

How do U.S. Visa Policies Affect Unauthorized Immigration?*

Brian K. Kovak
Carnegie Mellon University
NBER and IZA

Rebecca Lessem
Carnegie Mellon University

February 2020

Abstract

We examine how increasing the number of visas available to potential migrants would affect unauthorized immigration from Mexico to the U.S. Current U.S. policy bans people who are deported from receiving legal status for a period of time. This policy aims to serve as an additional deterrent to unauthorized immigration, but may be ineffective given that most potential Mexican migrants have an extremely low probability of ever being able to legally move to the U.S. We develop a dynamic discrete location choice model, which we estimate using data from the Mexican Migration Project, and consider various counterfactual policies that vary the intensity of enforcement and access to work visas. We find that legal entry bans for deported individuals are ineffective at current rates of legal immigration, but that increased legalization rates would amplify the deterrent effects of deportation. We also show that a temporary work visa program would yield similar deterrent effects as an increase in permanent legalization without resulting in very large increases in the total stock of migrants residing in the U.S. These findings have important implications for structuring future immigration reforms.

*We thank Laurence Ales, Sam Bazzi, Kelly Bishop, Brian Cadena, Gordon Hanson, Carl Sanders, Lowell Taylor, Yuan Tian, Ariel Zetlin-Jones, and seminar participants at the Carnegie-Rochester-NYU Conference and the NYU Trade and Labor Mini-Conference for their feedback on this project. Michael Stafford provided excellent research assistance. Contacts – Kovak: bkovak@cmu.edu, Lessem: rlessem@andrew.cmu.edu

1 Introduction

Approximately 8 million unauthorized immigrants have been present in the U.S. workforce since 2005 (Passel and Cohn 2018). U.S. employers demand these workers' services in spite of the significant barriers to employment facing unauthorized workers and potential sanctions facing their employers. Because U.S. immigration policy is quite restrictive, the vast majority of potential immigrants can only reside and work legally in the U.S. if they have a close family member who is a U.S. citizen or permanent resident.¹ In this paper, we ask how increasing the number of visas available to potential immigrants would affect the flow of unauthorized immigrants to the U.S.

U.S. immigration law states that in many cases an immigrant who was formally deported from the U.S. cannot legally reenter for a period of time for any reason, including family reunification or via a work visa.² We refer to this as the "legal entry ban" policy. Given this policy environment, immigration enforcement through deportation discourages unauthorized migration to the U.S. through at least two channels. First, a higher probability of deportation directly reduces the expected value of moving to the U.S., since there is an increased probability of being removed before the individual would have chosen to return home. Second, deportation results in a loss of the option value of migrating legally in the future. As the baseline probability of receiving legal status increases, this second channel becomes more important. Therefore, the policy of banning deportees from returning to the U.S. creates a complementarity between enforcement measures that increase the probability of deportation and policies that expand the available options for legal migration. We quantify this channel using detailed data on potential Mexican migrants' location choices and legal status in a dynamic discrete location choice framework, considering the effects of counterfactual deportation, permanent legalization, and temporary work visa policies.

Specifically, we construct a simplified version of the setup in Lessem (2018). Potential Mexican migrants are forward looking, and in each period choose whether to live in Mexico or the U.S. in order to maximize the expected discounted value of their lifetime utility. They take into account the utility of living in each location given their education and legal status, the cost of moving, the probabilities of deportation and legalization, and their idiosyncratic payoff to living in each location. We estimate the model using data from the Mexican Migration Project (MMP), which provides unparalleled detail regarding the migration histories of migrants between Mexico and the U.S. Importantly, the MMP data include information on the timing of migration events and changes in legal status, showing that many migrants move temporarily and repeatedly, making the dynamic nature of the model essential to accurately understand the implications of migration policy for migration decisions.

¹In 2016, 68 percent of those obtaining legal permanent residence in the U.S. did so as immediate relatives of U.S. citizens or through family-based preferences, while only 12 percent did so under employment-based preferences, 13 percent as refugees and asylees, 4 percent under the diversity visa lottery program, and 3 percent under other smaller programs (DHS 2017).

²See footnote 12 for specifics of the entry ban policy for those formally removed from the U.S.

After estimating the model using maximum likelihood, we consider various counterfactual policies that alter deportation rates and the probability that a potential migrant receives legal status in the U.S. The results are consistent with complementarity between deportation rates and increased probability of legal status when deportees are banned from reentering the U.S. As expected, increasing the deportation rate reduces the rate of unauthorized migration to the U.S. and the cumulative number of years a potential migrant spends living in the U.S. as an unauthorized immigrant. However, even with very high deportation rates, the policy of excluding those with prior deportations has minimal effect on rates of unauthorized migration because the baseline probability of obtaining legal status is so low. Only when the probability of gaining legal status is much higher than that currently observed does the legal entry ban policy measurably reduce unauthorized migration. These findings confirm the importance of losing the opportunity to legally move to the U.S. and highlight the interactions between enforcement and visa policies.

Although increases in the probability of achieving legal status deter unauthorized immigration, they also sharply increase the number of authorized immigrants living permanently in the U.S. In some contexts, this outcome may be politically infeasible, so we additionally consider the effects of expanding access to temporary work visas, which allow migrants to work in the U.S. for a fixed period of time, after which they must return home. Our counterfactual analysis shows that permanent legal status and temporary visas drive similar reductions in unauthorized immigration, but the latter increases the stock of authorized immigrants by far less. This finding suggests that expanding the number of temporary work visas would be effective in deterring unauthorized migration without resulting in very large increases the overall stock of migrants resident in the U.S.

Our model is based on prior work that has estimated structural models of migration, starting with Kennan and Walker (2011) who develop and estimate a discrete choice dynamic model of internal migration in the U.S. They develop a dynamic framework in which forward-looking individuals make a sequence of migration decisions, considering the benefits of living in each location, costs of migrating between locations, and information gained through past location choices. Lessem (2018) adapts this framework to examine migration between Mexico and the U.S., focusing on wage differences across countries and the role of family members' location choices. We use a similar framework, but focus on the interactions between legal status and enforcement policies and consider a variety of policy counterfactuals focused on varying deportation rates and changes in permanent and temporary visa policies. Given this focus, we simplify the location choice set to include 2 locations, the U.S. and Mexico, instead of allowing for a variety of locations in the U.S. as in Lessem (2018). Gorchach (2020) also uses a dynamic discrete choice model to study migration from Mexico to the U.S., but focuses instead on the role of borrowing constraints in influencing potential migrants' ability to move to the U.S. All of these models are partial equilibrium, in the sense that changes in migration do not affect the returns to living in either location.

In spite of broad agreement in the policy community that expanded legal work opportunities

for immigrants would reduce unauthorized immigration, we are aware of no systematic evidence regarding the likely magnitude of this effect.³ Instead, prior work has focused on how unauthorized immigration responds to changes in enforcement, including border enforcement personnel, border barriers, interior deportation policies, and state-level immigration policies.⁴ The most closely related of this work is Bazzi et al. (2019), who examine the effects of the U.S. Border Patrol's Consequence Delivery System (CDS). This policy, starting in 2008, increased the share of formal deportations among unauthorized Mexican migrants, involved releasing some deportees in Mexican locations far from their point of capture, and increased criminal prosecution for migration-related violations. Bazzi et al. (2019) find that, among those with a previous apprehension, the imposition of these sanctions substantially reduced the probability of subsequent reaprehension. The effects of CDS were largest for those whose prior removals had not already triggered a reentry ban, supporting the idea that potential unauthorized immigrants are deterred by the possibility of losing the option to migrate legally in the future. We complement these findings by examining how increased visa access amplifies the deterrent effects of enforcement policies by increasing the option value associated with future legal migration.

Our findings are important for contemporary immigration policy debates. Specifically, the complementarity between enforcement and legal immigration policy informs the choice of whether to enact different types of immigration policies simultaneously or sequentially. Many of the comprehensive immigration reforms that have been proposed in the past 25 years include increases in enforcement and expanded temporary worker programs that would begin simultaneously. Our results suggest that these policies would reinforce one another in reducing unauthorized immigration to the U.S. However, an alternative approach requires reductions in unauthorized migration prior to increasing the options for legal migration. This sequential approach is implemented in practice either through the use of “trigger” clauses within a single piece of legislation or by proposing legislation focused exclusively on enforcement prior to separate legislation expanding the options for legal immigration.⁵ While there may be other justifications for the sequential approach, our findings suggest that achieving a target reduction in unauthorized migration will be more costly in the absence of increased legal access to the U.S. than when implementing both sets of policies simultaneously.

Our paper proceeds as follows. Section 2 summarizes the relevant aspects of U.S. immigration policy, highlighting aspects that drove important decisions in constructing and estimating our

³Massey, Durand, and Malone (2002) speculate that the Bracero guest worker program, in place during 1942-1964, may have caused the observed decline in border apprehensions during that time period.

⁴For example, among many others, Hanson and Spilimbergo (1999), Bohn and Pugatch (2015) and Lessem (2018) study changes in Border Patrol resources, Bohn, Lofstrom, and Raphael (2014) and Caballero, Cadena, and Kovak (2018) study an Arizona law reducing employment opportunities for unauthorized immigrants, Feigenberg (2017) and Allen, Dobbin, and Morten (2019) study border barriers between Mexico and the U.S., and East et al. (2018) and East and Velasquez (2019) study the effects of deportations under the Secure Communities program.

⁵See Section 2 for a more detailed discussion including examples of legislative proposals exemplifying these approaches to immigration reform.

model. Section 3 describes the Mexican Migration Project data and provides summary statistics. Sections 4 and 5 describe the model and estimation. Section 6 presents the results, including measures of model fit and the results of counterfactual simulations. Section 7 concludes.

2 Policy background

Since 1965, U.S. immigration policy has largely been based upon a categorical preference system focused on admitting close relatives of U.S. citizens and prior immigrants and those with skills deemed valuable to the U.S. labor market.⁶ Individuals may be admitted to the U.S. as lawful permanent residents or as temporary residents or visitors. About two-thirds of those gaining permanent residence fall under family-based categories of admission with the remainder falling under employment-based preferences, humanitarian admissions, and the diversity visa lottery program (CBO 2010).⁷ There are also many categories of temporary visas, covering tourists, temporary workers, students, and many others. Of particular relevance to our study are the temporary worker programs, which cover highly skilled workers (H-1) or other workers in agriculture (H-2A) and services (H-2B). The latter programs for less-skilled temporary workers are quite small, accounting for only 537,150 admissions in fiscal year 2017 (DHS 2019). The small scale of these programs implies that potential immigrants without advanced degrees and without close relatives in the U.S. have very few opportunities to pursue lawful residence and employment in the U.S.

Partly due to the limited options available to the majority of Mexican migrants seeking to work in the U.S., since the 1970s a significant number of Mexican-born individuals have moved to the U.S. as unauthorized immigrants. Unauthorized immigrants may enter the U.S. by crossing the border between ports of entry, by being smuggled through a port of entry, or by entering legally on a temporary visa and staying in the U.S. after the visa's expiration. Estimating the number of unauthorized immigrants is difficult due to the lack of administrative records for unauthorized migrants, but a standard approach is to use household survey data to estimate the total number of foreign-born individuals residing in the U.S. and then subtract the number of authorized immigrants based on administrative data. Figure 1 shows two such measures of the unauthorized immigrant population, one constructed by the Pew Research Center and another showing official estimates produced by the Immigration and Naturalization Service and the Department of Homeland Security.⁸ In spite of differences in the analyses, the two data sources provide remarkably similar estimates for the unauthorized population in each year. The unauthorized population fell

⁶See CBO (2006) for an accessible review of current and past U.S. immigration policy.

⁷In 2017, 88 percent of Mexican migrants gaining legal permanent residence did so as immediate relatives of U.S. citizens or through family-sponsored preferences, 3 percent under employment-based preferences, and the remaining 9 percent under the diversity program, as refugees and asylees, or through other smaller categories.

⁸See Appendix B.3 for details on these data. Note that the official government estimates were produced by the Immigration and Naturalization Service prior to 2003 and by the Department of Homeland Security (DHS) Office of Immigration Statistics thereafter, following the creation of DHS in 2003.

between 1986 and 1989 before increasing steadily until the onset of the Great Recession in 2007, after which the unauthorized population has been relative stable around 11 million.

