate Illegally (Additional Specifications)

	1	2	3	4	5	6	7	8
	Enforcement		**Wages**	**Changes across Time**		**Discrete Probability Models**		
	Non-Linear	*Regional*	*Wage-Index*	*Macro*	*Year Dummies*			
	OLS-IFE	OLS-IFE	IV-IFE	IV-IFE	OLS-IFE,TE	Probit	IV-Probit	Cond. Logit
Border Enforcement	0.0143		0.0015	0.0039		0.0023	0.0019	0.0256
(millions of line-watch hours)	(0.0044)***		(0.0005)***	(0.0011)***		(0.0004)***	(0.001)**	(0.0023)***
Regional Enforcement		0.0056			0.0086			
(millions of enforcement hours)		(0.0012)***			(0.0083)			
Border Enforcement squared	-0.0011							
(millions of line-watch hours^2)	(0.0004)***							
Predicted Mexican Wages	-0.0021	-0.0020		-0.0020	-0.0073	-0.0021	-0.0021	-0.0328
(const. 2000 Pesos, thousands)	(0.0008)**	(0.0006)***		(0.0008)**	(0.0027)**	(0.001)**	(0.0008)***	(0.0028)***
Predicted U.S. Wages	0.0291	0.0245		0.0437	0.3038	0.0267	0.0259	0.1335
(const. 2000 Dollars, thousands)	(0.0077)***	(0.0073)***		(0.0117)***	(0.0300)***	(0.0050)***	(0.0056)***	(0.0174)***
Migration Networks	0.0307	0.0383	0.0318	0.0330	0.0413	0.0217	0.0217	0.1100
(# of parents ever in US)	(0.0069)***	(0.0065)***	(0.0073)***	(0.0077)***	(0.0163)**	(0.0019)***	(0.0018)***	(0.0381)***
Green Cards	0.9739	3.0062	1.8268	3.7266		6.5850	6.3088	4.4271
(millions granted to Mexicans)	(2.6922)	(3.3713)	(3.0943)	(5.8986)		(2.740)**	(2.895)**	(18.5770)
Mexican Inflation	0.0648	0.0259	-0.0005	0.0204		0.1233	0.1161	0.3680
(annual change in CPI * 10^3)	(0.0482)	(0.0355)	(0.0211)	(0.0553)		(0.0500)***	(0.050)**	(0.1000)***
MX Manufacturing Earnings			-0.0345					
(real index)			(0.0449)					
U.S. Manufacturing Earnings			0.0306					
(constant 2000 Dollars)			(0.0349)					
LWH Instrumented			YES	YES			YES	
Individual Dummies	YES	YES	YES	YES	YES			YES
Additional Individual Controls						YES	YES	
Additional Macro Controls				YES				
Year Dummies					YES			
Observations	346545	295614	353404	313842	276909	346545	346545	69339
Enforcement Elasticity	0.25	0.34	0.15	0.30	0.02	0.43	0.36	0.11

Notes: "***," "**," and "*" significant at the 1%, 5% and 10 % level, respectively. Standard errors in parentheses are robust to clustering at year level. Regional enforcement is millions of total enforcement hours per year and Mexican state (see Appendix A-II). Additional controls are listed in Table C.2. In column 5 all independent variables are in first differences. Columns 6 to 8 use a probit, probit IV and Chamberlain's (1980) conditional fixed effect specification, respectively; marginal effects at mean and standard errors are shown. IV regressions use political majority instruments.

Probit specifications, equivalent to the OLS and IV specifications without individual fixed effects in Table 1, produce very similar estimates for marginal effects, statistical significance levels and point elasticities (columns six to eight).[30] The main difference is that the impact of predicted Mexican wages increases by about one-fourth.[31] Finally, my results are robust to a reduction of the recall period to a maximum of fifteen years (see Table C.5 in Appendix C).

7. THE DETERMINANTS OF INTENSIVE MIGRATION BEHAVIOR

I now turn to the determinants of migration intensity, that is, migrants' degree of socio-economic reorientation from their place of origin, as measured by the IMI. Column one of Table 3 reports a simple OLS regression that includes line-watch hours and predicted real wages in the U.S. and Mexico. Column two adds migration networks, the number of green cards granted to Mexicans, and the Mexican inflation rate. Columns three onward include individual fixed effects, and columns four and five instrument line-watch hours.

[30] Since the decision whether or not to migrate is a discrete choice, a linear probability model is an approximation. I have used linear probability models because, in this case, no unbiased discrete choice model exists that can control for unobserved individual heterogeneity.

[31] Results from logit regressions were very similar to the probit results. Column eight uses Chamberlain's (1980) conditional fixed effects logit model. Border enforcement's predicted point elasticity remains positive but is close to zero (0.11). Due to Chamberlain's conditioning procedure all observations of life-time stayers - about 80 percent - have to be dropped, making a comparison to the other results difficult.

Table 3: The Determinants of Mexican Migration Intensity

	1	2	3	4	5
	OLS	**OLS**	**OLS-IFE**	**IV-IFE**	**IV-IFE**
Border Enforcement	0.0391	0.0427	0.0241	0.0273	0.0318
(millions of line-watch hours)	(0.0022)***	(0.0084)***	(0.0052)***	(0.0061)***	(0.0056)***
Predicted Mexican Wages	-0.0113	-0.0085	-0.0031	-0.0026	-0.0029
(const. 2000 Pesos, thousands)	(0.0012)***	(0.0070)	(0.0030)	(0.0035)	(0.0025)
Predicted U.S. Wages	0.4203	0.4482	0.0639	0.0725	0.0639
(const. 2000 Dollars, thousands)	(0.0100)***	(0.0411)***	(0.0264)**	(0.0334)**	(0.0228)***
Migration Networks		0.1633	0.2068	0.2032	0.1823
(# of parents ever in US)		(0.0145)***	(0.0226)***	(0.0246)***	(0.0257)***
Green Cards		0.3552	0.1575	0.1621	0.1351
(millions granted to Mexicans)		(0.0285)***	(0.0302)***	(0.0319)***	(0.0296)***
Mexican Inflation		2.2271	0.6070	0.6684	0.5717
(annual change in CPI)		(0.5754)***	(0.3437)*	(0.3787)*	(0.3689)
Indiviudal Dummies			YES	YES	YES
LWH Instrumented				YES	YES
Observations	24948	24948	24948	24948	21371
R-squared	0.26	0.41	0.82	0.85	0.86
Elasticity of Enforcement	4.58	5.08	2.87	3.24	2.47
Elasticity of Mexican Wages	-2.11	-1.59	-0.58	-0.49	-0.32
Elasticity of U.S. Wages	26.14	27.67	3.94	4.47	2.24
Δ IMI if Δ-SD in LWH (#)	21.75%	23.75%	13.40%	15.18%	17.69%
First Stage:					
President Republican				0.7359	
(past period)				(0.3712)*	
Senate Majority Republican				0.0566	
(past period)				(0.4021)	
House Majority Republican				4.4387	
(past period)				(0.751)***	
DEA Budget					0.0058
(const. 2000 Dollars, millions)					(0.0006)***
R-squared				0.85	0.85

Notes: "***," "**," and "*" significant at the 1%, 5% and 10% level, respectively. Standard errors in parentheses are robust to clustering at year level. All elasticities are predicted point elasticities at sample mean. (#) Normalized change in IMI: change in IMI due to standard deviation increase in border enforcement divided by IMI's standard deviation. First stage regressions include all regressors from second stage. For a description of the variables see Table C.1.

