Fenced Out: The Impact of Border Construction on U.S.-Mexico Migration

By Benjamin Feigenberg*

This paper estimates the impact of the U.S.-Mexico border fence on U.S.-Mexico migration by exploiting variation in the timing and location of U.S. government investment in fence construction. Using Mexican survey data and data I collected on fence construction, I find that construction in a municipality reduces migration by 27% for municipality residents and 15% for residents of adjacent municipalities. In addition, construction reduces migration by up to 35% from non-border municipalities. I also find that construction induces migrants to substitute towards alternative crossing locations, disproportionately deters low-skilled migrants, and reduces the number of undocumented Mexicans in the United States.

In the last two decades, the total number of global migrants has increased by approximately 43%, to 221 million (UN Population Division, 2013). In response to this rise in aggregate migration, the world's destination countries have paid increasing attention to border security and the regulation of migratory inflows. In the United States, tough talk on curbing illegal immigration has become commonplace and has been accompanied by an almost ten-fold increase in Border Patrol spending over the past two decades, to $3.6 billion in Fiscal Year 2014 (U.S. Customs and Border Protection, 2015). U.S. efforts to deter illegal immigration have focused almost entirely on increasing the associated costs by increasing policing at the border. Despite this focus, we know surprisingly little about the cost effectiveness of increased border enforcement, and we know even less about the mechanisms and subpopulations driving any changes in migration patterns. Studying the effectiveness of border enforcement activities is particularly policy-relevant at present. In past years, proposed immigration legislation has dictated that the U.S.-Mexico border be classified as "secured" before undocumented immigrants already in the United States are allowed to apply for permanent residence (Preston, 2013). More recently, President Trump signed an executive order mandating the immediate construction of a supplementary border wall (Davis, 2017).

Research on the impact of changing migration costs has been limited by the difficulty of identifying exogenous shocks to costs. In the context of border enforcement, macroeconomic factors typically co-determine both the allocation of

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governmental resources and the labor market opportunities available to prospective migrants. While government representatives tasked with securing the U.S. border frequently attribute reductions in the number of apprehended migrants to the improved efficacy of border enforcement activities (Napolitano, 2011), we generally cannot rule out the possibility that cited reductions in cross-border migration are, for instance, driven by business cycle fluctuations that have little to do with border enforcement resource allocation.

In this paper, I use novel datasets to accurately estimate the effect of changing costs on migration from Mexico to the United States and on the stock of Mexicans living in the U.S. In addition, I estimate how the impact of changing costs varies based on migrants' access to alternative crossing locations, as well as their demographic characteristics. To conduct this analysis, I exploit plausibly exogenous variation in the geographic distribution and timing of Department of Homeland Security (DHS) and Customs and Border Protection (CBP) tactical infrastructure investment. In particular, I study the 2006 Secure Fence Act, which authorized the construction of 698 miles of double-layered pedestrian fence along the United States-Mexico border. Documentation related to border fence construction reveals that the process of land acquisition, environmental evaluation, and construction design and contracting that preceded each construction project generated variation in the timing of construction across border municipalities. Empirically, I find no evidence of municipality-level trends in migration rates that can predict when a particular municipality was fenced (or whether it was fenced at all).

Based on this identification strategy, I find that, for residents of a given border municipality, fence construction in that municipality reduces the migration rate to the United States by 27%. Construction in an adjacent border municipality reduces migration rates by an additional 15% (relative to a baseline rate of 4.2 migration episodes per 1,000 residents per quarter). Using migration data on households in the interior of Mexico, I show that fence construction reduces the likelihood that migrants cross through the fenced municipality. This construction also increases the probability that migrants cross through adjacent municipalities in addition to other municipalities through which residents of their home state were historically most likely to cross. Next, exploiting geographic heterogeneity in the pre-period migration routes taken by households living away from the border, I conclude that fence construction reduces migration rates for prospective migrants from non-border municipalities by 35%.

The deterrent effect of the fence is especially large for those who migrate from areas in which a high share of past migrants cited ease of crossing as the reason they chose a particular crossing location. These individuals presumably face particularly large cost increases if forced to use alternative crossing routes. Taken together, my findings are inconsistent with a model in which border crossing costs are simply a function of distance to the nearest unfenced crossing location. While estimates of the effect of the fence on Mexican return migration are imprecise, I employ complementary data sources to show that fence construction significantly decreases the size of the likely undocumented, Mexican-born population on the U.S. side of the border and in the U.S. interior.