The significant growth in the unauthorized immigrant population prompted a number of attempts to address the issue. Most prominent among these is the Immigration Reform and Control Act of 1986 (IRCA), which provided legal permanent residence and the possibility of citizenship for more than 3 million previously unauthorized immigrants, more than 2 million of whom were from Mexico (Massey, Durand, and Malone 2002). IRCA provided two paths to legal status, one requiring applicants to show continuous residence in the U.S. since January 1, 1982, and a Special Agricultural Worker program for those who worked for at least 90 days on certain specified crops during the 1985-86 season. It also strengthened enforcement measures, with a 50 percent increase in the enforcement budget of the Immigration and Naturalization Service and, for the first time, imposing sanctions on employers knowingly hiring unauthorized workers (Massey, Durand, and Malone 2002). The law's passage was generally viewed as a surprise, following a decade of failed attempts at reform, so it is unlikely that migrants or other agents anticipated its arrival (Cascio and Lewis 2019). The effect of IRCA in legalizing a significant share of the previously resident unauthorized immigrant population is visible in Figure 1 between 1986 and 1990, but the subsequent years make clear that the policy did not have the intended effect of reducing unauthorized immigration in the long run.

The ensuing decades saw various attempts at reducing unauthorized immigration to the U.S., generally through increasing border enforcement, including personnel, physical barriers, and technology to detect illegal crossing, and additional resources for interior enforcement such as workplace raids. Figure 2 shows border enforcement budgets and the number of Border Patrol staff assigned to the "Southwest Sectors" along the U.S.-Mexico border.⁹ Both series exhibit very large increases in enforcement resources starting in the mid 1990s and continuing through the late 2000s. Of particular interest for this study is the Illegal Immigration Reform and Immigrant Responsibility Act (IIRIRA) of 1996.¹⁰ As with other policies enacted during the 1990s, IIRIRA increased border enforcement, but it also broadened the options available for law enforcement seeking to deport unauthorized immigrants, and strengthened reentry bans for those violating immigration law under various circumstances.

IIRIRA expanded the ability of enforcement officers to directly remove unauthorized immigrants, without a hearing before an immigration judge, and limited immigrants' ability to request waivers or to appeal decisions.¹¹ These non-judicial removal processes made it much easier for

⁹Figure 2 shows the budget for the Immigration and Naturalization Service (INS) and the combined budgets of Customs and Border Protection (CBP) and Immigration and Customs Enforcement (ICE), which took over INS enforcement functions following the creation of the Department of Homeland Security in 2003. Both series are presented in year-2015 dollars.

¹⁰See Rosenblum et al. (2014) for a thorough summary of IIRIRA, upon which this discussion of IIRIRA is based.

¹¹Such procedures include "expedited removal" for those arriving in the U.S. without valid entry documents, "reinstatement of removal" for those who illegally reenter after a previous removal, and "administrative removal" for

enforcement agencies to formally remove unauthorized immigrants who previously might have been allowed to return informally, through a “voluntary departure” or “withdrawal of application for admission.” This distinction is particularly important; after a formal removal the individual is not allowed to reenter the U.S. for any reason for a specified period of time, i.e. they lose access to the possibility of legal immigration.¹² Those departing informally do not face these reentry bans. Figure 3 shows the numbers of formal removals (which result in reentry bans) and informal returns (which do not) on the left axis, along with removals’ share of the total on the right axis. Formal removals became much more prevalent starting in 1997, and constituted more than 70 percent of the total in recent years, meaning that the vast majority of removals were subject to entry bans.

The combination of increased reliance on formal removals and entry bans for formally deported individuals leads to the primary mechanism we examine in this paper. When those apprehended migrating illegally are banned from migrating legally in the future, the deterrent effect of immigration enforcement will depend upon the baseline probability that one can obtain legal status. The lost option value of legal immigration will be larger when obtaining legal status is more likely, increasing the deterrent effect of enforcement. In Sections 4 – 6 we estimate a model and generate counterfactuals allowing us to investigate these interactions between immigration enforcement and legal immigration policies.

Understanding the interactions between immigration enforcement and legal immigration policies is important for contemporary immigration policy debates. In the decades since IIRIRA, U.S. lawmakers have proposed many immigration reforms seeking to address the ongoing issue of unauthorized immigration, and these proposals have taken different forms. Comprehensive reforms generally incorporate increases in immigration enforcement and significant changes to the legal immigration system, often including expanded temporary worker programs.¹³ Other proposals focus on enforcement alone, with the idea that subsequent legislation may address the legal immigration system after enforcement objectives have been met.¹⁴ Yet other proposals take a hybrid approach, including both increased enforcement and expanded legal immigration provisions in the same piece of legislation, but structured such that the legal immigration programs are implemented only after certain enforcement “triggers” are met.¹⁵ While all of these approaches envision increased enforce-

those without lawful permanent residence who commit aggravated felonies.

¹²Those deported through expedited removal are ineligible for a visa for 5 years, those removed through standard procedures are ineligible for 10 years, those removed a second time after apprehension at arrival are ineligible for 20 years, and those removed a second time after re-entering the U.S. are permanently barred. Moreover, those apprehended after re-entering the U.S. after a removal order may be subject to criminal charges, rather than civil charges as in most cases involving violations of immigration law. See Rosenblum et al. (2014) for additional detail.

¹³For example, see the W-Visa low-skilled guest worker program proposed in the “Border Security, Economic Opportunity, and Immigration Modernization Act,” Senate Bill S.744, in July 2013.

¹⁴An example of the border-security-first approach is the “Border Security and Immigration Reform Act” of 2018 (H.R.6136), which would have increased border security funding significantly without expanding legal immigration channels.

¹⁵There are many examples of “triggers” in recent comprehensive reform proposals. In the “Secure Borders, Economic Opportunity, and Immigration Reform Act” of 2007 (S.1639), unauthorized immigrants would only have

ment and reforms of the legal immigration system, the latter two pursue these changes sequentially rather than simultaneously. Given the complementarity between enforcement and legal immigration policies that we will document below, whether various immigration policies are implemented sequentially or simultaneously is likely to substantially influence their effects.

3 Data

We use data from the Mexican Migration Project (MMP), a joint project of Princeton University and the University of Guadalajara.¹⁶ The MMP is a repeated cross-sectional dataset that was first collected in 1982 and is still ongoing. In each year, a few target communities in Mexico are selected, and a random sample of households is surveyed in an effort to understand the circumstances, decisions, and outcomes related to international migration for Mexican individuals. To our knowledge, this is the most detailed source of information available on migration decisions between the U.S. and Mexico. Although the survey is cross-sectional, it asks respondents about their entire migration history, recording detailed information on when each individual lived in Mexico or the U.S. and whether and when they had legal authorization to reside in the U.S. We are aware of no other large scale data source that provides this level of detail on migration and legal status, both of which are essential to our analysis.

Although the MMP sample is representative of the communities surveyed in a given year, the dataset is not representative of Mexico as a whole, since the survey has oversampled communities with historically high rates of migration to the U.S. For example, the early years of the survey oversampled relatively rural communities in Western-Central Mexico with high historical migration rates.¹⁷ Over time, however, the MMP sampling frame has shifted to other areas in Mexico, including those with lower migration rates. Since the MMP collects retrospective data on migration and legal status, we can still observe migration behavior in early years for individuals in the communities that were surveyed more recently, mitigating representativeness concerns somewhat.¹⁸ Another restriction of the MMP data is that the sample captures a relatively small number of permanent migrants to the U.S. Although the MMP does survey some individuals who have moved to the U.S., this represents a small share of the survey sample (see Table 1).¹⁹

received access to an expanded guest worker program 18 months after the appropriation of funds for an employment verification system. In the “Border Security, Economic Opportunity, and Immigration Modernization Act” of 2013 (S.744), formerly unauthorized immigrants could seek legal permanent residence only following deployment of additional Border Patrol agents, construction of additional border fencing, and other enforcement investments, with the objective of a 90% apprehension rate for attempted border crossings.

¹⁶The data are publicly available at mmp.opr.princeton.edu

¹⁷Appendix Figure B1 shows a map with the current coverage of the survey.

¹⁸Appendix Table B1 compares the demographic and educational distributions of household heads in the MMP and the Mexican Census for the year 2000, finding quite similar results across the two datasets.

¹⁹The possibility of omitting permanent migrants to the U.S. may lead us to underestimate the rate at which Mexican individuals obtain legal status. As discussed in footnote 33, we reimplement our analysis using administrative data on legalization, finding nearly identical results.

We utilize MMP data collected in 1997 and later because earlier waves of the survey omitted information on migrants' legal status in the U.S. We also consider retrospective migration and legalization information from 1980 onward in order to avoid earlier years in which migration patterns may have been quite different from those in more recent years. We focus on individuals born in Mexico and restrict the sample to household heads in order to take advantage of the extensive migration and legalization histories the MMP reports for them. In doing so, we abstract from joint household migration decisions.²⁰ We focus on migration decisions for individuals age 18 to 65 and omit those already in the U.S. by age 18 in order to avoid migration decisions that may have been heavily influenced by family members. Finally, we omit a small number of observations exhibiting inconsistencies or missing key information, such as location, education, and legal status.

We present summary statistics for our sample in Table 1. Panel (a) shows the characteristics of the household heads in our sample, as observed in the year of the survey (i.e. with one observation for each individual). We observe 17,538 unique individuals across all years of the survey from 1997 to 2018. 85% of the sample is male, and the majority of individuals is between age 30 and 59 in the survey year. We split the sample by years of education, grouping people as low education (0-5 years) or high education (6+ years). Reflecting the educational distribution of the broader Mexican population, 66% of the sample has 6 or more years of education. The vast majority of the sample is surveyed in Mexico, but 4.7% is surveyed in the U.S., while 2.9% of the sample has legal authorization to reside in the U.S. in the survey year.

Panel (b) uses the retrospective panel dimension of the survey to measure migration patterns. We observe 4,694 Mexico-to-U.S. migration events between 1980 and 2018. The vast majority (83.4%) never migrated to the U.S. prior to being surveyed by the MMP, 11.2% of individuals migrated north once, and the remaining 5.4% migrated 2 or more times. Most observed spells of time living in the U.S. were relatively short, with 48.1% of spells lasting only one year. However, there is a long tail, with 20.7% of spells lasting 5 or more years, 10.4% lasting 10 or more years, and 2.9% lasting 20 or more years. This pattern reflects the diversity of migration experiences for Mexican migrants to the U.S., with many individuals migrating for a short time, often visiting repeatedly for seasonal work, and more recent migrants who tend to stay in the U.S. for a longer period of time, particularly as border enforcement has increased.

We now describe yearly migration rates in more detail. Figure 4 examines Mexico-to-U.S. migration separately for those with or without legal authorization to reside in the U.S. Panel (a) shows the share of those in Mexico and *without* U.S. legal status in year $t - 1$ who migrated to the U.S. in year t . Panel (b) shows the same northward migration rate for those *with* U.S. legal status in year $t - 1$. A few patterns are apparent. First, people with the ability to move legally migrate to the U.S. at much higher rates. We also see fluctuations over time, most notably high migration

²⁰See Gemici (2011) and Lessem (2018) for papers with dynamic models of migration decisions in which an individual's migration decision is influenced by those of family members.

rates in both directions in the 1990's and early 2000s and lower migration rates in 2010 and later, following the U.S. Great Recession.²¹ Figure 5 performs a similar exercise, measuring the share of those in the U.S. in year $t - 1$ who return to Mexico in year t separately by legal status in period $t - 1$. The results largely mirror those for northward migration, with authorized immigrants less likely to return to Mexico. Together, the results in Figures 4 and 5 demonstrate the importance of accounting for cyclical factors that may influence the incentive to move between the U.S. and Mexico during different portions of the sample period.

The retrospective panel nature of the MMP also allows us to observe when Mexican individuals obtain legal status in the U.S. Figure 6 plots the probability of receiving legal status in each year. To be precise, it shows the share of those without legal status in year $t - 1$ who get legal status in year t . It is clear that legalization rates are generally quite low, with the exception of the years immediately following the passage of IRCA in 1986. The dashed black line shows legalization probabilities omitting those reporting receiving legal status under IRCA, and shows that in the absence of this policy, legalization rates were quite consistent over time, averaging around 0.05% per year. However, the overall legalization rate was an order of magnitude larger during the IRCA implementation period of 1987-1991. Therefore, when parameterizing the model in Section 5, we allow the legalization rate during 1987-1991 to differ from the rate in other years, and the estimates confirm the much higher legalization rate during these years.

As a final piece of descriptive evidence influencing the modeling choices in the following section, we consider the choice to apply for legal status in the U.S. Starting in the 1997 survey, the MMP records when an individual applied for legal status, along with the date, if any, when legal status was granted. When analyzing this information, it became clear that there was little distinction between applying for legal status and obtaining it. 85% of those ever applying for legal status received it by the survey year, and more than 90% of individuals who eventually received legal status did so within 3 years of applying. It appears that potential migrants in the MMP sample only apply for legal status when they know they are very likely to be approved and when that approval is likely to come quickly, so the application information available in the MMP data provided little information beyond what is already present in the information on realized legal status. For this reason, we choose not to include information on applications for legal status in our model estimation.