Consistently across all specifications, an increase in U.S. border enforcement results in a sizable and statistically highly significant increase in migration intensity. In other words, it leads to greater socio-economic reorientation of migrants from Mexico to

the U.S. The magnitude of this intensification effect falls once I control for unobserved individual heterogeneity, suggesting cross-person differences, but it remains strong and indeed increases slightly once line-watch hours are instrumented. Mexicans' intensive migration behavior appears to be more sensitive to changes in U.S. border enforcement than extensive migration behavior. The IMI's predicted point elasticity with respect to border enforcement, evaluated at the sample mean, is quite high: between 2.9 and 3.2, when controlling for individual hetereogeneity. Table 3 also reports marginal changes in the IMI, normalized by the IMI's own standard deviation. If border enforcement increases by one standard deviation, this causes a normalized IMI change of 13.4 to 17.7 percent.

An increase in Mexican wages reduces the IMI, but the effect is small.[32] Higher U.S. wages lead to a greater detachment of migrants. A one standard deviation increase in predicted real U.S. wages results in a normalized IMI change of 12 to 14 percent, comparable to the effect of border enforcement. Nuclear migration networks have a strong intensification effect: having one parent in the U.S. raises normalized IMI by about 55 percent. The availability of long-term visas increases the IMI, while the availability of short-term visas lowers it (see Table C.5 in Appendix C). These findings are consistent with the hypothesis that long-term visas' main impact is to improve migrants' foreign quality-of-life, while short-term visas' main impact is to ease travel restrictions, impacts that increase and decrease migrants' detachment from their place of origin, respectively.

[32] Moreover, the effect is statistically significant only if the standard errors are not corrected for clustering at the year level (not shown).

Table 4: The Determinants of Mexican Migration Intensity (Additional Specifications)

	1	2	3	4	5	6	7	8	9	10	11
	Enforcement	**Changes over Time**			**Decomposition: Dependent Variable is**				**"Migrant Types"**		
	Regional Measure	*Macro Controls*	*Year Dummies*		*% Time in U.S.*	*U.S. House Index*	*% Dependents in U.S.*	*U.S. Visa*	*Emigrant*	*Active Migrant*	*First-Time Migrant*
	IV-IFE	IV-IFE	OLS-TE	OLS-IFE,TE	IV-IFE	Mult. Logit	IV-IFE	IV-IFE	IV-IFE	IV-IFE	IV
Border Enforcement		0.0230			0.0270	0.0094	0.0375	0.0354	0.0906	0.0597	0.0089
(millions of line-watch hours)		(0.0043)***			(0.0068)***	(0.0011)***	(0.0071)***	(0.0086)***	(0.0157)***	(0.0107)***	(0.004)**
Regional Enforcement	0.0620		0.2860	0.0129							
(millions of enforcement hours)	(0.0195)***		(0.1250)*	(0.0242)							
Predicted Mexican Wages	-0.0050	0.0003	-0.0364	-0.0115	-0.0028	-0.0020	0.0015	-0.0065	0.0010	-0.0004	-0.0049
(const. 2000 Pesos, thousands)	(0.0027)*	(0.0031)	(0.0097)***	(0.0023)***	(0.0058)	(0.0011)*	(0.0028)	(0.0037)*	(0.0094)	(0.0053)	(0.003)
Predicted U.S. Wages	0.0324	0.1648	0.7780	0.3693	0.1270	0.0770	0.0114	0.0261	0.1115	0.0181	0.2692
(const. 2000 Dollars, thousands)	(0.0391)	(0.0398)***	(0.0510)***	(0.0373)***	(0.0339)***	(0.0067)***	(0.0358)	(0.0497)	(0.0696)	(0.0377)	(0.024)***
Migration Networks	0.1862	0.1395	0.1150	0.1215	0.1684	0.0416	0.1934	0.2018	0.2112	0.1828	0.0850
(# of parents ever in US)	(0.0293)***	(0.0262)***	(0.0106)***	(0.0252)***	(0.0284)***	(0.0036)***	(0.0304)***	(0.0278)***	(0.0394)***	(0.0294)***	(0.007)***
Green Cards	0.1104	0.0694			0.1115	0.0713	0.1905	0.2497	0.4619	0.2879	0.1794
(millions granted to Mexicans)	(0.0348)***	(0.0384)*			(0.0338)***	(0.0107)***	(0.0304)***	(0.0510)***	(0.0893)***	(0.0550)***	(0.031)***
Mexican Inflation	0.1233	-0.0791			0.8712	0.3450	0.6874	0.9757	2.4551	1.200	1.4739
(annual change in CPI * 10^3)	(0.3611)	(0.2150)			(0.3839)**	(0.0681)***	(0.4099)	(0.5808)	(1.0650)**	(0.600)*	(0.247)***
Additional Macro Controls		YES									
Year Dummies			YES	YES							
Individual Dummies	YES	YES		YES	YES		YES	YES	YES	YES	YES
LWH Instrumented	YES	YES			YES		YES	YES	YES	YES	
Observations	18462	19653	18462	18462	24948	24948	24948	24948	2861	10597	5253
Δ IMI if Δ-SD in LWH (#)	8.32%	12.21%	43.73%	1.97%	13.77%	-	29.84%	17.45%	50.26%	26.07%	7.59%

Notes: "***," "**," and "*" significant at the 1%, 5% and 10 % level, respectively. Standard errors in parentheses are robust to clustering at year level. Regional enforcement is millions of total enforcement hours per year and Mexican state (see Appendix A-II). Additional macro controls are listed in Table C.1. In columns 5 to 8 IMI indicators are independent variables (see Table C.1). Column 6 is a multinomial logit regression and reports estimated marginal effects and standard errors (evaluated at sample mean) that individuals choose U.S. house ownership (no ownership is base outcome). Columns 9, 10 and 11 include only observations of individuals whose household is in the U.S., who have made a U.S. trip in the current period, or whose first U.S. trip is no more than five years ago, respectively. All IV regressions use political majority instruments. (#) Normalized change in IMI: change in IMI due to standard deviation increase in border enforcement divided by IMI's standard deviation (columns 5 to 8 refer to respective IMI indicator).

Robustness Tests

Table 4 reports the results of additional tests. The first column replaces line-watch hours with the regional border enforcement measure. Border enforcement's effect is somewhat reduced but still strong and statistically significant. To control for possible shocks, additional macroeconomic control variables are included in column two. Border enforcement's intensification effect remains significant, but the coefficient of Mexican wages becomes negligible. Next, I include year dummies, drop all person-invariant variables, and use the regional border enforcement measure. Border enforcement's coefficient remains statistically significant and strong, as long as I do not simultaneously include individual fixed effects (see column three). Once individual fixed effects are added, border enforcement's coefficient becomes insignificant (see column four), which is not surprising.[33] The results also are robust to a restriction of migrants' recall period and remain valid if I do not use the MMP's sampling weights (see Table C.5 in Appendix C, columns eight and nine, respectively).[34]

Decomposing Migrants' Intensive Migration Behavior

Different aspects of migrants' socio-economic reorientation may have distinct trajectories. For example, in response to tighter border controls migrants might cut back on home-time consumption but continue to invest, or even invest more, at home. The IMI summary measure

[33] Enforcement hours progress highly collinear across regions over time. Once I control for different starting levels, by including fixed effects, almost no variation remains.