I next analyze the dynamics of migration selection and find that fence construction mitigates negative baseline selection based on respondent earnings and educational attainment. A simple migration selection model shows that these findings can be rationalized by a disproportionate increase in crossing costs among low-skilled potential migrants. I use the high elasticity of migration with respect to fence construction ($\beta = -0.32$) along with observed changes in the risk of death associated with crossing to argue that the crossing cost increases induced by fence construction are significant.

Estimating the elasticity of migration with respect to associated costs builds on an extensive literature, dating back to Sjaastad (1962), that documents the forces driving migration and has placed great importance on understanding so-called Push-Pull factors (Borjas, 1989). While there is a large body of theoretical work related to heterogeneous and changing migration costs (e.g., Rosenzweig, 2007), most empirical studies have relied on cross-sectional correlations between network characteristics (that proxy for migration costs) and migration rates.[1] Previous work that relies on time-varying migration costs is limited and data issues have generally prevented the accurate estimation of migration impacts. For instance, Hanson and Spilimbergo (1999) finds that potentially exogenous increases in hours spent by U.S. Border Patrol agents patrolling the border increase apprehensions. However, a rise in apprehensions may mask a fall in migration rates given that a single individual may be apprehended multiple times during the same migratory episode, and given that the likelihood of being apprehended is presumably increasing in enforcement. Consequently, the authors cannot interpret their findings in relation to migration flows. Angelucci (2012) uses household survey data to identify a negative impact of agent "linewatch" hours on both migration from Mexico to the United States and return migration to Mexico, but relies on a sample of high-migration communities.[2] [3] In a closely-related recent paper, Allen, Dobbin and Morten (2019) estimates a general equilibrium spatial model to quantify the economic impact associated with border fence construction between 2007 and 2010. To do so, the authors exploit changes in the shortest (unfenced) overland path between each Mexican municipality and U.S. PUMA (Public Use Microdata Area) to identify the effect of fence construction on migration costs. Based on this approach, the authors identify a negative but more modest change in Mexican migration to the U.S. in response to fence construc-

[1]See, for instance, McKenzie and Rapoport (2010), which examines how the characteristics of migrants vary as a function of cross-sectional variation in the strength of community-level migration networks.

[2]Angelucci (2012) does employ a choice-based sampling method to address sample selection concerns.

[3]Relatedly, Gathmann (2008) employs a similar identification strategy and finds that increased linewatch hours are associated with only a moderate rise in smuggler prices, no change in demand for smugglers, and a shift in migration towards more remote areas.

tion.[4]

More broadly, this work contributes to a small existing literature that examines potentially important non-wage determinants of migration flows. Research in this area includes Ortega and Peri (2013), which estimates the elasticity of migration with respect to the tightening of visa laws, Belot and Ederveen (2012), which emphasizes the importance of cultural barriers in explaining migration flows between OECD countries, Adserà and Pytliková (2015), which highlights the importance of linguistic proximity in explaining migration to OECD countries, and Mayda (2010), which identifies various correlates of bilateral immigration flows, including geographic distance. Much of this literature is descriptive rather than causal, and there has been limited research on how the relevance of non-wage factors varies over time and across settings.

Borjas (1987) provides the theoretical foundation for the cross-sectional migration selection literature in his application of the classic Roy model (1951) to the expected earnings maximization problem faced by prospective migrants. A number of papers have subsequently tested for migration selection using data on Mexico-U.S. migration patterns.[5] However, the only papers to address dynamic migration selection are Angelucci (2012), in which the author compares migration selection in the 1970s to selection in the 1990s when border control was more intensive, and Orrenius and Zavodny (2005), in which the authors find that worsened economic conditions in Mexico and increased border enforcement are associated with higher migrant education levels. The latter paper uses the same sample of high-migration communities as the former one.

My contributions to these existing literatures are two-fold. First, I provide novel, policy-relevant evidence on the net impact of border fence construction on cross-border migration flows based on Mexican and U.S. survey and administrative data. The municipality-level variation that I exploit allows me to examine impacts away from the border and cross-municipality spillovers in order to shed light on the nature of border crossing costs. Second, by using the Mexican ENE/ENOE, a quarterly household survey conducted throughout Mexico, in combination with U.S.-based data sources, my analysis mitigates sample selection concerns. Moreover, the rotating panel structure of the ENE/ENOE data allows me to characterize migration selection dynamics.