4 Model

Our model is based on a simplified version of the setup in Lessem (2018), in which there are only two locations: the U.S. and Mexico. A person starts each period knowing their legal status and their prior period location. They then receive a set of payoff shocks to living in each location and

²¹Due to the MMP's retrospective panel structure, the sample sizes are largest in the middle of the sample period. In early years fewer migrants who were surveyed in later years had already reached age 18, while few survey years are able to observe migration events later in the sample.

decide whether to live in the U.S. or Mexico, considering the utility of living in a location, the cost of moving, the payoff shocks to each location, and the expected continuation value of living in that location. If they currently lack legal status in the U.S., they may be granted legal status in the future with some probability, which we will estimate. Consistent with the MMP data, we assume that legal status is an absorbing state, so once a person is granted legal status they do not lose it.²² In addition, unauthorized immigrants may be deported, in which case they are forced to return to Mexico.

The timing of the model is as follows. People start the period knowing their prior location and legal status for this period. They learn their payoff shocks and decide where to live. If they choose to live in the U.S., they are deported with some probability, which forces them to return to Mexico. At the end of the period, if they previously did not have the ability to move to the U.S. legally, with some probability they get a visa that enables them to move legally, should they choose to do so in a subsequent period.

The state space includes a person's prior location $j_{t-1} \in \{M, US\}$, their legal status at the start of the period l_{s_t} ($= 1$ if legal and 0 otherwise), their fixed characteristics X , their age a_t , and their set of preference shocks η_{kt} . The value function is written as follows:

$$V_t(j_{t-1}, l_{s_t}, X, a_t, \eta_t) = \max_{k \in \{M, US\}} v_t(k, j_{t-1}, l_{s_t}, X, a_t) + \eta_{kt} , \quad (1)$$

A person chooses the location k with the highest valuation each period t , where the valuation has a deterministic component, which we denote as $v_t(\cdot)$, and a random component, which we denote as η_{kt} . We assume that the random shocks follow the type-I extreme value distribution.

The following expressions show the deterministic component of choosing location k . First, consider an individual who already has legal status, $l_{s_t} = 1$.

$$\begin{aligned} v_t(k, j_{t-1}, l_{s_t} = 1, X, a_t) &= u_t(k, l_{s_t}, X) - MC_t(k, j_{t-1}, l_{s_t}, X) \\ &+ \beta E_t V_{t+1}(k, l_{s_{t+1}} = 1, X, a_{t+1}, \eta_{t+1}) . \end{aligned} \quad (2)$$

The first component on the right side of equation (2) is the utility of living in a location, which we assume depends on legal status and characteristics. Utility differences across locations arise from two sources: wage differentials between the two countries and preference to live in one's home country, likely due to the presence of one's family, familiarity with the culture, etc. The second component of equation (2) is the cost of moving between locations. This is normalized to equal 0 if a person does not change locations. We allow the cost of moving to vary with legal status,

²²Of course, an individual may have temporary legal status in the U.S., or an immigrant may lose legal permanent residence for a variety of reasons, including if they "move to another country, intending to live there permanently" (USCIS 2016). However, the MMP data only report the date in which an individual immigrant received legal status in the U.S., without providing any information reporting whether or when an individual might have lost that status.

given that it is more costly for unauthorized immigrants to cross the border, since they will have to evade detection. The last component of equation (2) is the expected continuation value, in this case maintaining legal status since it is an absorbing state.

Those without legal status ($l_{s_t} = 0$) additionally consider the possibility that they may receive legal status in the next period; this happens with probability $p_{t+1}^l(X)$. This legal status transition may occur whether the individual chooses to live in Mexico or the U.S., and only depends on year and characteristics. However, if an individual without legal status chooses to live in the U.S., they face the additional possibility of deportation, with probability p_t^d .²³ Those who are deported start the subsequent period in Mexico.²⁴ Therefore, the deterministic component of choosing to live in Mexico for those without U.S. legal status is

$$\begin{aligned} v_t(k = M, j_{t-1}, l_{s_t} = 0, X, a_t) &= u_t(k, l_{s_t}, X) - MC_t(k, j_{t-1}, l_{s_t}, X) \\ &+ \beta p_{t+1}^l(X) E_t V_{t+1}(k, l_{s_{t+1}} = 1, X, a_{t+1}, \eta_{t+1}) \\ &+ \beta (1 - p_{t+1}^l(X)) E_t V_{t+1}(k, l_{s_{t+1}} = 0, X, a_{t+1}, \eta_{t+1}) . \end{aligned} \quad (3)$$

The same expression for choosing the U.S. without legal status is

$$\begin{aligned} v_t(k = US, j_{t-1}, l_{s_t} = 0, X, a_t) &= u_t(k, l_{s_t}, X) - MC_t(k, j_{t-1}, l_{s_t}, X) \\ &+ \beta p_{t+1}^l(X) (1 - p_t^d) E_t V_{t+1}(k = US, l_{s_{t+1}} = 1, X, a_{t+1}, \eta_{t+1}) \\ &+ \beta p_{t+1}^l(X) p_t^d E_t V_{t+1}(k = M, l_{s_{t+1}} = 1, X, a_{t+1}, \eta_{t+1}) \\ &+ \beta (1 - p_{t+1}^l(X)) (1 - p_t^d) E_t V_{t+1}(k = US, l_{s_{t+1}} = 0, X, a_{t+1}, \eta_{t+1}) \\ &+ \beta (1 - p_{t+1}^l(X)) p_t^d E_t V_{t+1}(k = M, l_{s_{t+1}} = 0, X, a_{t+1}, \eta_{t+1}) . \end{aligned} \quad (4)$$

To compute the expected continuation values in equations (2) - (4), we need to integrate out future payoff shocks, η_{t+1} . Because we assumed the shocks follow the extreme value distribution, we can solve for a closed form expression for the continuation values. This leads to choice probabilities with the standard logit form:

$$P_t(j_t | j_{t-1}, l_{s_t}, X, a_t) = \frac{\exp(v_t(j_t, j_{t-1}, l_{s_t}, X, a_t))}{\sum_k \exp(v_t(k, j_{t-1}, l_{s_t}, X, a_t))} \quad (5)$$

Finally, we assume a terminal period T at age 65, such that $V_{T+1} = 0$, and then solve the model using backward induction.

²³We assume this probability is constant across demographic groups and only varies over time.

²⁴The only penalty facing deported individuals is that they start the next period in Mexico. We do not impose the U.S.-to-Mexico moving cost on deportees because doing so would substantially complicate model timing.

5 Estimation

5.1 Parameterization

In this section, we parameterize the utility function, moving cost function, and legal status transition function. We write the utility function as follows:

$$u_t(j, ls, X) = \begin{cases} u_{X,ls}^M & \text{if } j = M \\ u_{X,ls}^{US} + \gamma_{X,t} & \text{if } j = US \end{cases} \quad (6)$$

$$\text{where } \gamma_{X,t} = \begin{cases} 0 & \text{if } t \leq 1993 \\ \gamma_{X,1} & \text{if } t \geq 1994 \text{ and } t \leq 2000 \\ \gamma_{X,2} & \text{if } t \geq 2001 \text{ and } t \leq 2005 \\ \gamma_{X,3} & \text{if } t \geq 2006 \text{ and } t \leq 2009 \\ \gamma_{X,4} & \text{if } t \geq 2010 \end{cases}$$

The utility from living in a location $j \in \{M, US\}$ may vary arbitrarily by individual characteristics X and legal status. These utilities capture both the intrinsic value of living in a location and the wage one could earn there in a given year.²⁵ Characteristics X capture individuals' education levels, taking on two possible values reflecting low (0-5 years) and high (6+ years) educational attainment.²⁶ This allows the locations' utility levels to vary by education level, reflecting the possibility that earnings differences across countries vary by education level. We also allow utility to vary by legal status, given that authorized and unauthorized immigrants may have different earnings, particularly in the U.S. In order to capture changes over time in the relative attractiveness of living in the U.S. and Mexico, which may vary by educational attainment, we allow the U.S. utility to vary over time by including the term $\gamma_{X,t}$, which may take on different values across 5 different time ranges and the two education groups, as shown in (6). We need to make a normalization for identification, so we set $u_{ls,X}^M = 0$ (see Appendix A for a discussion of how the parameters are identified).²⁷

²⁵(Lessem 2018) estimates the utility as a function of wages in each location. In that case, the effect of wages on utility was identified by looking at where people move as a function of wages. In the 2 location case, however, if the wage differential is the same for everyone, it is difficult to identify the effect of wages on utility separately from moving costs. This was not a problem in (Lessem 2018) which considered internal migration, as well as a choice of locations in the U.S. We do have variation in the self-reported wage differential across locations for individuals, but in practice that does a poor job of predicting who chooses to migrate, as the people most likely to move do not report the largest wage differentials.

²⁶These categories were chosen to reflect natural breakpoints in the Mexican educational distribution and to separate groups with distinct baseline migration probabilities in the MMP.

²⁷This normalization can be imposed across all legal status and education groups because we do not allow migration decisions to endogenously affect future types, including legal status. This precludes us from including the legal entry ban policy in the baseline model that we use for estimation. However, as shown in Section 6, at the low legalization rates faced by potential migrants in our sample, the presence or absence of the legal entry ban policy has very minimal effect on migration decisions. Therefore, omitting it from the estimation will have little effect on our

We parameterize moving costs as follows.

$$MC_t(k, j, ls, X) = \begin{cases} c_{X,ls}^{M-US} + \delta b_t \mathbb{1}(ls = 0) & \text{if } j = M \text{ and } k = US \\ c_{X,ls}^{US-M} & \text{if } j = US \text{ and } k = M \\ 0 & \text{otherwise} \end{cases} \quad (7)$$

The moving cost when not changing locations is zero, and we allow costs to differ when moving from Mexico to the U.S. or from the U.S. to Mexico. Moving costs critically depend on legal status, given that it is much easier for authorized immigrants to move to the U.S. We also allow the moving costs to vary with education level, which may affect a person's access to the resources necessary to move between countries. In addition, we allow unauthorized immigrants' cost of moving to the U.S. to vary over time with U.S. border enforcement b_t .²⁸ We estimate the parameter δ , which captures the relationship between border enforcement resources and the moving costs faced by unauthorized migrants.

We also parameterize the function characterizing the probability of transitioning to legal status.

$$p_t^l(ls_{t-1}, X) = \begin{cases} p_X + \phi \mathbb{1}(IRCA_t) & \text{if } ls_{t-1} = 0 \\ 1 & \text{if } ls_{t-1} = 1 \end{cases} \quad (8)$$

As stated in Section 4, we assume that U.S. legal status is an absorbing state. Consistent with Figure 6, we assume a constant baseline legalization probability over time, but we allow that probability p_X to differ for the two education groups. Furthermore, we assume that the probability of being granted legal status increases by ϕ in the IRCA years of 1987-1991 (again following Figure 6). Since this policy was unanticipated and did not apply to migrants arriving after the policy was announced, when computing value functions we assume that $\phi = 0$. However, in the likelihood function, where we consider transitions over legal status, we allow for $\phi \neq 0$, potentially increasing the probability of being granted legal status during the IRCA years, to match the observed rates in the data.

Finally, in equation (4) there is a probability p_t^d of being deported each period. We calculate these deportation rates using data on interior apprehensions of unauthorized immigrants and estimates of the unauthorized population in each year, as described in Appendix B.3.

Given this setup, we have 4 parameters for the utility of living in the U.S., 8 moving cost parameters, 8 relative U.S. utility parameters over time, the border enforcement cost parameter (δ), 2 legalization probabilities across the education groups (p_X^l), and the IRCA legalization rate parameter (ϕ), for a total of 24 parameters. We assume perfect foresight over changes in deportation rates (p_t^d), border enforcement (b_t), and the relative U.S. utility parameters (γ_t). As just mentioned,

parameter estimates.

²⁸Appendix B.2 describes the data sources and construction of the border enforcement series.

agents do not take changes in legalization rates due to IRCA (ϕ) into account when making location choices.

5.2 Likelihood function

The likelihood function is as follows:

$$L(\theta) = \sum_i \sum_0^{T_i} \log \left(P_t(j_{it}|j_{i,t-1}, l_{sit}, X_i, a_{it}) \times p_t^l(l_{s_{i,t-1}}, X_i)^{l_{sit}} \times \left(1 - p_t^l(l_{s_{i,t-1}}, X_i)\right)^{1-l_{sit}} \right) \quad (9)$$

Given the type-I extreme value preference shocks, the choice probabilities, $P_t(\cdot)$, are given by equation (5).