[34] The reason for the coefficients' decrease once I do not use the MMP's sampling weights is a reduction of the IMI's sample variation by three-fourths. As it is costlier to interview emigrants, the MMP samples fewer emigrants but weights them more strongly to achieve better representativeness. Since emigrants are high-intensity migrants, the right tail of the IMI's sampling distribution is effectively deflated if no weighting is used.

could conceal such differential trajectories. To examine this possibility, I decompose the IMI into its four components and use these individually as dependent variables (columns five to eight in Table 4). The previous findings map closely to each of the IMI components: not only are the signs of all coefficients identical and their levels of statistical significance comparable, but the coefficients' relative magnitudes are also similar. [35,36] This strong correspondence vindicates the use of the IMI.

The decomposed estimations again suggest that the tripling of line-watch hours during the 1990s led to a considerable socio-economic reorientation of migrants to the U.S.: it induced Mexican migrant household heads to move one-fourth of their family dependents to the U.S., elevated their total U.S. time by 18 percent, reinforced their efforts to obtain a long-term visa by 23 percent, and increased their likelihood of acquiring a U.S. house by 6 percent. [37]

Border Enforcement's Impact on Remittances

The MMP database does not include data on migrants' remittances that vary across both time and individuals.[38] To examine how border enforcement affects migrants' remittance sending

[35] Columns five, seven, and eight use IV estimation and include individual fixed effects. As the house index may take on three discrete values – Mexican ownership, no ownership, and U.S. ownership – column six implements a multinomial logit model with three choices (see Greene 2005, Equation 21-45). The base outcome is "no ownership;" that is, all shown results are relative to the "no ownership" case. I report estimated marginal effects, evaluated at the sample mean (average marginal effects were very similar), and associated standard errors.

[36] The only exceptions to this strong correspondence are the parameter estimates of the wage variables in column seven.

[37] To obtain these estimates, I multiply each component's marginal effect with respect to border enforcement (reported in columns 5 to 8) by the increase in line-watch hours in the 1990s (6.5 million).

[38] The lack of both time- and person-variant information is also the reason why the IMI that I have used throughout was constructed without including a remittance indicator, despite the fact that migrants' remittance sending behavior was found to be correlated to the other IMI indicators in a cross-section of Mexican migrants (see Kaufmann 2008a).

behavior, I thus construct a cross-sectional sample, using information on migrants' remittances from their last U.S. trip. Table C.4 in Appendix C then reports the results of different econometric specifications that examine the effects of border enforcement, and other commonly included variables, on migrants' decision whether to remit or not (columns 1 and 2) and the proportion of income remitted (columns 3 to 6). I find that border enforcement reduces both migrants' probability to remit and the proportion of income migrants remit. Border enforcement's impact is most significant for the amount remitted, in terms of both the magnitude of the marginal effect and the level of statistical significance. The results further suggest that the tripling of line-watch hours in the 1990s reduced migrants' probability to remit by 4 to 8 percent and decreased the amount of income they sent by 12 to 17 percent.

"Migrant-Type" Differences

Changes in U.S. immigration policies may affect the migration behavior of different "migrant types" differently. In particular, increases in border enforcement may have a stronger intensification effect on high-intensity migrants, for whom further detachment may be comparatively more appealing than abandonment of migration. Columns nine to eleven of Table 4 report regression results that use sub-samples of migrant types: "emigrants" whose household is in the U.S.; "active" migrants who started a U.S. trip in the current period; and "first-time migrants" whose first U.S. trip happened during the last five years. For emigrants, border enforcement's intensification effect is almost four times higher than in the overall sample; for active migrants, it is double; and for first-time migrants, the intensification effect is 42 percent lower than in the overall sample.

8. ACCOUNTING FOR BORDER ENFORCEMENT'S INDIRECT STIMULATION OF ILLEGAL MIGRATION

In Mexican communities with high out-migration rates, the incomes of "stayers" – residents who stay in Mexico – depend not only on their own economic activity but also on migrants' remittances and migrants' economic activity at home, including consumption and investment. In such a setting, the intensification of migration strategies in response to increased border enforcement could importantly impact on stayers' incomes, and this in turn could thus induce more community members to migrate. This would provide a plausible explanation for the perverse effect of border enforcement reported above (section six). To test whether border enforcement exerts an indirect stimulation effect via this pathway, and if so, to quantify its magnitude, I construct a community-level indicator of migrants' average degree of detachment from the community of origin ("average community IMI"): I calculate village-year averages of predicted individual IMI values and lag them to account for time delays.[39] To disentangle border enforcement's direct and indirect effects, I include average community IMI as a regressor in addition to line-watch hours and the other control variables and reproduce the main regressions from section six. The results are reported in Table 5.[40]

[39] Specification three of Table 3 was used for prediction. I use predicted IMI values to avoid endogeneity with border enforcement. I tried different lags of the predicted average community IMI variable. I found that an average of two to six-year lags gave best results and used this in the regressions reported here.

[40] One might be concerned about reverse causality; that is, that extensive migration behavior might drive intensive migration behavior. This is not likely to be a problem in this specification, however, for two reasons. First, average community IMI is lagged but ME is not. Second, ME is an individual-level variable, but average community IMI is a community average. It seems unlikely that the choice of one individual would have a noticeable impact on a community aggregate.

Table 5: Mexicans' Propensity to Migrate Illegally: Accounting for Border Enforcement's Direct and Indirect Effect

	1	2	3	4
	IV-IFE	**OLS-IFE**	**IV-IFE**	**IV-IFE**
Border Enforcement	0.0019	0.0012	0.0004	0.0003
(millions of line-watch hours)	(0.0009)**	(0.0004)***	(0.0008)	(0.0008)
Predicted Mexican Wages	-0.0022	-0.0023	-0.0024	-0.0023
(const. 2000 Pesos, thousands)	(0.0008)***	(0.0008)**	(0.0008)***	(0.0008)***
Predicted U.S. Wages	0.0140	0.0226	0.0213	0.0446
(const. 2000 Dollars, thousands)	(0.0062)**	(0.0063)***	(0.0069)***	(0.0111)***
Migration Networks	0.0324	0.0306	0.0310	0.0327
(# of parents ever in U.S.)	(0.0070)***	(0.0070)***	(0.0069)***	(0.0075)***
Green Cards	1.0096	-1.7377	-3.2640	-6.5871
(millions granted to Mexicans)	(3.1685)	(2.7008)	(2.8396)	(3.7630)*
Mexican Inflation	0.0000	0.0001	0.0001	-0.0000
(annual change in CPI)	(0.0001)	(0.0000)	(0.0000)	(0.0001)
Average Community IMI		0.0751	0.0862	0.0700
(predicted, lagged)		(0.0176)***	(0.0151)***	(0.0214)***
LWH Instrumented	YES		YES	YES
Additional Macro Controls				YES
Individual Dummies	YES	YES	YES	YES
Observations	346545	327734	327734	299126
R-squared	0.28	0.28	0.28	0.30
Net Impact of Border Enforcement:				
Δ ME if +1,000 BPO (†)	0.00172	0.00272	0.00224	0.00180
Δ Migrants if +1,000 BPO (+)	35,211	55,780	45,912	36,823

Notes: "***," "**," and "*" significant at the 1%, 5% and 10% level, respectively. Standard errors in parentheses are robust to clustering at year level. (†) and (+) estimate the net impact of hiring 1,000 additional U.S. border patrol officers on the probability to migrate illegally and on the flow of illegal Mexican migration for sample period, respectively (see also footnote 28); for calculation of indirect effect see text. All IV regressions use real budget of DEA as instrument. For description of variables see Table C.2 in Appendix C.