The remainder of the paper is presented as follows. Section I documents the history and anticipated efficacy of border enforcement along the U.S.-Mexico bor-

[4]The authors' analysis relies primarily on a confidential version of the public use Mexican Matrícula data that I employ in supplemental analyses. Their contrasting findings may be explained by the inclusion of vehicular barriers in their benchmark analyses (through which pedestrians can cross), by differences in the level of disaggregation used to characterize the timing and location of fence construction, and by the authors' use of a travel distance-based exposure measure that differs from the historical crossing location-based variation that I exploit.

[5]Findings range from neutral-negative selection (e.g., Moraga, 2011; Martinez and Woodruff, 2007; Ibarraran and Lubotsky, 2007) to positive selection (e.g., Chiquiar and Hanson, 2005) with differences driven primarily by the datasets used for estimation. More recently, Kaestner and Malamud (2014) finds neutral selection along alternative margins, such as cognitive ability and health.

der. Section II discusses the data used for my analysis. Section III estimates the impact of fence construction on migration flows between Mexico and the U.S. and examines the spatial structure of estimated impacts. Section IV outlines a simple model of migration behavior and uses dynamic migration selection estimates to characterize heterogeneity in changing migration costs. Section V provides a cost-benefit analysis and Section VI offers concluding remarks.

I. U.S.-Mexico Border Control Policy

This section first provides a brief history of U.S. border control policy, including a summary of relevant legislation and previous fence construction efforts. I then preview the anticipated impacts of the Secure Fence Act, which authorized the large-scale wave of fence construction that provides my identifying variation.

A. Historical Border Control Policy

The United States-Mexico border is the most frequently crossed international border in the world and has a total length of 1,920 miles (3,090 km). There are four U.S. states adjacent to the border (California, Arizona, New Mexico, and Texas) and six Mexican states (Baja California, Sonora, Chihuahua, Coahuila, Nuevo León, and Tamaulipas), including 38 adjacent Mexican municipalities.

Efforts to restrict migration from Mexico to the U.S. are a fairly recent phenomenon. Between 1942 and 1964, over four million Mexicans immigrated to the U.S. as contract laborers through the Bracero Program. Although the Immigration and Nationality Act of 1965 officially restricted the number of Mexicans that could migrate to the U.S., it was not until 1986 that the federal government put in place legislation aimed at curbing undocumented immigration. The 1986 Immigration Reform and Control Act (IRCA) made knowingly hiring undocumented immigrants illegal for the first time and authorized a significant expansion of Border Patrol activities. This 1986 legislation was followed by Border Patrol campaigns in the early 1990s in the San Diego and El Paso Sectors that increased the number of agents on the border and also authorized construction of border fencing for the first time (Hanson and Spilimbergo, 1999; Nuñez-Neto and Viña, 2006). In 1996, the Illegal Immigration Reform and Immigrant Responsibility Act (IIRIRA) authorized the Attorney General to construct fencing along the border and mandated additional construction in the San Diego Sector, but only nine of the mandated fourteen miles of secondary fence were completed and construction outside of the San Diego Sector remained limited (Nuñez-Neto, B. and S. Viña, 2006).

The REAL ID Act of 2005 paved the way for future fence construction by authorizing the Secretary of DHS to waive any laws that impeded construction of security fences and barriers along the border. In November of 2005, DHS launched the Secure Border Initiative, which called for the construction of border fencing as well as complementary roads and lighting.[6]

The Border Protection, Antiterrorism, and Illegal Immigration Control Act, which first identified the specific locations where border fence construction was to occur, subsequently passed in the House of Representatives in December of 2005, but the bill did not garner sufficient votes to pass in the Senate (Border Protection Act of 2005). However, the Secure Fence Act, which maintained identical language regarding the location of planned fence construction, passed in both the House of Representatives and the Senate in 2006 and was signed into law by President George W. Bush on October 26, 2006.