6 Results

We estimate the model using maximum likelihood with data from the MMP, and the resulting parameter estimates are reported in Tables 2 – 4. Table 2 shows the estimated utility of living in the U.S. and the moving cost parameters, conditional on education and legal status. Recall that the utility of living in Mexico, u^M , was normalized to zero for each group. The positive U.S. utility estimates for authorized immigrants and low education unauthorized immigrants imply that these groups of immigrants prefer living in the U.S. relative to Mexico. In contrast, high education unauthorized immigrants prefer Mexico to the U.S. This is not surprising given the limited U.S. employment opportunities facing those without legal status and the fact that potential migrants may simply prefer to live in their home country, all else equal. We find large costs of moving from Mexico to the U.S., and much higher costs for those moving without legal status. The return migration costs are much smaller in magnitude and are negative for unauthorized immigrants.

Table 3 presents estimates governing how the relative utility of living in the U.S. varies with time. As shown in (6), the $\gamma_{X,t}$ parameters additively shift the relative utility of living in the U.S., and vary by education group. The variation over time is consistent with aggregate migration trends, with steadily increasing Mexico-U.S. migration rates through the 1990s and early 2000s, and a decline following the Great Recession.²⁹ Table 3 also shows the effect of border enforcement on the costs unauthorized immigrants face when moving from Mexico to the U.S. (δ in (7)). The effect of border enforcement is modest in comparison to the baseline migration costs reported in Table 2. During our sample period, enforcement expenditures increased by more than 10 billion dollars.³⁰ Since we measure b_t in (7) in billions of dollars, we can multiply the estimate of δ by 10

²⁹See Figures 4 and 5. While migration rates do vary significantly in other time periods, northward and southward migration tend to move together, so net migration is quite constant, until the 2010-2018 period.

³⁰See Appendix B.2

to evaluate the effect of increased border enforcement spending on migration costs. The resulting value of 0.331 is an order of magnitude smaller than the baseline moving costs.

Finally, Table 4 shows the estimated legal status transition rates. The rates are extremely small for both education groups, consistent with the baseline legalization rates shown in Figure 6. We also see a very substantial increase in transition rates in the IRCA years, consistent with the spike in the share receiving legal status after 1986 in Figure 6. Recall that we assume individuals did not anticipate the increase in legalization probabilities that came with IRCA, but the inclusion of this effect is important to match the realized increase in transitions from illegal to legal status in the years immediately after IRCA.

Table 5 shows the model fit, comparing average migration rates in the data (columns (1) and (3)) to migration probabilities predicted by the model (columns (2) and (4)). We show the probability of moving to the U.S. and of return migration from the U.S. to Mexico. The model fits the data very well, with predicted migration rates falling within a few tenths of a percentage point of the observed migration rates in all cases.

6.1 Counterfactuals

We use various counterfactuals to study the effects of changing both enforcement policies and opportunities to obtain legal status, highlighting the complementarities between these policies. First, we consider an increase in deportation rates. This has a mechanical effect of lowering the number of unauthorized immigrants by forcing people to return to Mexico. However, it also influences potential migrants' decisions on where to live. If a person knows that they could be forced to return to Mexico if they move to the U.S. illegally, then this lowers the value of moving to the U.S. and can reduce immigration rates for those without legal status. Next, we consider a policy imposing perfectly enforced legal entry bans on those who were previously deported, i.e. their legalization probability goes to zero. In theory, this should further reduce immigration rates for a given deportation probability, because deportation both removes an individual from the U.S. and causes them to lose the option value of returning legally in the future. This potential loss of option value will result in an additional deterrent effect for unauthorized immigrants considering migrating to the U.S. However, given that the estimated legal transition rates are quite low, we anticipate this channel will drive small changes in migration behavior. We then explore how the deterrent effect of legal entry bans increases when the probability of gaining legal status is higher. Finally, we compare a policy with increased probability of permanent legal status to one in which workers may obtain temporary work visas that allow them to reside and work legally in the U.S. for three years, after which they must return to Mexico.

We examine three different outcomes under the various counterfactual immigration policies just described. In Table 6, we examine migration probabilities in order to understand how the different policies affect potential immigrants' location choices and hence migrant flows. Specifically, we show

the probability of moving to the U.S. for a person without legal status, in the high education group (6+ years), and age 33 in 2017. We separate these estimates into those for individuals with and without a previous deportation, a distinction that becomes relevant when we impose the legal entry ban policy. We then consider two different measures of immigrant stocks, which is important since relatively small changes in migration flows can lead to large changes in stocks over time. Changing legalization probabilities affects the stock of unauthorized immigrants directly by providing legal status to unauthorized immigrants and indirectly by changing the incentives faced by potential unauthorized immigrants. The first stock measure, shown in Table 7, isolates the incentive effect by changing the legalization rates immigrants perceive when making location choices, but without actually legalizing immigrants in the simulations. It reports the average amount of time spent as an unauthorized immigrant in the U.S., assuming that they never receive legal status.³¹ We refer to this as the “incentive-only” stock measure. The second stock measure, shown in Table 8, includes both the mechanical and incentive effects of changing legalization rates. It reports the average time spent in the U.S. as an unauthorized immigrant or as an authorized immigrant. In both Tables 7 and 8, the averages include zeros (those with no time in the U.S.).

Rows 1 and 2 of Tables 6 – 8 examine the effect of a perfectly enforced legal entry ban for those previously deported, holding deportation rates and legalization probabilities at their baseline values. The resulting migration flows and stocks are nearly identical across rows 1 and 2 in all three counterfactual tables, showing that the legal entry ban has minimal effect at the baseline deportation and legalization rates. This is not surprising; since the probability of obtaining legal status for the potential migrants in our sample is very small, so is the option value of legal migration that is lost after deportation under a legal entry ban policy.^{32, 33}

Comparing rows 1 and 3 of Tables 6 – 8 shows the effects of increased deportation rates in the absence of a legal entry ban policy. We increase the deportation rate from the approximately 1–3% baseline rate (see Appendix B.3) to 10% per year. This substantial increase in enforcement drives

³¹To calculate this, we took the total number of person years where a person does not have legal status, and computed the share of those years spent in the US. We then multiplied this ratio times the average number of years we observe a person in the sample (9 years).

³²This finding may seem to contrast with those of Bazzi et al. (2019), who find substantial deterrent effects of the Border Patrol’s Consequence Delivery System (CDS), which increased enforcement of the legal entry ban policy. Our contrasting results likely stem from two differences in our analysis. First, while Bazzi et al. (2019) examine subsequent apprehensions for those who were already apprehended previously, we consider all migration events for a sample including all potential migrants. Second, CDS increases enforcement of the legal entry ban policy, but also involves deporting some individuals far from their location of entry and increased criminal prosecution for migration-related offenses. We only consider the mechanism related to the legal entry ban policy, potentially explaining our more modest effects.

³³A concern with this finding is that we may be underestimating the true rate of legalization because the MMP data may systematically omit those who receive legal status and remain in the U.S. With that in mind, we reran the estimation and counterfactual analysis after calibrating the yearly legalization probabilities based on administrative data on legal immigration in the U.S. and Mexican Census data on the Mexican population, which indeed imply higher legalization rates than those observed in the MMP. All results, which are available upon request, are nearly identical to those presented here.

large declines in the probability that those without legal status choose to migrate to the U.S and, as a result, large reductions in the stock of unauthorized migrants in the U.S. For example, in Table 8, we see that for individuals in our sample, the average time spent as an unauthorized migrant in the U.S. falls from 0.65 to 0.35 years, a 46% decline.

Row 4 maintains the increased deportation rate of row 3, but also imposes the perfectly enforced legal entry ban for previously deported individuals. In this case, we still see minimal effects on migration rates and unauthorized immigrant stocks. Even with the much higher deportation rate in rows 3 and 4, the legal entry ban policy is ineffective at the extremely low baseline legalization probabilities. With this in mind, row 5 drastically increases the yearly legalization probability to 1% from the baseline level of approximately 0.05% (see Table 4). In this case, the legal entry ban policy has a nontrivial effect on migration rates. Comparing rows 4 and 5 in Table 6, the northward migration rate falls from 0.59% to 0.55% for unauthorized immigrants without a prior deportation. This decrease results from immigrants deciding not to migrate illegally for fear of being deported and losing the option to move legally in the future. Note that the migration rate for those with a prior deportation is unaffected by the increased legalization rate, since those with a prior deportation have already lost the option value of migrating legally. Comparing rows 4 and 5 in Table 7, we see that this change reduces by 4.4% the incentive-only measure of average years in the U.S. as an undocumented immigrant.

This comparison between rows 4 and 5 reflects the complementarity between deportation and legalization policies in the presence of the legal entry ban policy. The complementarity can be seen from yet another perspective by examining the the effect of an increase in deportations when the legalization rate is high, i.e. comparing rows 5 and 6. Increasing the deportation rate when the legal status transition rate is high (row 6 vs. 5) reduces the unauthorized migration of the never-deported from 0.80% to 0.55%.

Increasing the legal transition rate amplifies the deterrent effect of deportations, but it also increases the total number of immigrants resident in the U.S. Focusing on the last two columns of rows 4 and 5 in Table 8, increasing the legal status transition rate does deter unauthorized migrants somewhat, but it also increases the number of authorized immigrants by roughly an order of magnitude. We now investigate whether a temporary guest worker program can provide similar deterrence without such large increases in the legal immigrant population. To be specific, we start with the situation in row 5 of Tables 6 – 8: 10% deportation rate, 1% legal status transition rate, and the legal entry ban policy in place. The results from this counterfactual scenario are reproduced in the first row of Table 9. The last three columns of Table 9 report the migration rate for unauthorized immigrants from Table 6, the incentive-only unauthorized immigrant stock measure from Table 7, and the sum of overall authorized and unauthorized immigrant stock measures from Table 8.

The second row of Table 9 then considers a situation with the baseline rate of obtaining permanent legal status, but additionally creates a temporary visa program in which immigrants who

obtain a visa may live and work in the U.S. for up to 3 years, after which they must return to Mexico. The probability of obtaining a temporary visa is 5% per year. Note that this policy changes the evolution of legal status over time; it is no longer an absorbing state. Compared to increasing the rate of receiving permanent legal status, this temporary visa program yields an even larger deterrence effect in terms of unauthorized migration flows and incentive-based stocks, and does so while roughly halving the total years spent in the U.S. Thus, in the presence of a legal entry ban policy, the temporary visa program amplifies the deterrent effect of enforcement policies by creating a valuable legal alternative. However, its temporary nature means that it drives more modest increases in the overall numbers of immigrants in the U.S., which may be more politically feasible in certain contexts. The temporary visas provide an effective deterrent because many immigrants seem to prefer relatively short stays in the U.S. even absent policy incentives to do so. Panel (b) in Table 1 shows that 65% of migrant spells in the U.S. last less than 3 years, so for a substantial share of potential migrants the 3-year limit on the simulated work visas may not be binding.

7 Conclusion

This paper examines how increasing the number of visas available to potential migrants would affect the flow of unauthorized immigrants to the U.S. We develop a dynamic discrete location choice model, which we estimate using data from the Mexican Migration Project, and consider a variety of policy counterfactuals to understand the interactions between i) enforcement policies that change the probability of deportation facing unauthorized immigrants and ii) increased access to work visas that increase the probability that a migrant will obtain legal status in the future. Our results make clear that these two sets of policies reinforce one another to lower unauthorized migration rates. Increased deportation rates directly reduce the value of migrating to the U.S. by making it more likely that unauthorized migrants will be forced to return to Mexico before they would have chosen to do so. In the presence of a nontrivial probability of receiving legal status, the costs of deportation are even larger because deportation also causes migrants to lose access to the possibility of migrating to the U.S. legally in the future.

Our findings inform ongoing immigration policy debates along three main dimensions. First, because for most potential Mexican migrants the probability of obtaining legal status is small, the legal entry ban policy for previously deported individuals has a minimal deterrent effect on unauthorized immigration. The implementation of this policy is costly in terms of enforcement personnel, immigrant detention, and immigration court resources, yet our counterfactual simulations suggest that it currently has a very small impact.