Consistently, I find that an increase in migrants' detachment from their community of origin – which heightened border enforcement induces, as shown in the previous section – significantly raises fellow community members' future propensity to migrate illegally. In other words, the empirical evidence supports the existence of an indirect stimulation channel operating through the effect of border enforcement on intensive migration behavior; that is, migrants' heightened detachment from home puts greater pressure on "stayers" to migrate, too, most

plausibly due to a reduction of migrants' remittances and economic activity at home, and associated negative multiplier effects. According to the estimates reported in column three, for example, the addition of 1,000 U.S. border patrol officers (0.904 million line-watch hours) raised individuals' predicted IMI by 0.0218 (0.904 x 0.0241; see column 3 in Table 3), which indirectly increased fellow community members' propensity to migrate illegally by 0.188 percent (0.0218 x 0.0862), and thus indirectly added about 41,600 undocumented migrants per year (0.00188 x 22.17 million; see footnote 28).

Once border enforcement's indirect channel is accounted for, by controlling for average community IMI, the coefficient on border enforcement becomes statistically indistinguishable from zero in the instrumental variables, individual fixed-effects estimates. The finding in section six that U.S. border enforcement increases illegal migration can thus be attributed to border enforcement's adverse impact on migrants' average degree of detachment from the community of origin.

9. POLICY IMPLICATIONS

The Department of Homeland Security estimated in 2006 that the costs of hiring, training, and equipping one additional border patrol agent were $187,955 per year (cited in Mulhausen 2006; see also CBO 2006). Hiring 14,000 additional U.S. border patrol agents, as proposed by the Senate Agricultural Job Opportunities, Benefits and Security Act of 2007 ("AgJOBS"), would thus cost $2.6 billion in the hiring year and would create annual expenditures likely to be around $1.2 billion in subsequent years. Proponents might consider this policy to be worth the expense if its promised goal - deterrence of illegal migration - were achieved. The econometric results presented in this paper suggest that this will not be the case. On the contrary, my estimations

suggest that this escalation of border enforcement will induce between 735,000 and 1,081,000 Mexicans per year to migrate illegally.[41,] In the 1990s, a period during which "only" 5,345 of the proposed 14,000 border patrol officers were added, the net increase in the *stock* of undocumented Mexican migrants in the U.S. was on average 300,000 per year (Passel and Suro 2005; DHS 2007); the increase in the *gross inflow*, that is, before subtracting the outflow of migrants, was likely even higher.[42] This suggests that the magnitude of the estimated increase is plausible.[43]

My estimation results from Table 4 suggest that the addition of 14,000 U.S. border patrol agents would further induce Mexican migrants to move half of their family dependents to the U.S., expand their total U.S. time by 34 percent, intensify their efforts to obtain a long-term visa by 45 percent, and increase their likelihood of acquiring a U.S. home by 12 percent. Researchers have long noted that once migrants settle, reunify with their family, and legalize, their remittances will drop (e.g., Lucas 2005). If a significant part of the current $23 billion in annual remittances – equivalent to 2 million full-time annual salaries at the official Mexican minimum wage rate[44] – were to disappear, as my regression results above suggest, a substantial increase in the volume of illegal Mexican migration could be a plausible consequence.

---

[41] I multiply my estimate of the current pool of potential migrants – the ILO's most recent census-based estimate of the size of Mexico's labor force (34.15 million) – with the predicted net increase in the propensity to migrate illegally due to the addition of 12.66 million line-watch hours (between 0.0017 x 12.66 and 0.0025 x 12.66; see Tables 1 and 5).

[42] Indeed, according to Espenshade's (1995) method for measuring the gross inflow of undocumented migrants – for which I combine INS data on the number of border apprehensions and MMP data on the annual average probability to be apprehended – an average of 2.5 million undocumented Mexicans entered the U.S. per year in the 1990ies.

[43] The estimations should be taken with a grain of salt, however. First, they assume that the inherent propensity to migrate illegally of the average potential migrant does not change as more Mexicans migrate. Second, due to the immense increase in border enforcement, linear extrapolation might be inadequate. Third, migrants' detachment may reach an upper boundary (e.g., "emigration"), at with which point additional border enforcement does not cause additional migration stimuli.

[44] The Mexican Central Bank states that the 2005 federal daily minimum wage was 45.24 pesos, corresponding to about 5.7 purchasing-power-corrected U.S. dollars.

U.S. border enforcement thus backfires with respect to its main policy goal. In addition, it is likely to provoke other unwanted consequences, such as reducing transfers that benefit the Mexican society (e.g., remittances), but increasing the volume and permanency of detrimental outflows in human, financial and political capital.[45] This suggests that a profound rethinking of U.S. migration management is in order. When designing immigration policies and visa programs, policy makers may wish to consider their effects on migrants' degree of socio-economic reorientation. Some of the recent proposals for "immigration reform" have included provisions for an expansion of guest-worker programs. Such programs, that facilitate cross-border mobility and seem less prone to cause detachment, might be the preferred short-term policy from both the U.S. and Mexican perspectives. In the longer run, a reduction in the volume of Mexican migration seems most likely if U.S. migration management takes a broader perspective and supports the Mexican government in providing better economic opportunities for Mexicans at home. In this respect, the European Union's support for the convergence of the development levels of its member states may offer useful lessons.

10. SUMMARY

External border enforcement has been the main pillar of U.S. migration management in the recent decades, and there are no signs that this will change in the near future (CRS 2006). This study finds that further escalation of U.S. border enforcement is an ill-advised policy that is likely to yield perverse effects, contrary to the goals of U.S. policy makers as well as to the prospects for Mexico's economic development. Controlling for individual heterogeneity, macroeconomic shocks, and endogeneity of border enforcement, I find that the net impact of U.S.

[45] Eschbach et al. (2003) describe the human hardship that border enforcement causes.

border enforcement is to *stimulate* Mexicans' propensity to migrate illegally. For example, I estimate that the tripling of U.S. border enforcement in the 1990s induced between 245,000 and 360,000 Mexicans per year to migrate illegally. I attribute this striking result to border enforcement's impact on migrants' degree of socio-economic reorientation, and the adverse effects this has upon the sending communities.