B. *Anticipated Impacts of the Secure Fence Act*

The Secure Fence Act called for the construction of 698 miles of double-layered (pedestrian) fence along designated segments of the U.S.-Mexico border.[7] The Act initially specified that a 370-mile segment of fence from Calexico, California to Douglas, Arizona be completed by May 30, 2008 (along with a 30-mile segment adjacent to Laredo, Texas). However, the Consolidated Appropriations Act, enacted on December 26, 2007, significantly increased the Secretary's discretion in determining where to install fencing. This legislation required only that a minimum of 700 miles of fencing be constructed where it would be "most practical and effective," and that the Secretary identify either 370 miles or "other mileage" which would be completed by December 31, 2008.

It seems likely that relaxed restrictions on the location of fencing can be at least partly explained by concerns that DHS would not meet the timeline set out in the original Secure Fence Act legislation. By September 2007, the GAO reported that only 71 miles of pedestrian fence, along with 2 miles of vehicle barriers, had been constructed since late 2005. However, significant fence construction did occur over the following year, and there were a total of 140 pedestrian fence miles and 75 vehicle barrier miles in place by October 2008 (Stana, Quinlan and Espinola, 2009). As of April 2010, 262 miles of pedestrian fence and 227 miles of vehicle barriers had been constructed (Stana, 2010).[8] Declassified government documents indicate that final fence construction locations had been chosen based as much on expediency and cost as on security concerns. In one conversation, for instance, Border Patrol agents reported that "They [Army engineers] were looking at placing fencing in areas that would not be our operational priority"

[6] A second component of the Secure Border Initiative, SBInet, involved the development and installation of "new integrated technology solutions to provide enhanced detection, tracking, response, and situational awareness capabilities" at the border (Stana, 2010). In practice, however, SBInet faced repeated delays and the program was ultimately cancelled in 2011 (Stana, 2010, Gambler, 2015).

[7] Technically, the Secure Fence Act called for "at least 2 layers of reinforced fencing" (Secure Fence Act of 2006). While this language has subsequently been revised, and there has been some debate regarding what exactly is required based on the legislation, DHS documentation makes clear that the original interpretation was that all 698 miles would be pedestrian fence (CBP, 2007).

[8] While 78 miles of fencing were already in place by late 2005, some subset of these miles were subsequently replaced and counted as Secure Fence Act miles (Stana, Quinlan and Espinola, 2009).

and that Army engineers had stated "We need to throw up fence in the areas that are most advantageous to meeting the timeline" (DHS, 2007).

The fence was intended to increase the time until illegal entrants could blend into the US communities closest to fenced crossings (DHS, 2008). Even in cases in which border crossers were able to climb over the fence, CBP officials report that the fence "slowed them ...They got over it but we caught them. It served its purpose and did exactly what we planned it to do" (Janes, 2009). Fence construction was covered extensively in the Mexican press, and it seems likely that potential migrants were consequently aware of the increased difficulties they would face crossing the border. The available evidence suggests that migrants crossing the U.S.-Mexico border had little choice but to climb the fence or travel to an unfenced crossing location after border fence was constructed.[9]

II. Data

This section summarizes the procedure employed to construct a comprehensive record of the dates and locations of fence construction that took place. I then introduce the various data sources used to analyze Mexican out-migration, border crossing location choice, and changes in the stock of potentially undocumented Mexicans residing in the U.S.

A. Fence Construction

This project required that I collect my own data on the precise timing of fence construction along the U.S.-Mexico border, given that such data are not made publicly-available by the government.[10] To do so, I relied on the following two-step procedure. First, I identified potential fence locations by reviewing GAO and CBP documents related to border fence construction and by speaking with representatives from the Sierra Club (an environmental organization charting fence construction in order to understand environmental impacts) to identify likely fence locations.[11] After identifying a set of potential fence locations, I searched

[9]While drug traffickers have employed alternative technologies to circumvent newly-constructed border fencing, including tunneling and using lightweight aircraft, evidence suggests that these technologies were rarely used to smuggle migrants (Gambler, 2017).

[10]One particularly comprehensive source, Castaneda and Quester (2017), provides the year in which each fence segment was completed. Allen, Dobbin and Morten (2019) uses these data, along with a 2013 engineering report (Michael Baker Jr., Inc., 2013), to identify construction completed between 2007 and 2010. While I have also used these data sources to validate my own measure of fence construction, my use of quarterly data and focus on the quarters in which fence construction began required the use of additional data sources as well.