Second, our findings are informative regarding how to structure immigration reforms designed to address the issue of unauthorized migration. Because enforcement and visa policies reinforce each other, implementing them together will likely have a larger impact on unauthorized immigra-

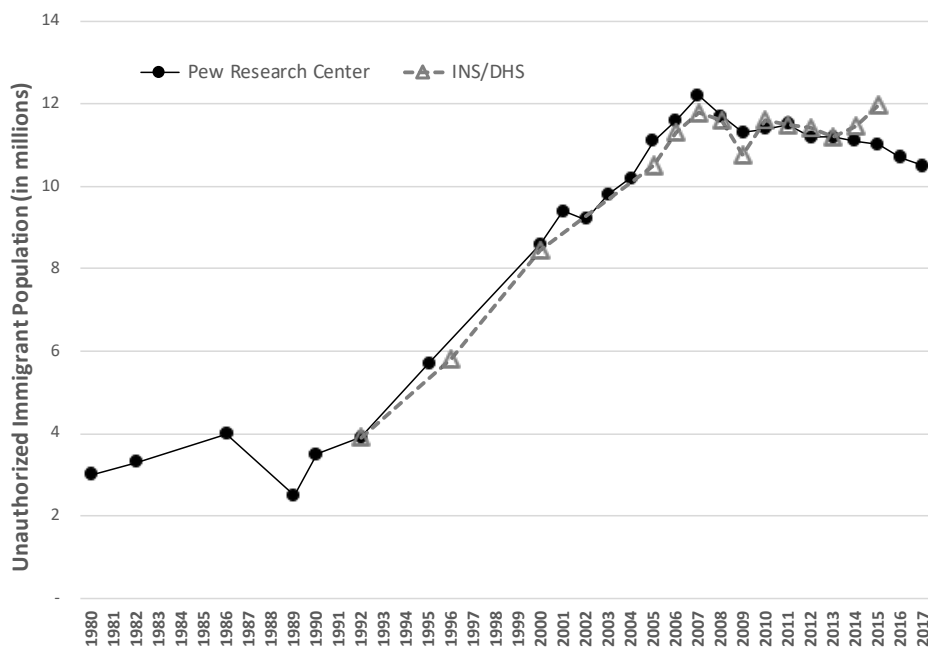
tion than would alternative approaches that seek to achieve enforcement goals prior to expanding the options for legal immigration. Moreover, if increasing legal access to the U.S. labor market substantially reduces unauthorized immigration, then it may help reduce other enforcement costs. For example, a decrease in the numbers of immigrants crossing the border illegally to work in the U.S. would make it easier to identify those involved in drug or weapons smuggling.

Third, we find that a temporary work visa program provides a similar deterrent effect to that of an increase in the probability of receiving permanent legal status, without such large increases in the total number of immigrants residing in the U.S. at a given moment in time. Therefore, in certain contexts, temporary work visa programs may provide a more politically feasible means of providing legal access to the U.S. labor market while still amplifying the deterrent effects of immigration enforcement policies.

References

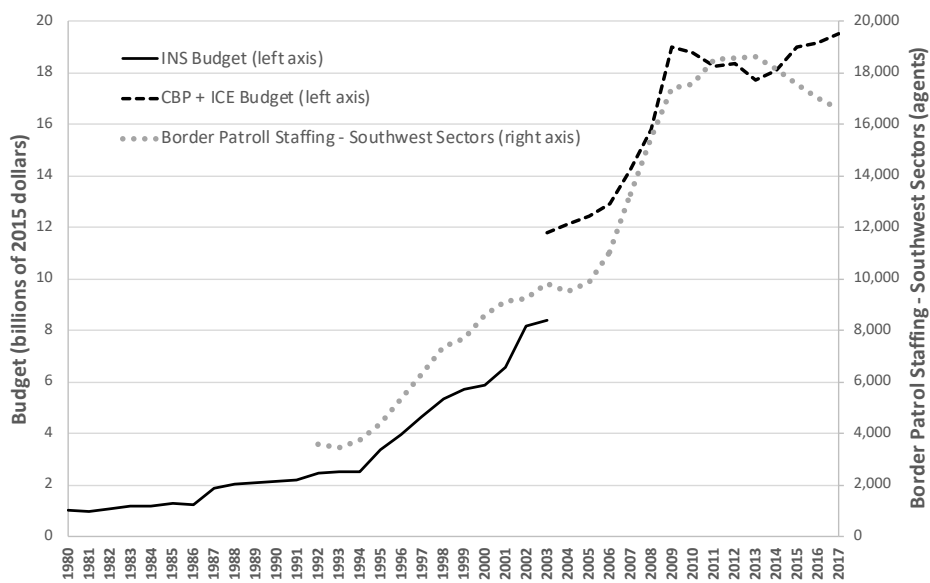
- Allen, Treb, Caue Dobbin, and Melanie Morten. 2019. "Border walls." *NBER Working Paper*, no. 25267.
- Bazzi, Samuel, Sarah Burns, Gordon Hanson, Bryan Roberts, and John Whitley. 2019. "Deterring Illegal Entry: Migrant Sanctions and Recidivism in Border Apprehensions." *NBER Working Paper*, no. 25100.
- Bohn, Sarah, Magnus Lofstrom, and Steven Raphael. 2014. "Did the 2007 Legal Arizona Workers Act reduce the state's unauthorized immigrant population?" *Review of Economics and Statistics* 96 (2):258–269.
- Bohn, Sarah, and Todd Pughatch. 2015. "U.S. border enforcement and Mexican immigrant location choice." *Demography* 52 (5):1543–1570.
- Caballero, Maria Esther, Brian C. Cadena, and Brian K. Kovak. 2018. "Measuring Geographic Migration Patterns Using Matrículas Consulares." *Demography*, no. 55:1119–1145.
- Cascio, Elizabeth U., and Ethan G. Lewis. 2019. "Distributing the Green (Cards): Permanent residency and personal income taxes after the Immigration Reform and Control Act of 1986." *Journal of Public Economics* 172 (April): 135–150.
- CBO. 2006, February. "Immigration Policy in the United States." Technical Report, Congressional Budget Office.
- . 2010, December. "Immigration Policy in the United States: An Update." Technical Report, Congressional Budget Office.
- DHS. 2017. "Yearbook of Immigration Statistics: 2016." Technical Report, U.S. Department of Homeland Security, Office of Immigration Statistics.
- . 2019. "Yearbook of Immigration Statistics: 2017." Technical Report, U.S. Department of Homeland Security, Office of Immigration Statistics.
- East, Chloe N., Annie Laurie Hines, Phillip Luck, Hani Mansour, and Andrea Velasquez. 2018. "The Labor Market Effects of Immigration Enforcement." *unpublished*.
- East, Chloe N., and Andrea Velasquez. 2019. "Unintended Consequences of Immigration Enforcement: Personal Services and High-Skilled Women's Work." *unpublished*.
- Feigenberg, Benjamin. 2017. "Fenced Out: Why Rising Migration Costs Matter." *unpublished*.
- Gemici, Ahu. 2011. "Family Migration and Labor Market Outcomes." *working paper*.
- Gorlach, Joseph-Simon. 2020. Borrowing Constraints, Migrant Selection, and the Dynamics of Return and Repeat Migration.
- Hanson, Gordon H, and Antonio Spilimbergo. 1999. "Illegal immigration, border enforcement, and relative wages: Evidence from apprehensions at the U.S.-Mexico border." *American Economic Review* 89 (5):1337–1357.
- Kennan, John, and James Walker. 2011. "The Effect of Expected Income on Individual Migration Decisions." *Econometrica* 79 (1): 211–251.
- Lessem, Rebecca. 2018. "Mexico-U.S. immigration: Effects of wages and border enforcement." *Review of Economic Studies* 85 (4):2353–2388.
- Massey, Douglas S., Jorge Durand, and Nolan J. Malone. 2002. *Beyond smoke and mirrors: Mexican immigration in an era of economic integration*. Russell Sage Foundation.
- Passel, Jeffrey S., and D'Vera Cohn. 2018. "U.S. unauthorized immigrant total dips to lowest level in a decade." Technical Report, Pew Research Center.
- Rosenblum, Marc R., Doris Meissner, Claire Bergeron, and Faye Hipsman. 2014. "The Deportation Dilemma: Reconciling Tough and Humane Enforcement." Technical Report, Migration Policy Institute, Washington, D.C.
- USCIS. 2016, February. Maintaining Permanent Residence.

Figure 1: Unauthorized Immigrant Population Measures



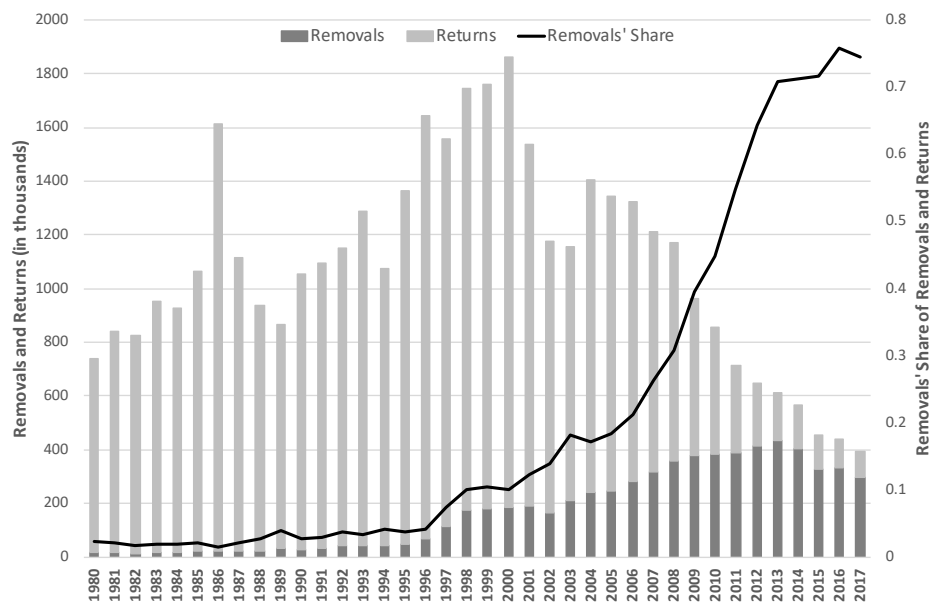
Sources: Both the Pew Research Center and INS/DHS series estimate the unauthorized immigrant population using a residual method, in which administrative measures of the number of authorized immigrants is subtracted from a survey-based estimate of the total foreign-born population. For the Pew Research Center series, estimates for 1990, 1995, 2000, and 2005-2017 are from <https://www.pewresearch.org/hispanic/2019/06/03/facts-on-u-s-immigrants/>; estimates for 1980, 1982, 1986, 1989, and 1992 are from <https://www.pewresearch.org/hispanic/2006/03/07/ii-unauthorized-migrants-the-numbers/>; and estimates for 2001-2004 are from <https://www.pewresearch.org/hispanic/2008/10/02/trends-in-unauthorized-immigration/>. For the INS/DHS series the estimate for 1992 is from <https://www.dhs.gov/sites/default/files/publications/Unauthorized%20Immigrant%20Population%20Estimates%20in%20the%20US%201996.pdf>; the estimate for 1996 is from <https://www.dhs.gov/sites/default/files/publications/Unauthorized%20Immigrant%20Population%20Estimates%20in%20the%20US%201990%20to%202000.pdf>; estimates for 2000 and 2005-2009 are from https://www.dhs.gov/sites/default/files/publications/18_1214_PLCY_pops-est-report.pdf using the 2000 Census, while 2010-2015 are from the same source using the 2010 Census.

Figure 2: Border Enforcement Resources



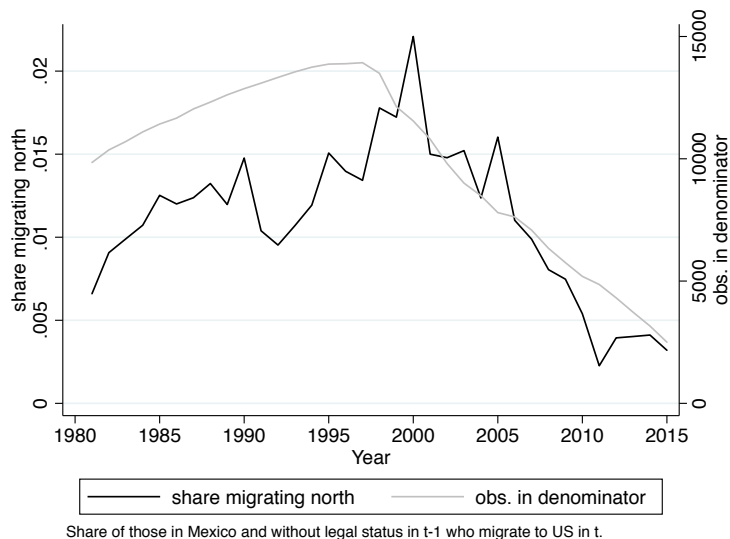
Sources: Immigration and Naturalization Service (INS) Budget for 1980-2003 from https://www.justice.gov/archive/jmd/1975_2002/2002/html/page104-108.htm. Customs and Border Protection (CBP) and Immigration and Customs Enforcement (ICE) Budgets for 2003-2017 from yearly Department of Homeland Security Budgets-in-Brief, available at <https://www.dhs.gov/dhs-budget>. Both are reported in billions of year-2015 dollars (left axis) using the CPI-U yearly price deflator. Border Patrol staffing numbers for the Southwest Sectors (right axis) from the U.S. Border Patrol Fiscal Year Staffing Statistics, available at <https://www.cbp.gov/document/stats/us-border-patrol-fiscal-year-staffing-statistics-fy-1992-fy-2018>.