Using a summary measure of migrants' degree of socio-economic reorientation, the Index of Migration Intensity (IMI), I find strong econometric evidence that stricter U.S. border enforcement causes a significantly greater detachment of Mexican migrants from their community of origin. I argue that such a development can spur new migration by suppressing stayers' incomes from remittances, migrants' economic activity at home, and associated multiplier effects. I find statistical support for the hypothesis that an increase in the community average IMI – which greater border enforcement increases – makes it more likely that fellow community members will migrate illegally. This effect largely accounts for the finding that the net impact of stricter border controls is to stimulate more illegal migration.

I also find that an increase in predicted real U.S. wages induces both more illegal migration and greater socio-economic detachment from the origin. Higher predicted real Mexican wages deter illegal migration and reduce migrants' detachment. This suggests that reducing the U.S. – Mexican wage gap may be the most promising long-term migration management technique. In the short term, guest-worker programs, which facilitate continuing attachment to the migrant's place of origin, might be a desirable option.

REFERENCES

Angelucci, Manuela (2005). "U.S. Border Enforcement and the Net Flow of Mexican Illegal Migration," IZA Discussion Papers No. 1642.

Brownell, Peter (2005). "The Declining Enforcement of Employer Sanctions," Washington, DC: Migration Information Source.

Carrión-Flores, Carmen, and Sorensen, Todd (2006). "The Effects of Border Enforcement on Migrants Border Crossing Choices: Diversion, or Deterrence?," mimeo, University of Arizona.

CBO (2006). *Cost Estimate: S. 2611 - Comprehensive Immigration Reform Act of 2006*, Washington, DC: Congressional Budget Office.

Chamberlain, Gary (1980). "Analysis of Covariance with Qualitative Data," *Review of Economic Studies*, 47(1), 225-38.

Conapo (2000). *Índice de Intensidad Migratoria México-Estados Unidos, 2000*, Mexico, D.F.: Consejo Nacional de Población.

Cornelius,Wayne (2005). "Controlling 'Unwanted' Immigration: Lessons from the United States, 1993–2004," *Journal of Ethnic and Migration Studies*, 31, 775–794.

Cornelius, Wayne (2007). "Introduction: Does Border Enforcement Deter Unauthorized Immigration," in W. Cornelius and J. Lewis (eds.) *Impacts of Border Enforcement on Mexican Migration,* La Jolla, CA: Center for Comparative Immigration Studies.

CRS (2006a). *Immigration: Policy Considerations Related to Guest Worker Programs*, Washington, DC: Congressional Research Service.

DHS (2007). *Estimates of the Unauthorized Immigrant Population Residing in the United States: January 2006*, Washington, DC: U.S. Department of Homeland Security.

Donato, Katharine, Jorge Durand, and Douglas Massey (1992). "Stemming the Tide? Assessing the Deterrent Effects of the Immigration Reform and Control Act," *Demography*, 29(2), 139-57.

Eschbach, Karl, Jacqueline Hagan, and Nestor Rodríguez (2003). "Deaths During Undocumented Migration: Trends and Policy Implications in the New Era of Homeland Security," *In Defense of the Alien,* 26, 37-52.

Espenshade, Thomas (1995), "Using INS border apprehension data to measure the flow of undocumented migrants crossing the U.S.-Mexico frontier," *International Migration Review*, Vol. 29 (2): 545-65.

GAO (2006), Illegal Immigration, *GAO-06-770*, Washington, DC: General Accounting Office.

Gathmann, Christina (2004). "The Effects of Enforcement on Illegal Markets: Evidence from Migrant Smuggling along the Southwestern Border," IZA Working Paper No. 1004.

Greene, William (2005). "*Econometric Analysis-Fifth Edition*," New York, NY: Pearson Education.

Hanson, Gordon and Antonio Spilimbergo (1999). "Illegal Immigration, Border Enforcement, and Relative Wages: Evidence from Apprehensions at the U.S.-Mexico Border," *The American Economic Review,* 89(5), 1337-57.

Hanson, Gordon, and Antonio Spilimbergo (2001). "Political Economy, Sectoral Shocks, and Border Enforcement," *The Canadian Journal of Economics*, 34 (3), 612-638.

Hanson, Gordon H., Raymond Robertson and Antonio Spilimbergo (2002) "Does Border Enforcement Protect U.S. Workers from Illegal Immigration?" *The Review of Economics and Statistics,* 84(1), 73-92.

Harris, John and Michael Todaro (1970). "Migration, Unemployment and Development: A Two-Sector Analysis," *American Economic Review*, 60(1), 126-42.

Hill, John (1987). "Immigrant Decisions Concerning Duration of Stay and Migratory Frequency," *Journal of Development Economics*, 23, 221 - 234.

Kaufmann, Florian K. 2008a, "Emigrant or Sojourner? Migration Intensity and Its Determinants," University of Massachusetts, Political Economy Research Institute Working Paper # 154.

Kaufmann, Florian K. (2008b), "Emigrant or Sojourner? The Determinants of Mexican Labor Migration Strategies to the United States," University of Massachusetts, Department of Economics, Unpublished Ph.D. Dissertation.

Kossoudji, Sherrie (1992). "Playing Cat and Mouse at the Mexican-American Border," *Demography*, 29(2), 159-180.

Lucas, Robert (2005). *International Migration and Economic Development: Lessons from Low-Income Countries,* Northampton, MA: Edward Elgar.

Massey, Douglas, Rafael Alarcón, Jorge Durand, and Humberto González (1987). *Return to Aztlan: The Social Process of International Migration from Western Mexico*, Berkley, CA: University of California Press.

Massey, Douglas and Audrey Singer (1998). "The Social Process of Undocumented Border Crossing among Mexican Migrants," *International Migration Review*, 32 (3), 561-592.

Massey, Douglas S., Jorge Durand, and Nolan J. Malone (2002). *Beyond Smoke and Mirrors: Mexican Immigration in an Era of Economic Integration*, New York: Russell Sage Foundation.

Massey, Douglas, and Jorge Durand (2005). C*rossing the Border. Research from the Mexican Migration Project*, New York, NY: Russell Sage Foundation.

Mulhausen, David (2006). "Building a Better Border: What the Experts Say," Backgrounder No. 1952, Washington DC: Heritage Foundation.

Munshi Kaivan. (2003). "Networks in the Modern Economy: Mexican Migrants in the U.S. Labor Market," Quarterly Journal of Economics, 118(2), 549-599.

Orrenius, Pia and Madeline Zavodny (2003). "Do Amnesty Programs Reduce Undocumented Immigration? Evidence from IRCA," *Demography*, 40 (3), 437–450.

Palloni, Alberto, Douglas Massey, Miguel Ceballos, Kristin Espinosa, and Michael Spittel (2001). "Social Capital and International Migration: A Test Using Information on Family Networks," *The American Journal of Sociology,* 106 (5), 1262–98.

Passel, Jeffrey and Roberto Suro (2005). *Rise, Peak, and Decline: Trends in U.S. Immigration 1992–2004*, Washington, DC: Pew Hispanic Center.

Reyes, Belinda, Hans Johnson, Richard Van Swearingen (2002). *Holding the Line? The Effect of the Recent Border Build-up on Unauthorized Immigration*, San Francisco, CA: Public Policy Institute of California.

Richter, Susan, Edward Taylor, and Antonio Yúnez-Naude (2005). "Impacts of Policy Reforms on Labor Migration from Rural Mexico to the United States," NBER Working Paper No 11428.