[11]CBP documents were made available thanks to a successful lawsuit brought by Citizens for Responsibility and Ethics in Washington to challenge DHS' failure to release border fence documentation in response to a Freedom of Information Act (FOIA) request. Restricted access by DHS and CBP has been justified on the basis of national security concerns- a 2008 newspaper article quotes a CBP official, who states that "all data regarding the placement of the fence is classified because you don't want to tell the very people you're trying to keep from coming across the methodology used to deter them" (del Bosque, 2008).

for news articles, legal documents, local government reports, and published contracts with the responsible construction firms in order to identify (1) whether a fence was indeed constructed, (2) the construction start date, and (3) the length of fence constructed.[12] As an example, Appendix Figure 1 illustrates the progress of fence construction in the Mexican border state of Sonora.

B. Mexican Survey Data

Data on Mexican migration rates covers the period from the third quarter of the year 2003 through the third quarter of 2013 and comes from the Mexican Encuesta Nacional de Ocupación y Empleo (ENOE) and its precursor, the Mexican Encuesta Nacional de Empleo (ENE).[13] The ENE/ENOE is a quarterly survey that is representative at the state level. The survey is a rotating panel that includes selected households for five consecutive quarters before they are rotated out of the panel. In the first quarter that a household enters the panel, the surveyor records all current household members. In subsequent quarters, the surveyor records whether any household members left or returned to the household, and the Mexican state or country for which they left or from which they returned (i.e., the United States).[14]

In the empirical analysis, I restrict the sample of potential migrants to those aged 15 to 65, although results are robust to alternative age cutoffs. The data include age, gender, marital status, and education for all household members. In addition, all household members aged 12 and older are asked a series of questions about labor force participation and monthly earnings. While the ENE/ENOE has been used frequently in the past to analyze Mexican labor markets, its application to migration research has been limited despite the unique advantages of its scale, breadth, and frequency.[15] One limitation of the ENE/ENOE data is that, as is the case for other Mexico-based migration surveys, it does not capture migration episodes undertaken by entire households. To assuage related concerns, I supplement the primary analysis with specifications that test for differential household-level attrition and find no significant changes in response to fence construction.[16]

[12] I have not made use of fence length data given concerns about the accuracy of the data. In particular, while I can identify the date on which construction began and generate a noisy measure of final fence segment length, it is very difficult to impute the quarter-wise length of fence constructed.

[13] These data were made available by the Mexican Instituto Nacional de Estadística y Geografía (INEGI, 2018).

[14] A small share of households are not uniquely identified based on the procedures outlined in survey manuals, in which case I use the year-quarter of survey to distinguish households. Based on this two-step procedure, less than 1% of respondents do not have an associated identifier. Results are robust to including or excluding this subsample.

[15] Research that has used ENE/ENOE data to study migration includes Moraga (2011), Rendall, Brownell and Kups (2010), Cadena and Kovak (2016), and a number of press releases produced by the Mexican Instituto Nacional de Estadística y Geografía (INEGI).

[16] Using EMIF data, Moraga (2011) finds that 8.6% of individuals crossing the border by land between 2000 and 2003 brought all household members with them and notes that the difference in educational attainment between those migrating with and without all family members is not statistically significant.

In my analysis, I also use data from the Encuesta sobre Migración en la Frontera Norte de México (EMIF).[17] The EMIF surveys individuals aged fifteen and older who arrive in one of up to eighteen border areas chosen as survey locations due to the high share of migrants traveling through these locations. Surveys are conducted with individuals who were not born in the U.S. and have recently arrived to the border region from another area in Mexico or from the U.S. The EMIF survey of return migrants provides detailed migration histories for each respondent that include the year of the most recent crossing undertaken by each respondent, the location of the crossing, the reason that particular crossing location was chosen, and the previous U.S. state of residence. I first employ EMIF data on those traveling from Mexico to the U.S. to examine planned crossing location choice. I then use the EMIF data for those returning from the U.S. to construct historical migration networks for residents of Mexican non-border municipalities (I then return to the ENE/ENOE data to estimate actual migration flows). I also use EMIF data to construct historical migration networks by last U.S. state of residence that are used in the subsequent analysis.[18]

C. ACS and Mexican Matrícula Data

To measure migratory impacts on the U.S. side of the border, I make use of American Community Survey (ACS) data.[19] Border region analyses examine heterogeneity by Public Use Microdata Area (PUMA), the most disaggregated geographical identifier available. To examine impacts away from the border, I rely on U.S. state of residence.