Figure 3: Removals and Returns

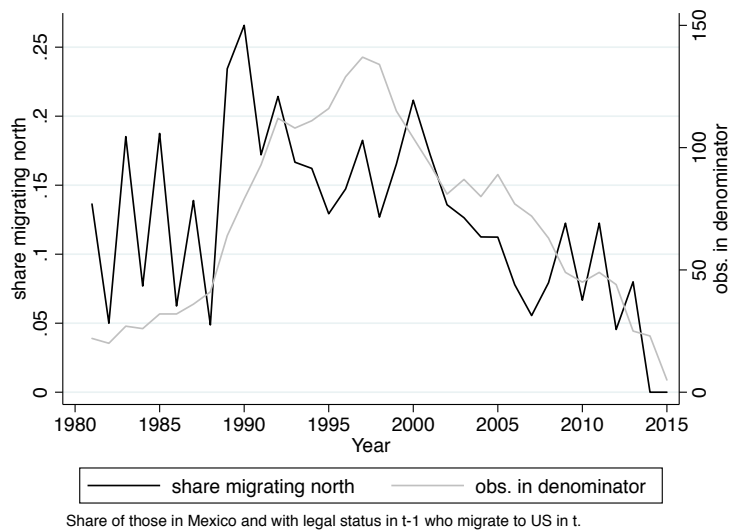


Sources: Table 39 of the 2017 Yearbook of Immigration Statistics, available at <https://www.dhs.gov/immigration-statistics/yearbook/2017>. Removals include standard removals, stipulated orders, expedited removals, reinstatement of removal, and administrative removal. Returns include withdrawal of application for admission, voluntary return, and voluntary departure. See Rosenblum et al. (2014) for details on each category of departure.

Figure 4: Mexico to U.S. migration rates



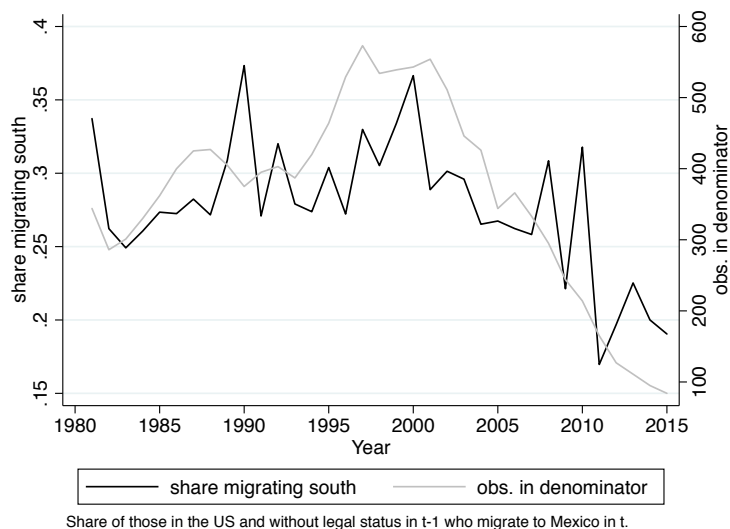
(a) Immigrants Without Legal Status in the U.S.



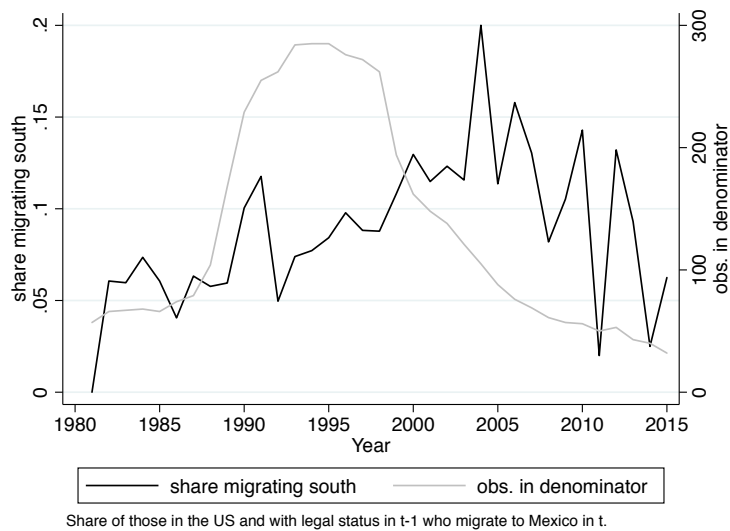
(b) Immigrants With Legal Status in the U.S.

Source: Authors' calculations based on Mexican Migration Project data. See text for sample restrictions. The black line in panel (a) shows the share of those in Mexico and without U.S. legal status in year $t-1$ who migrate to the U.S. in year t , listed on the x-axis, with values plotted on the left axis. Panel (b) shows the share of those in Mexico and with U.S. legal status in year $t-1$ who move to the U.S. in year t . In both panels, the gray line shows the number of observations in the denominator of the relevant share in each year (i.e. those in Mexico and without U.S. legal status in year $t-1$ in panel (a) and those in Mexico and with U.S. legal status in year $t-1$ in panel (b)), plotted on the right axis.

Figure 5: U.S. to Mexico migration rates



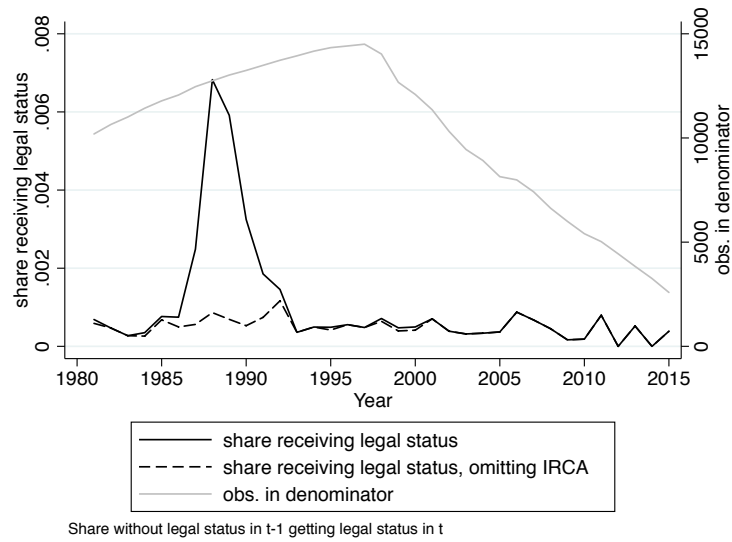
(a) Immigrants Without Legal Status in the U.S.



(b) Immigrants With Legal Status in the U.S.

Source: Authors' calculations based on Mexican Migration Project data. See text for sample restrictions. The black line in panel (a) shows the share of those in the U.S. and without U.S. legal status in year $t - 1$ who migrate to Mexico in year t , listed on the x-axis, with values plotted on the left axis. Panel (b) shows the share of those in the U.S. and with U.S. legal status in year $t - 1$ who move to Mexico in year t . In both panels, the gray line shows the number of observations in the denominator of the relevant share in each year (i.e. those in the U.S. and without U.S. legal status in year $t - 1$ in panel (a) and those in the U.S. and with U.S. legal status in year $t - 1$ in panel (b)), plotted on the right axis.

Figure 6: Legal Status Transition Rates



Source: Authors' calculations based on Mexican Migration Project data. See text for sample restrictions. The solid black line shows the share of those without U.S. legal status in year $t - 1$ who get legal status in year t . The dashed black line plots the same share, omitting those who report receiving legal status under IRCA. The gray line shows the number of observations in the denominator of the relevant share (i.e. those without U.S. legal status).

Table 1: Summary Statistics.

Panel (a): Characteristics in survey year (or last year in sample)	
Number of household heads observed	17,538
Share female	0.153
Age distribution	
18-29	0.094
30-39	0.211
40-49	0.232
50-59	0.204
60-65	0.259
Education distribution (years)	
0-5 (low)	0.340
6+ (high)	0.660
Share in the U.S.	0.047
Share with U.S. legal status	0.029
Panel (b): Migration patterns	
Number of observed Mexico to U.S. migration events	4,694
Distribution of Mexico to U.S. migration events per person	
0	0.834
1	0.112
2	0.033
3+	0.021
Distribution of spell length in the U.S. (years)	
1	0.481
2	0.173
3	0.089
4	0.050
5+	0.207
10+	0.104
20+	0.029

Authors' calculations based on Mexican Migration Project data on household heads. See text for additional sample restrictions. Panel (a) shows the characteristics of the household heads in our sample as observed in the year of the survey, or the last year of the sample (the survey year for those surveyed after age 65 does not appear in our sample due to the age restriction of 18-65). This yields one observation per individual household head. Panel (b) uses the retrospective panel dimension of the data to measure migration patterns. Note that the distribution of spell lengths includes censored spells at the beginning or end of the panel for each individual.

Table 2: Utility and moving cost parameter estimates

Legal Status:	Unauthorized		Authorized	
Education:	Low	High	Low	High
U.S. utility (u^{US})	0.219 (0.030)	-0.263 (0.050)	0.169 (0.030)	0.012 (0.030)
Moving cost, Mexico to U.S. (c^{M-US})	6.068 (0.413)	5.969 (0.735)	3.513 (0.351)	2.356 (0.474)
Moving cost, U.S. to Mexico (c^{US-M})	-0.739 (0.410)	-0.947 (0.731)	0.517 (0.343)	1.681 (0.471)

These parameters show the estimated utility from living in the U.S. (recall that the utility from living in Mexico, u^M , is normalized to zero), and the moving cost estimates. Standard errors in parentheses.

Table 3: Time effects in utility

Education:	Low	High
1994-2000	0.0267 (0.0218)	0.0915 (0.0162)
2001-2005	0.0930 (0.0288)	0.1375 (0.0191)
2006-2009	0.0739 (0.0514)	0.1150 (0.0281)
2010-2018	0.0034 (0.0503)	-0.0108 (0.0273)
Enforcement (δ)	0.0331 (0.0068)	

These parameters report the additive increase in utility when living in the U.S. in a given year for the relevant education group. The excluded group is years 1980-1993. Enforcement reports the effect of border enforcement on moving costs when moving from Mexico to the US. Standard errors in parentheses.

Table 4: Legal transition rates

Education group	p_t^l
Low (0-5)	0.000523 (0.000071)
High (6+)	0.000526 (0.000050)
IRCA (ϕ)	0.003413 (0.000247)

We report the probability of being granted legal status in a given period. These depend on education level, and we allow the probability to shift in the years following IRCA (1987-1991).

Table 5: Model fit

Education group	Legal status	Mexico to U.S.		U.S. to Mexico	
		Data	Model	Data	Model
		(1)	(2)	(3)	(4)
Low	Unauthorized	1.02%	1.02%	29.34%	28.62%
Low	Authorized	15.21%	15.03%	9.11%	9.05%
High	Unauthorized	1.28%	1.28%	29.81%	29.54%
High	Authorized	14.20%	14.28%	9.95%	9.92%

Columns (1) and (2) consider people who start a period in Mexico. Column (1) shows the share of people in the relevant group that moves to the U.S. in the MMP data. In column (2) we calculate the model-predicted probability of moving to the U.S. for each individual, and then report the average over the sample. Columns (3) and (4) repeat this for the set of people who start a period in the U.S., considering the model-predicted and observed rates of return migration to Mexico.

Table 6: Counterfactuals: Mexico to U.S. migration probabilities

Row	Deportation rate	Legal status transition rate	Entry ban for deported	Mex. to U.S. Migration rate	
				Never deported	Deported
1	Baseline	Baseline	No	0.8342%	0.8342%
2	Baseline	Baseline	Yes	0.8339%	0.8361%
3	10%	Baseline	No	0.5868%	0.5868%
4	10%	Baseline	Yes	0.5856%	0.5876%
5	10%	1%	Yes	0.5529%	0.5876%
6	Baseline	1%	Yes	0.7975%	0.8361%

We report the model-predicted migration probabilities. This is for a 33 year old unauthorized immigrant in 2017 with the high education level. We show these probabilities for situations where a person has never been deported, and when they have been deported previously.

Table 7: Counterfactuals: Average years unauthorized in the U.S. - incentive-only stock

Row	Deportation rate	Legal status transition rate	Entry ban for deported	Years unauthorized
				in the U.S.
1	Baseline	Baseline	No	0.2705
2	Baseline	Baseline	Yes	0.2702
3	10%	Baseline	No	0.1463
4	10%	Baseline	Yes	0.1462
5	10%	1%	Yes	0.1397
6	Baseline	1%	Yes	0.2586

Considering only years in which a person does not have U.S. legal status, we compute the share of those years spent in the U.S.. We multiply this by 9 (the average number of years observed in the data) to get the average number of years spent in the U.S. for unauthorized immigrants in each scenario.