APPPENDIX A: Mathematical Appendix

1.) Optimal Migration Strategy

Table A.1: Optimal Migration Strategy

$t^{IM} = \frac{\alpha M}{(1-\alpha)(w^* - w)}$	$HT^{IM} = R^{IM} = \frac{\delta(E-AD)}{D}$
$n^{IM} = \frac{\delta(E-AD)}{t^{\alpha} D}$	$C^{IM} = \delta t^{-\alpha}\left(\frac{\delta}{1-\delta}E + AD\right)$

Notes: $D = \frac{M}{1-\alpha} + t^{\alpha}$ and $E = \frac{1-\delta}{\delta} w^* T t^{\alpha}$.

2.) Partial Derivatives of Optimal Migration Strategy

A) Let X= (n, t, R, C, t^*) be the optimal solution as defined in Table A.1. Then the partial derivates are (with superscripts suppressed):

$$\frac{\partial X}{\partial M} = \begin{Bmatrix} -\delta \dfrac{\left\{\dfrac{\alpha}{(1-\alpha)} + \dfrac{\alpha}{M} t^{\alpha}\right\}(E-AD)+E}{t^{\alpha} D^2} & (<0) \\ \dfrac{t}{M} & (>0) \\ -\dfrac{\delta E}{D^2} & (<0) \\ \dfrac{\delta A}{t^{\alpha}} & (>0) \\ \dfrac{T t^{\alpha} \Delta\left\{w + \alpha^2 t^{\alpha-1} - \alpha(1-\delta) w^*\right\} + \alpha\delta AD}{\delta(1-\alpha)\Delta w(E-AD)} & (>0)^{a} \end{Bmatrix}, \quad \frac{\partial X}{\partial w^*} = \begin{Bmatrix} \dfrac{\delta}{t^{\alpha} D^2}\left\{\dfrac{DE}{w^*} + \dfrac{\alpha}{\Delta w}(E-AD)\right\} & (>0) \\ -\dfrac{t}{\Delta w} & (<0) \\ \dfrac{(1-\delta) T t^{\alpha}}{D^2}\left\{\dfrac{t\Delta w}{\alpha} - t w^* + t^{\alpha}\right\} & (>0)^{b} \\ \delta \dfrac{T t^{\alpha} + At}{t^{\alpha}} & (>0) \\ \dfrac{T t^{\alpha}}{\delta(E-AD)^2}\left\{ADt - \dfrac{1}{w^*} DE - \dfrac{\alpha t^{\alpha}}{\Delta w}(E-AD)\right\} + \dfrac{t}{\Delta w} & (<0)^{b,c} \end{Bmatrix}$$

where $\Delta w = w^* - w$, $D = \frac{M}{1-\alpha} + t^{\alpha}$ and $E = \frac{1-\delta}{\delta} w^* T t^{\alpha}$. Superscripts "a)","b)", and "c)" require that for the indicated sign to be valid, Condition A1-a, A1-b or A1-c holds, respectively.

Condition A1:

a) $w^*\{1-\alpha(1-\delta)\} > w - \left\{\alpha^2 t^{\alpha-1} + \alpha\delta \dfrac{AD}{Tt^{\alpha}} + \dfrac{(1-\alpha)\Delta w AD}{E-AD}\right\}$

b) $w^*(1-\alpha) \geq w - \alpha t^{\alpha-1}$

c) $w^*\delta \geq w - \left\{\alpha t^{\alpha-1} + \dfrac{\delta AD}{Tt^{\alpha}}\right\}$

Note: Numerical simulation suggests that Conditions A1 are very likely to hold for optimal migration strategies (see Appendix D-II in Kaufmann 2008b).

APPPENDIX B: Construction of Variables

Regional Border Enforcement:

I compute two-way frequency tables of destination and origin states. I find that on average three-fourths of all trips from a certain Mexican state destine to no more than two U.S. states. Hence, it appears reasonable to focus on each Mexican state's two most favorite migration routes. I group the nine U.S. border enforcement zones into four regions – west, center-west, center-east, and east – and assess through which each state's favorite migration routes pass, assuming that migrants prefer to take the shortest possible way once in the U.S (see Figure C.1 in Appendix C). I then use the breakdown of total enforcement hours into enforcement zones and year to calculate a weighted regionalized total enforcement measure for each Mexican state and year.[46]

Predicted Real Wages in the U.S. and Mexico:

I use MMP income data to run three independent Mincer regressions on monthly nominal wages (in logs) and then predict wages for each individual and year. All regressions include the following variables: age, gender, marital status, work experience (either U.S. or Mexican), work experience squared, educational and occupational dummies, and state and year dummies. I first predict Mexican wages, which is simple since both migrants and non-migrants report their most recent Mexican income. Next, I use migrants' reported U.S. wages on their first and last U.S. trip to predict U.S. wages. For the MI panel, I need to predict U.S. wages for migrants only, which does not constitute a problem. Yet for the ME panel, I additionally need potential wages for non-migrants, which are not observed. Hence, I run a standard two-stage selection model in which I first model the migration choice and then the U.S. income equation. As exclusion restriction I use a measure of rainfall in the individual's state of origin. After prediction, I convert all wages into constant dollars or pesos of 2000.[47]

[46] I weight the total enforcement hours of the two border regions through which the state's two most popular migration routes pass by the routes' frequency and sum them.

[47] When I form year averages, I find great accordance between my predicted U.S. wages and the DOL's agricultural wages and between my predicted Mexican wages and the INEGI's real index of wages in Mexican manufacturing (for definitions of wage series see Table C.2 in Appendix C).

APPENDIX C: Additional Tables and Figures

Figure C.1: Map of U.S. - Mexican Border Regions, Crossing Points, and Enforcement Zones

Notes: Blue and yellow signs mark main border crossing points and center of U.S. enforcement zones, respectively.

Table C.1: Econometric Studies Analyzing the Effect of U.S. Border Enforcement on the Flow of Illegal Mexican Migration

Study	**Specification**		**Data**		**U.S. Border Enforcement**						**Wages**	
Author(s)	Dependent variable	Econometric Model	Size	Period	Coefficient				Instruments	Deterence Elasticity (at mean)	US wages	MX wages
					Significant?	Min	Max	Best				
Angelucci (2005)	Stay/ migrate	Linear probability model (OLS/ IV)	135,260	1972-1993	*Yes (less)*	-0.025	-0.007	-0.013	Real DEA budget	[- 0.65, -1.26]	Peso-wage (+)	Wage-index (+/0)
Carrion & Sorensen (2006)	% village in U.S. state j	Nested logit model (OLS/ IV)	17,631	1976-2001	*Yes (less)*	-0.93	1.09	-0.46	Border states' political clout		---	
Gathmann (2004)	Stay/ migrate	Linear probability model (OLS/ IV)	71,060	1978-1998	*No*	-0.012	-0.084	-0.021	Nominal budget of DEA	[-0.43, -3.05]	Predicted wage (+)	Predicted wage (-)
Genicot & Senesky (2004)	Stay/ Migrate	Cox's proportional hazard model	12,458	1967-1995	*No*	-0.121	0.005		---		Average wage (0)	Avgerage wage (0)
Hanson & Spilimbergo (2001)	# Appre-hensions	OLS/ IV (Levels & First Differences)	342	1968-1996	*Yes (less)*	0.533	1.292	---	Defense budget, elections, other	[-0.53, -1.292]	Peso-wage (0), dollar-wage (+/0)	Real wage (-), minimum wage (0)
Hanson & Spilimbergo (1999)	# Appre-hensions	Bivariate Vector Autoregression	240	1977-1996	*No*			0.605	---		Real wage (+)	Real wage (-)
Kossoudji (1992)	Duration in Mexico	Duration model	1,860	1974-1979	*Yes (more)*			0.362	---		Ratio of US & MX minimum wage	
Orrenius& Zavodny (2003)	# Appre-hensions	OLS/ IV (First Differences)	335	1969-1996	*Mixed*	–0.491	0.578*	---	Defense budget, past enforcement	[-0.58, 0.49]	Real wage (0), minimum wage (0)	Real wage (-/0), minimum wage (0)
Reyes et al. (2002)	Stay/ migrate	2-stage model: logit (1st) & OLS (2nd)	11,241/ 28	1970-1998	*No*	0.17 (a)	0.353 (a)	0.24 (a)	---		---	
Richter et al. (2005)	% village that migrates	Dynamic model (OLS)	1,759	1980-2002	*Yes (more)*			0.011	---	+3.77	---	