Table 8: Counterfactuals: Total years in the U.S. - overall stock

Row	Deportation rate	Legal status transition rate	Entry ban for deported	Total years (per person) in the U.S.	
				Unauthorized	Authorized
1	Baseline	Baseline	No	0.6521	0.1051
2	Baseline	Baseline	Yes	0.6516	0.1048
3	10%	Baseline	No	0.3527	0.1050
4	10%	Baseline	Yes	0.3524	0.1050
5	10%	1%	Yes	0.3015	1.0610
6	Baseline	1%	Yes	0.5575	1.0750

We compute the total number of person-years spent in the US as an authorized and unauthorized immigrant. We divide this by the total number of people in the sample.

Table 9: Counterfactuals: Temporary visas

Legal status transition rate	Temporary visas	Migration rate (M-US) Never deported	Years unauth. in U.S.	Total years in U.S.
1%	No	0.5529%	0.1397	1.3625
Baseline	Yes	0.5008%	0.1197	0.7300

Both rows apply a 10% deportation rate and the legal entry ban policy for those previously deported. The first row corresponds to row 5 in counterfactual Tables 6 – 8. The second row assumes the baseline rate of obtaining permanent legal status, but additionally creates a 3-year temporary visa program. The probability of receiving this visa is 5% per year. The column labeled “Migration rate (M-US), Never deported” presents the migration flow measure for those without prior deportation shown in Table 6. The column labeled “Years unauth. in U.S.” shows the incentive-only stock measure for unauthorized immigrants from Table 7. The column labeled “Total years in U.S.” shows the sum of the last two columns of Table 8, reporting the total immigrant stock measure including authorized and unauthorized immigrants.

Online Appendices

(Not for publication)

A Identification of net utility parameters	33
B Data	36
B.1 Migration Data Coverage	36
B.2 Border Enforcement Resources	38
B.3 Interior Apprehension Rate	40

A Identification of net utility parameters

We use a 2 period model to show how the net utility parameters are identified. We denote living in Mexico with M, and living in the U.S. with US. We abstract from legal status and characteristics, so this section can be interpreted as demonstrating the identification for a fixed set of characteristics.

We will work backwards, so first consider the period 2 decision. In the data, we see the share of people who make each location choice. First consider the people who start the period in Mexico. Denote p_2^{M-M} as the share of them who stay in Mexico and p_2^{M-US} as the share that move to the U.S. Next considering the people who start the period in the U.S., denote p_2^{US-M} as the share of them who return to Mexico and p_2^{US-US} as the share of them who stay in the U.S. We know the following relationship between these shares:

$$\begin{aligned} p_2^{M-M} &= 1 - p_2^{M-US} \\ p_2^{US-M} &= 1 - p_2^{US-US} \end{aligned} \tag{10}$$

Next we consider the choice probabilities derived from the model. We normalize the cost of moving to be 0 when not switching locations. Denote $v_t(\ell_t|\ell_{t-1})$ as the deterministic value of living in location ℓ_t after living in location ℓ_{t-1} in the previous period. Since period 2 is the terminal period, this just consists of the current utility from the location choice, as there is no continuation value since we assume $V_{T+1} = 0$. Denote u^M as the utility from living in Mexico and u^{US} as the utility from living in the US. The cost of moving from Mexico to the U.S. is c^{M-US} and the cost of return migration is c^{US-M} . Then for the terminal period,

$$\begin{aligned} v_2(M|M) &= u^M \\ v_2(US|M) &= u^{US} - c^{M-US} \\ v_2(M|US) &= u^M - c^{US-M} \\ v_2(US|US) &= u^{US} \end{aligned} \tag{11}$$

To make our identification arguments, we will rewrite the utility and moving costs in terms of net utilities, defining the \tilde{u} terms as follows

$$\begin{aligned} \tilde{u}^{M-M} &= u^M \\ \tilde{u}^{M-US} &= u^{US} - c^{M-US} \\ \tilde{u}^{US-M} &= u^M - c^{US-M} \\ \tilde{u}^{US-US} &= u^{US} \end{aligned} \tag{12}$$

If we can identify the \tilde{u} terms, we can back out the u and c terms.

Since we assumed a discrete choice model with extreme value shocks, the choice probabilities have a logit form. Denote the model-implied probability of choosing location ℓ_2 when you start the period in location ℓ_1 as $P_2(\ell_2|\ell_1)$. For example, consider the probability that someone starting in

Mexico chooses to stay there:

$$P_2(M|M) = \frac{\exp(\tilde{u}^{M-M})}{\exp(\tilde{u}^{M-M}) + \exp(\tilde{u}^{M-US})} \quad (13)$$

We observe this moment in the data, so

$$p_2^{M-M} = \frac{\exp(\tilde{u}^{M-M})}{\exp(\tilde{u}^{M-M}) + \exp(\tilde{u}^{M-US})} \quad (14)$$

We can also calculate the probability that a person moves from Mexico to the US:

$$P_2(US|M) = \frac{\exp(\tilde{u}^{M-US})}{\exp(\tilde{u}^{M-M}) + \exp(\tilde{u}^{M-US})} \quad (15)$$

Again, using the observed data moments,

$$\begin{aligned} p_2^{M-US} &= \frac{\exp(\tilde{u}^{M-US})}{\exp(\tilde{u}^{M-M}) + \exp(\tilde{u}^{M-US})} \\ 1 - p_2^{M-M} &= \frac{\exp(\tilde{u}^{M-US})}{\exp(\tilde{u}^{M-M}) + \exp(\tilde{u}^{M-US})} \\ p_2^{M-M} &= \frac{\exp(\tilde{u}^{M-M})}{\exp(\tilde{u}^{M-M}) + \exp(\tilde{u}^{M-US})} \end{aligned} \quad (16)$$

Comparing equations (14) and (16), we see that using both moments p_2^{M-M} and p_2^{M-US} yield the same equation since they are co-linear, so we have to make a normalizing assumption. We set $\tilde{u}^{M-M} = 0$. This allows one to identify \tilde{u}^{M-US} using equation (16) based solely on the observed migration rate in period 2.

We can also consider decisions for people who start the period in the U.S. In this case,

$$\begin{aligned} P_2(M|US) &= \frac{\exp(\tilde{u}^{US-M})}{\exp(\tilde{u}^{US-M}) + \exp(\tilde{u}^{US-US})} \\ p_2^{US-M} &= \frac{\exp(\tilde{u}^{US-M})}{\exp(\tilde{u}^{US-M}) + \exp(\tilde{u}^{US-US})} \end{aligned} \quad (17)$$

Absent additional information, we would need to impose an additional normalization to identify \tilde{u}^{US-M} or \tilde{u}^{US-US} . However, as we will show, we can use the period 1 migration rates combined with equation (17) to identify the remaining parameters.

We now consider the period 1 decision, and assume that the period 0 location is exogenously given. Denote η as the extreme value shocks, γ as Euler's constant, and β as the discount rate. We can write the value function for a person who starts period 1 living in Mexico as follows.

$$\begin{aligned} V_1(M) &= \max_{\ell=M,US} \tilde{u}^{M-\ell} + \eta_\ell + \beta E_1 V_t(\ell) \\ &= \max_{\ell=M,US} \tilde{u}^{M-\ell} + \eta_\ell + \beta \log \left(\exp(\tilde{u}^{\ell-M}) + \exp(\tilde{u}^{\ell-US}) \right) + \beta\gamma \end{aligned} \quad (18)$$

We can then use equation (18) to write the log probability that a person who starts the period in

Mexico chooses to stay in Mexico.

$$\begin{aligned}
\log (P_1(M|M)) &= \log \left(\exp \left\{ \tilde{u}^{M-M} + \beta \log \left[\exp(\tilde{u}^{M-M}) + \exp(\tilde{u}^{M-US}) \right] + \beta \gamma \right\} \right) \\
&- \log \left(\exp \left\{ \tilde{u}^{M-M} + \beta \log \left[\exp(\tilde{u}^{M-M}) + \exp(\tilde{u}^{M-US}) \right] + \beta \gamma \right\} \right) \\
&+ \exp \left\{ \tilde{u}^{M-US} + \beta \log \left[\exp(\tilde{u}^{US-M}) + \exp(\tilde{u}^{US-US}) \right] + \beta \gamma \right\} \\
&= \log \left(\exp \left\{ \beta \log \left[1 + \exp(\tilde{u}^{M-US}) \right] \right\} \right) \\
&- \log \left(\exp \left\{ \beta \log \left[1 + \exp(\tilde{u}^{M-US}) \right] \right\} + \exp \left\{ \tilde{u}^{M-US} + \beta \log \left[\exp(\tilde{u}^{US-M}) + \exp(\tilde{u}^{US-US}) \right] \right\} \right)
\end{aligned} \tag{19}$$

We can now calculate the log odds ratio of staying in Mexico between periods 1 and 2:

$$\begin{aligned}
\log \left(\frac{P_1(M|M)}{P_2(M|M)} \right) &= \log (P_1(M|M)) - \log (P_2(M|M)) \\
&= \log \left(\exp \left\{ \beta \log \left[1 + \exp(\tilde{u}^{M-US}) \right] \right\} \right) \\
&- \log \left(\exp \left\{ \beta \log \left[1 + \exp(\tilde{u}^{M-US}) \right] \right\} + \exp \left\{ \tilde{u}^{M-US} + \beta \log \left[\exp(\tilde{u}^{US-M}) + \exp(\tilde{u}^{US-US}) \right] \right\} \right) \\
&- \log \left(\exp(\tilde{u}^{M-M}) + \log \left[\exp(\tilde{u}^{M-M}) + \exp(\tilde{u}^{M-US}) \right] \right) \\
&= \log \left(\exp \left\{ \beta \log \left[1 + \exp(\tilde{u}^{M-US}) \right] \right\} \right) \\
&- \log \left(\exp \left\{ \beta \log \left[1 + \exp(\tilde{u}^{M-US}) \right] \right\} + \exp \left\{ \tilde{u}^{M-US} + \beta \log \left[\exp(\tilde{u}^{US-M}) + \exp(\tilde{u}^{US-US}) \right] \right\} \right) \\
&+ \log \left[1 + \exp(\tilde{u}^{M-US}) \right] \\
&= (1 + \beta) \log \left[1 + \exp(\tilde{u}^{M-US}) \right] \\
&- \log \left(\exp \left\{ \beta \log \left[1 + \exp(\tilde{u}^{M-US}) \right] \right\} + \exp \left\{ \tilde{u}^{M-US} + \beta \log \left[\exp(\tilde{u}^{US-M}) \right] - \beta \log(p_2^{US-M}) \right\} \right) \\
&= (1 + \beta) \log \left[1 + \exp(\tilde{u}^{M-US}) \right] \\
&- \log \left(\left[1 + \exp(\tilde{u}^{M-US}) \right]^\beta + \exp(\tilde{u}^{M-US}) \exp(\beta \tilde{u}^{US-M}) (p_2^{US-M})^{-\beta} \right)
\end{aligned} \tag{20}$$

Note that we have already identified \tilde{u}^{M-US} using equation (16) and the normalization $\tilde{u}^{M-M} = 0$. In equation (20), the odds ratio on the left-hand side is observed, as is p_2^{US-M} , meaning that (20) allows us to identify \tilde{u}^{US-M} . Given that, we can identify the remaining net utility parameter, \tilde{u}^{US-US} , using (17). Intuitively, identification is achieved in the dynamic setting because the incentive to move changes over time in a way that depends on the net utility parameters.

The two period model is sufficient to estimate the US baseline utility and moving cost parameters. However, in our model we also have some additional parameters that vary over time: the effect of border enforcement on moving costs and the time fixed effects in the relative utility of living in the U.S. To estimate these parameters, we require data from multiple years. Intuitively, the effect of border enforcement on moving costs comes from variation in migration rates as enforcement levels change. The time fixed effects in utility are identified based on time variation in migration rates that is unrelated to border enforcement.

B Data

B.1 Migration Data Coverage

The following figure shows a map of the communities covered by the MMP as of our sample.

Figure B1: Communities surveyed in the MMP



MMP Communities map produced by the MMP and obtained from <https://mmp.opr.princeton.edu/research/maps-en.aspx>. Black dots represent communities available in the current data extract (MMP170) and utilized in this study. Red dots will be available in subsequent data releases.

The following table compares the demographic and educational composition of the MMP data and the year 2000 Mexican Census. For consistency across the two datasets, we restrict the MMP sample to observations pertaining to the year 2000 for those resident in Mexico and restrict the Census to household heads. The share female, age distribution, and education distribution are quite similar across the two datasets, showing that although the MMP disproportionately samples high-migration areas, the demographic and educational composition of these regions is similar to that of household heads across Mexico as a whole.

Table B1: Comparison of MMP and Census Samples, Year 2000.

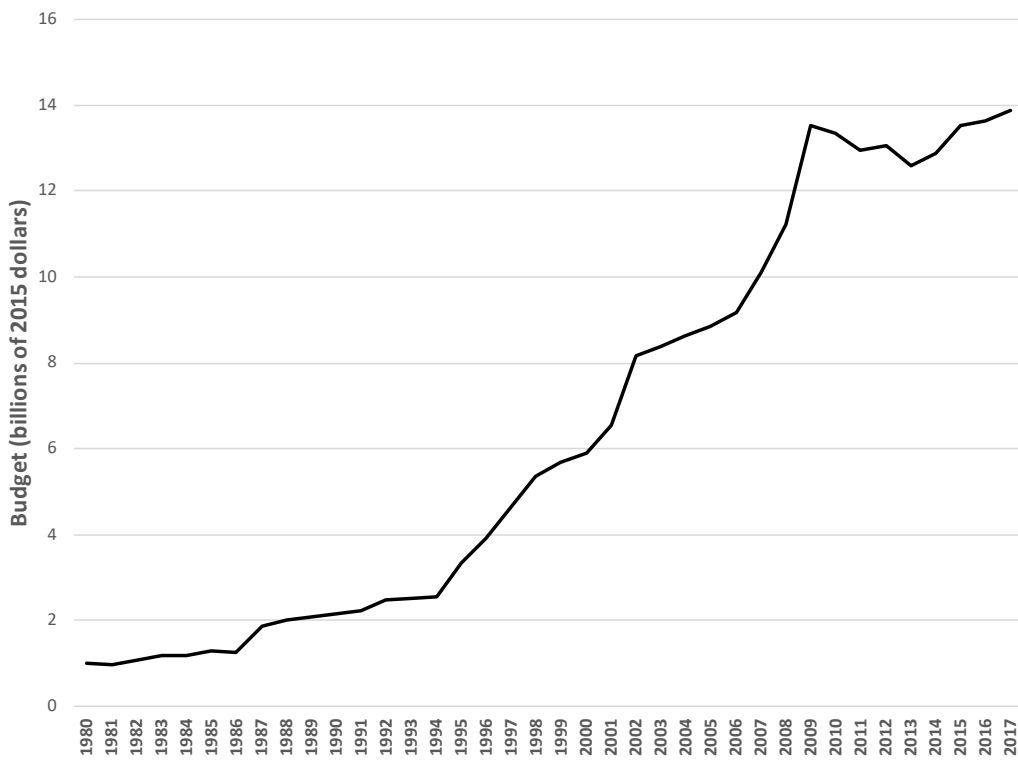
	MMP	Census
Share female	0.150	0.186
Age distribution		
18-29	0.225	0.197
30-39	0.265	0.297
40-49	0.244	0.248
50-59	0.185	0.176
60-65	0.081	0.083
Education distribution (years)		
0-2 (low)	0.162	0.168
3-11 (middle)	0.662	0.600
12+ (high)	0.176	0.232

Authors' calculations based on Mexican Migration Project data and year 2000 Mexican Census data. In order to have corresponding samples in the two datasets, we restrict the MMP data to observations for the year 2000 and for those residing in Mexico and restrict the Census data to household heads. Census data weighted using person-level sampling weights.

B.2 Border Enforcement Resources

Figure 2 provides various measures of border enforcement resources over time. We show the budget of the Immigration and Naturalization Service (INS) and the combined budgets of Customs and Border Protection (CBP) and Immigration and Customs Enforcement (ICE), which took on the enforcement duties of the INS after the creation of the Department of Homeland Security in 2003. Both budget series are reported in year-2015 dollars using the CPI-U yearly price deflator (shown on the left axis). We also show the number of Border Patrol officers assigned to the Southwest Sectors of Big Bend (formerly Marfa), Del Rio, El Centro, El Paso, Laredo, Rio Grande Valley (formerly McAllen), San Diego, Tucson, and Yuma. As is clear in the figure, these series track each other quite closely over time. Since the budget data span our entire sample period, we use them to generate a measure of border enforcement intensity over time. We simply proportionally rescale the CBP + ICE Budget series so that it coincides with the INS Budget series in 2003, the year in which we have observations for both series. The resulting series, appearing in Figure B2, is used to measure border enforcement in the moving cost function in (7).

Figure B2: Border Enforcement Series



Sources: Combines the INS Budget and CBP + ICE budget series shown in Figure 2 by proportionally rescaling the CBP + ICE series to equal the INS series in 2003.

B.3 Interior Apprehension Rate

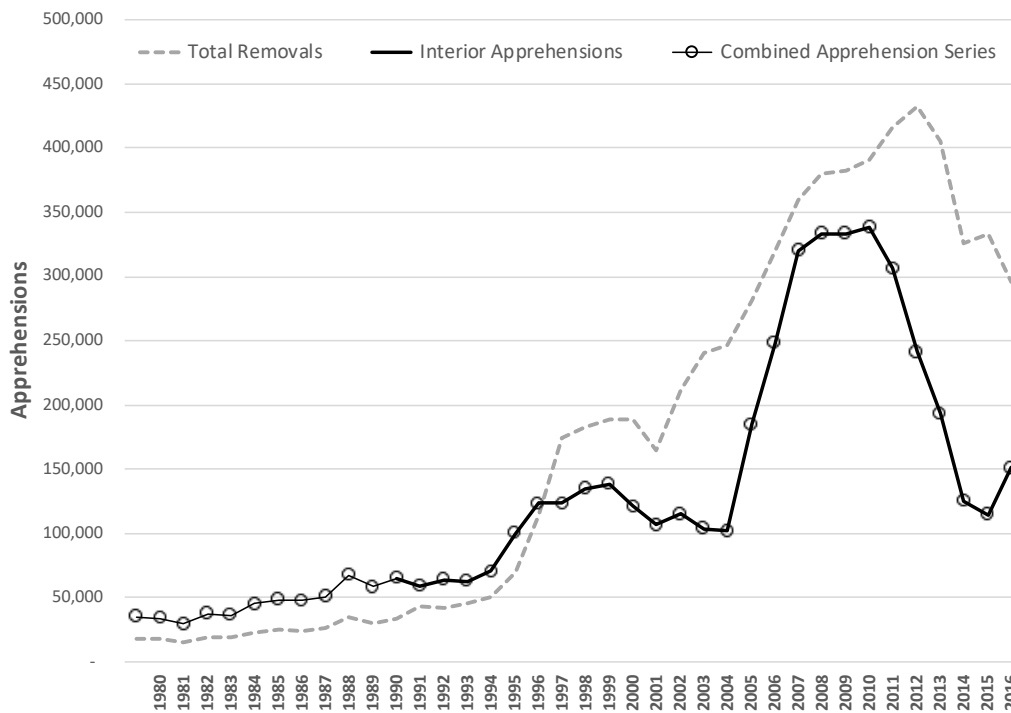
We measure the intensity of interior immigration enforcement as the interior apprehension rate, which we calculate as the yearly number of interior apprehensions divided by the estimated unauthorized immigrant population.

The bold black line in Figure B3 shows a measure of interior immigrant apprehensions covering 1991 to 2017, compiled from Yearbooks of Immigration Statistics, published by the Department of Homeland Security’s Office of Immigration Statistics. Interior immigration enforcement responsibility moved from the Immigration and Naturalization Service (INS) to Immigration and Customs Enforcement (ICE) in 2003 with the creation of the Department of Homeland Security. The data therefore aggregate the number of apprehensions falling under relevant INS and ICE programs in each year (see the note for Figure B3 for details). Because this series only extends back to 1991, we additionally plot total yearly removals reported in the 2017 Yearbook of Immigration Statistics, shown with the gray dashed line. These data cover formal removals both in the interior and at the border, but they nonetheless provide a measure of enforcement intensity in years prior to 1991. In order to construct a consistent series for interior apprehensions throughout our sample period, we proportionally rescale the Total Removals series to coincide with the Interior Apprehensions series in 1991 and use this rescaled measure as a proxy for interior apprehensions for years prior to 1991. The resulting series is shown in Figure B3 with hollow circles and a thin black line. This series forms the numerator of our interior apprehension rate measure.

Figure 1 shows two alternative measures of the unauthorized immigrant population of the U.S. We show estimates of the unauthorized population from the Pew Research Center and from official estimates produced by the Immigration and Naturalization Service and the Department of Homeland Security. In both cases, the unauthorized population is estimated using a “residual methodology” in which researchers use estimates of the total foreign-born population of the U.S. and subtract the population of authorized immigrants as measured in administrative data. The total foreign-born population is measured using either the American Community Survey (ACS) or the March Supplement to the Current Population Survey (CPS), with appropriate adjustments for potential undercount of unauthorized immigrants. The population of authorized immigrants comes from administrative data published by the Department of Homeland Security’s Office of Immigration Statistics. In spite of slight differences in the samples and various measurement choices, the two data sources provide remarkably similar estimates for the unauthorized population in each year. We therefore focus on the Pew data, since they span our entire sample period. We fill in the missing years by linearly interpolating values based on the adjacent years.

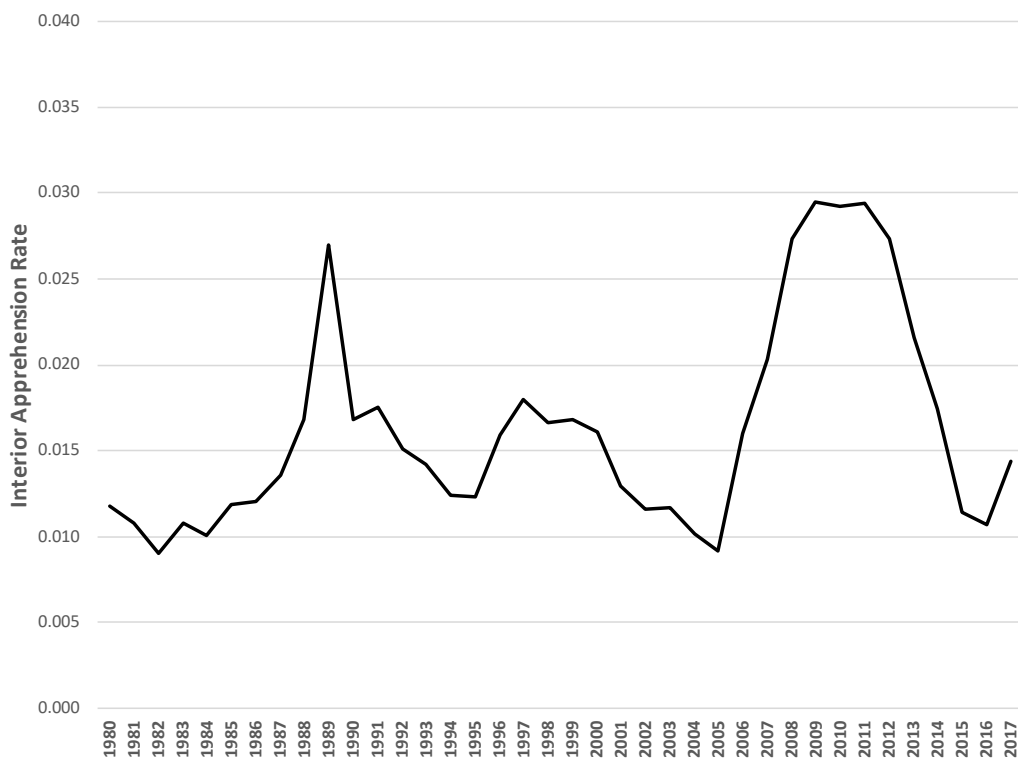
Finally, we combine the interpolated series on the unauthorized immigrant population with the combined apprehension series in Figure B3 to calculate the interior apprehension rate for unauthorized immigrants in each year. The resulting series, appearing in Figure B4, is used to measure the yearly probability of deportation for unauthorized immigrants living in the U.S., as discussed in Section 5.1.

Figure B3: Interior Apprehension Measures



Sources: Interior Apprehensions are measured as follows. For 1991-2005 they reflect apprehensions by the INS Office of Investigations or ICE Homeland Security Investigations. For 2006-2007 they reflect apprehensions by ICE Homeland Security Investigations, Detention and Removal Operations, and the Criminal Alien Program. For 2008-2017 they reflect apprehensions ICE Homeland Security Investigations and Enforcement and Removal Operations. These measures come from various Yearbooks of Immigration Statistics, available at <https://www.dhs.gov/immigration-statistics/yearbook> and the ICE Fiscal Year 2008 Annual Report, available at <https://www.hsd1.org/?abstract&did=35723>. Total Removals reports departures based on a formal order of removal, using data from the 2017 Yearbook of Immigration Statistics. Although these data cover formal removals in the interior and at the border, they provide information on enforcement intensity in years prior to 1991.

Figure B4: Interior Apprehension Rate



Source: Combined apprehension series from Figure B3 as a share of unauthorized population from the Pew Research Center series in Figure 1, including linearly interpolated values in missing years.