Notes: Column 6 reports if border enforcement's coefficient was significant at 5% level and caused *more* or *less* migration. All studies use line-watch hours of U.S. border patrol agents, except Kossoudji and Richter et al. who use number of apprehensions and change in border patrol budget, respectively. Columns 9 and 10 report border enforcements' estimated coefficient (may not be comparable across specifications); negative signs indicate deterrence (except for Hanson). (a) Reported results are from second stage.

Table C.2: Determinants of Mexican Migration Behavior: Descriptive Statistics

Category	Description	Mean	SD	Min	Max
Dependent Variables	IMI: Index of Migration Intensity	0.03	0.37	-0.31	0.95
	ME: Dummy if person starts new illegal U.S. trip in year t	0.03	0.17	0.00	1.00
Baseline Independent Variables	Line-watch hours of U.S. Border Patrol Agents at the Southern U.S. Border (*)	2.90	1.90	1.24	9.80
	Predicted monthly wages in Mexico (in constant 2000 pesos, thousands)	4.16	3.16	0.30	45.95
	Predicted monthly wages in U.S. (in constant 2000 dollars, thousands)	1.17	0.30	0.51	3.83
	# of parents of migrant that have gone to U.S. before year t	0.10	0.33	0.00	2.00
	Number of green cards availabe to Mexicans (*)	0.00	0.00	0.00	0.00
	Yearly change in Mexican CPI	38.79	35.03	4.55	131.83
Average Community IMI	Average of community members' predicted IMI in years t-2 to t-6	-0.09	0.14	-0.33	0.51
IMI Indicators	Proportion of time spend in U.S. in 5 years	0.25	0.36	0.00	1.00
	House index: house in Mexico (-1), no house (0), house in U.S. (1)	-0.51	0.55	-1.00	1.00
	Proportion of dependents that have gone to U.S. in last 3 years	0.11	0.27	0.00	1.00
	Dummy of long-term U.S. immigration	0.17	0.38	0.00	1.00
Alt. Enforce-ment	Total enforcement hours of U.S. Border Patrol agents by year and Mexican state (*) (see Appendix A)	1.48	0.56	0.85	3.75
Alternative Wage	Index of real earnings in Mexican manufacturing	116.27	31.10	72.26	164.04
	Weekly earnings in U.S. construction (in constant 2000 dollars)	599.24	19.75	568.20	644.79
Alternative Visas	Non-immigrant visas granted to Mexicans (*)	1.50	0.87	0.36	4.45
	Temporary worker permits granted to Mexicans (*)	0.02	0.03	0.00	0.14
Additonal Macro Controls	Growth in Mexican real per capita GDP (index)	0.01	0.04	-0.08	0.06
	Unemplyoment rate in Mexico (in percent)	0.05	0.02	0.02	0.08
	Unemplyoment rate in U.S. (in percent)	6.60	1.35	3.97	9.71
	Dummy if year is subsequent to IRCA	0.67	0.47	0.00	1.00
Additional Individual-Level Controls	Age of indiviudal	38.2	13.5	16.0	65.0
	Sex of indiviudal (1= male; 2 = female)	1.15	0.36	1.00	2.00
	Dummy if individual is married	0.67	0.47	0.00	1.00
	Dummy: 6-8 years of education	0.26	0.44	0.00	1.00
	Dummy: 9-11 years of education	0.12	0.33	0.00	1.00
	Dummy:12-14 years of education	0.08	0.26	0.00	1.00
	Dummy: >14 years of education	0.05	0.22	0.00	1.00
	Hectars of land owned	2.10	36.77	0.00	3600
	Number of businesses owned	0.15	0.39	0.00	4.00

Table C.2: Determinants of Mexican Migration Behavior - Descriptive Statistics (Continued)

Instruments for Border Enforcement	Dummy if U.S.president was Republican in past period	0.66	0.47	0.00	1.00
	Dummy if majority in Senate was Rebublicans in past period	0.40	0.49	0.00	1.00
	Dummy if majority in House of Representatives was Rebublican in year t-1	0.16	0.36	0.00	1.00
	Budget of DEA: Staffing and Appropriations - all sources (in constant 1995 dollars) (*)	676.09	341.05	237.70	1645.8
	Number of Representatives from Southern border states in U.S. House of Representatives in year t	77.63	6.93	73.00	96.00
	Highest within-party seniority of senators from Southern border states in year t	23.90	7.01	11.00	38.00
	Number of Representatives from Southern border states in House approprations committee in year t	9.72	2.89	5.00	14.00
	Number of Representatives from Southern border states in House judicidary committee in year t	7.61	1.40	6.00	10.00

Notes: Statistics are based on ME panel, but are similar for MI panel. (*) Measured in millions.

Table C.3: First Stage Regression Results for Extensive Migration Behavior

Correpsonds to Table 5.1, Column No.	**4**	**6**	**7**	**8**
	Political Majority	**Political Majority**	**DEA Budget**	**Political Clout**
President Republican	0.3885	0.4698		
(past period)	(0.005)***	(0.359)		
Senate Majority Republican	0.0014	-0.1393		
(past period)	(0.006)	(0.359)		
House Majority Republican	4.3065	4.1216		
(past period)	(0.007)***	(0.847)***		
DEA Budget			0.0051	
(constant 2000 Dollars, millions)			(0.001)***	
Senate Seniority (of senior senator from				-0.1250
border states)				(0.025)***
Size of House Delegation				0.7508
(from border states)				(0.096)***
# Members in House Appropriations				-0.1894
Committee (from border states)				(0.216)
# Members in House Judiciary				0.3109
Committee (from border states)				(0.256)
Observations	346545	346545	346545	290392
Adj. R-squared without instruments	0.26	0.12	0.12	0.10
Adj. R-squared with instruments	0.76	0.78	0.80	0.05

Notes: ***", "**", "*" significant at the 1%, 5% and 10% level, respectively. The dependent variable is line-watch hours. Standard errors in parentheses are robust to clustering at year level. Regressions include all second stage regressors.

Table C.4 Remittance Behavior of Migrant Household Heads on Last U.S. Trip

	1	2	3	4	5	6
	Migrant send any remittances on last trip		**Proportion of income remitted on last trip**			
	Probit		OLS		Tobit	
Border enforcement (millions of line-watch hours)	-0.0176	-0.0362	-0.0138	-0.0169	-0.0178	-0.0232
	(0.0145)	(0.0176)**	(0.0043)***	(0.0054)***	(0.0048)***	(0.0061)***
Dummy if migrant is married	0.1558	0.1499	0.0328	0.0317	0.0380	0.0360
	(0.0796)*	(0.0796)*	(0.0262)	(0.0262)	(0.0295)	(0.0295)
Age of migrant	-0.0092	-0.0084	-0.0006	-0.0005	-0.0012	-0.0010
	(0.0022)***	(0.0022)***	(0.0007)	(0.0007)	(0.0008)	(0.0008)
Migrant completed 6-8 years of education (dummy)	-0.2038	-0.1914	-0.0329	-0.0310	-0.0490	-0.0457
	(0.0620)***	(0.0624)***	(0.0187)*	(0.0188)	(0.0209)**	(0.0211)**
Migrant completed 9-11 years of education (dummy)	-0.3972	-0.3767	-0.0695	-0.0665	-0.1025	-0.0974
	(0.0786)***	(0.0794)***	(0.0240)***	(0.0242)***	(0.0271)***	(0.0273)***
Migrant completed 12-14 years of education (dummy)	-0.5526	-0.5367	-0.0560	-0.0533	-0.0940	-0.0893
	(0.0943)***	(0.0947)***	(0.0309)*	(0.0310)*	(0.0351)***	(0.0352)**
Migrant completed >14 years of education (dummy)	-0.5560	-0.5451	-0.0108	-0.0093	-0.0403	-0.0377
	(0.1377)***	(0.1378)***	(0.0470)	(0.0471)	(0.0531)	(0.0531)
% of household members that are working	-0.1310	-0.1355	-0.0793	-0.0803	-0.0985	-0.1004
	(0.1030)	(0.1030)	(0.0325)**	(0.0325)**	(0.0364)***	(0.0365)***
Annual rainfall in state of origin	-0.0000	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001
	(0.0002)	(0.0002)	(0.0000)	(0.0000)	(0.0001)	(0.0001)
Dummy if household owned a business prior to last US trip	0.0625	0.0595	0.0416	0.0415	0.0466	0.0466
	(0.0700)	(0.0699)	(0.0217)*	(0.0217)*	(0.0243)*	(0.0243)*
Annual change in Mexican CPI	0.0044	0.0040	0.0012	0.0011	0.0016	0.0015
	(0.0011)***	(0.0011)***	(0.0003)***	(0.0003)***	(0.0004)***	(0.0004)***
Growth in Mexican real per capita GDP (index)	-0.0796	-0.2587	0.3497	0.3307	0.5203	0.4885
	(0.9545)	(0.9551)	(0.2841)	(0.2849)	(0.3161)*	(0.3170)
LWH instrumented		YES		YES		YES
Observations	4533	4533	3492	3492	3492	3492
Marginal effect of border enforcement	-0.004	-0.0083	-0.0138	-0.0169	-0.0123	-0.0160

Notes: "***," "**," and "*" significant at the 1%, 5% and 10% level, respectively. Table shows regression coefficients and standard errors (in parentheses). All observations include dummies for migrants' community of origin. IV regressions use political majority instruments. For a description of the variables see Table C.2.

Table C.5: Determinants of Mexican Migration Behavior: Additional Specification Tests

	1	2	3	4	5	6	7	8
	Extensive Migration Behavior			**Intensive Migration Behavior**				
	Visas		**General**	**Enforcement**	**Visas**		**General Specification**	
	Non-Immig.	*Contract*	15a Recall	*Non-lin.*	*Non-Immig.*	*Contract*	*15a Recall*	*No Weights*
	IV-IFE	OLS-IFE	IV-IFE	OLS-IFE	IV-IFE	OLS-IFE	IV-IFE	IV-IFE
Border Enforcement	0.0038	0.0051	0.0015	0.1504	0.0420	0.0411	0.0179	0.0112
(millions of line-watch hours)	(0.0013)***	(0.0019)**	(0.0009)*	(0.0224)***	(0.0103)***	(0.0127)***	(0.0055)***	(0.0034)***
Enforcement squared				-0.0115				
(millions of line-watch hours)				(0.0019)***				
Predicted Mexican Wages	-0.0021	-0.0022	-0.0030	-0.0030	-0.0020	-0.0036	-0.0050	-0.0026
(const. 2000 Pesos, thousands)	(0.0008)***	(0.0008)***	(0.0007)***	(0.0030)	(0.0034)	(0.0029)	(0.0024)**	(0.0021)
Predicted U.S. Wages	0.0200	0.0153	0.0174	0.1632	0.0859	0.0684	0.0455	0.0709
(const. 2000 Dollars, thousands)	(0.0071)***	(0.0047)***	(0.0085)**	(0.0267)***	(0.0380)**	(0.0272)**	(0.0283)	(0.0246)***
Migration Networks	0.0318	0.0323	0.0336	0.1677	0.2014	0.2032	0.1450	0.1381
(# of parents ever in US)	(0.0072)***	(0.0071)***	(0.0076)***	(0.0212)***	(0.0256)***	(0.0225)***	(0.0245)***	(0.0138)***
Green Cards	0.0790	3.2705	-4.2288	0.1207	0.1590	0.1639	0.1074	0.0929
(millions granted to Mexicans)	(3.3130)	(3.1674)	(3.5998)	(0.0310)***	(0.0328)***	(0.0319)***	(0.0285)***	(0.0202)***
Mexican Inflation	0.0071	0.0048	-0.0020	0.4561	0.3764	0.5624	0.1810	0.3838
(annual change in CPI)	(0.0401)	(0.0039)	(0.0033)	(0.3137)	(0.3722)	(0.3553)	(0.2870)	(0.2034)*
Non-Immigrant Visas	-0.0053				-0.0422			
(millions granted to Mexicans)	(0.0029)*				(0.0157)**			
Labor Contract Visas		-0.2268				-1.2727		
(millions granted to Mexicans)		(0.1267)*				(0.7676)		
Individual Dummies	YES	YES	YES	YES	YES	YES	YES	YES
LWH Instrumented	YES		YES		YES		YES	YES
Observations	346545	346545	232701	24948	24948	24948	17664	24948
Enforcement Elasticity	0.33	0.58	0.18					
Δ IMI if Δ-SD in LWH (#)				16.83%	21.68%	22.78%	8.22%	6.83%

Notes: ***", "**", "*" significant at the 1%, 5% and 10 % level, respectively. Standard errors in parentheses are robust to clustering at year level. Regional enforcement is millions of total enforcement hours per year and Mexican state (see Appendix A). Columns 3 and 7 include maximum of 15 years of recall. Column 8 uses no MMP sampling weights. (#) Normalized change in IMI: change in IMI due to standard deviation increase in border enforcement divided by IMI's standard deviation (columns 5 to 8 refer to respective IMI indicator). All IV regressions use political majority instruments.