To characterize how the stock of likely undocumented Mexicans living in the U.S. responds to border fence construction, I make use of administrative Matrícula data provided by the Mexican government's Instituto para los Mexicanos en el Exterior (Institute for Mexicans Abroad). These data tabulate the number of identity cards issued annually to Mexican citizens living in the U.S. during the 2006-2012 period. Tabulations are available at the Mexican municipality-by-U.S. state level. Previous work has validated the quality and coverage of these data using external data sources and has concluded that it is reasonable to infer that all applicants are undocumented given that there are no benefits to receiving an ID card for those in the U.S. legally (Caballero, Cadena and Kovak, 2018, Massey, Rugh and Pren, 2010).

This finding provides additional evidence that the effect of unobserved whole-household migration on my own estimates of migration flows and migration selection is likely limited.

[17]These data were obtained from El Colegio de la Frontera Norte, which conducts the EMIF in partnership with a number of additional institutions (COLEF, 2018).

[18]I do not use the survey weights included in the EMIF. Documentation provided by the survey administrators indicates that the data are neither representative of the population migrating illegally to the U.S. nor the population migrating illegally by land.

[19]These data were obtained from the Integrated Public Use Microdata Series (IPUMS) (Ruggles et al., 2018).

D. Descriptive Statistics

Table 1 presents descriptive statistics based on the ENE/ENOE and EMIF data used in the analysis. Panel A summarizes differences by migration status in ENE/ENOE respondent characteristics for the border municipality sample and the sample of non-border residents. In both samples, migrants are younger, more likely to be male and less likely to be married. Migrants are more educated, less likely to be employed and have higher conditional earnings in the border sample, whereas these patterns are reversed in the non-border sample.

Panel B presents descriptive statistics from the EMIF for both those who last migrated in 2000 or before (the sample used to construct historical border crossing networks) and for those who last migrated after fence construction began. Since the EMIF sample is restricted to those who have returned from a migration episode and so is subject to selection concerns, parallel measures are presented from Mexican Migration Project (MMP) data.[20] In the EMIF, 39% of historical migrants were undocumented and 43% of those who were undocumented hired a smuggler. In the period after the start of fence construction, the undocumented share of migrants increased to 50% and three-quarters of undocumented migrants chose to hire a smuggler. Both the share of undocumented migrants and smuggler use are somewhat higher in the MMP. The average duration of migration is also higher in the MMP (71.6 months) than the EMIF (52.0 months). Previewing the finding that fence construction significantly impacted crossing location choice, the share of EMIF respondents who chose a crossing location based on distance fell by 50% between the pre- and post-fence construction periods, while the share who chose a crossing location based on ease of crossing correspondingly increased by a similar magnitude. Smuggler prices also rose after fence construction began, perhaps reflecting the increased challenges associated with crossing the border.

III. Fence Construction and Migration Flows

The responsiveness of migration to changes in cost is the most important determinant of the efficacy of border control policies designed to make migration more difficult. I first look for impacts of border fence construction on residents of municipalities in Mexico that border the U.S. using ENE/ENOE data. I next use EMIF data to examine how border crossing location choice responds to fence construction, and I leverage my findings to estimate impacts on migrant stocks and flows away from the border in both Mexico and the U.S. Lastly, I study how the deterrent effect of the fence varies with the sociodemographic characteristics of prospective migrants. Across analyses, I include only those Mexican border municipalities which the Secure Fence Act designated to be fenced. In practice, this includes 28 of the 38 Mexican border municipalities, but the 10 excluded

[20] The MMP is a binationally representative sample for the subset of high-migration communities surveyed. Unfortunately, very few migration episodes are recorded after the start of fence construction in 2006 and so only a single set of descriptive statistics from the MMP is constructed (MMP, 2018).

municipalities are significantly more rural and less densely-populated than their counterparts in which fence construction was proposed.[21]

A. Migration from Mexican Border Communities

My identification strategy relies on the assumption that, absent border fence construction, residents of fenced and unfenced municipalities would have exhibited parallel trends in migratory behavior. To provide evidence that differential out-migration in fenced municipalities is not driven by pre-trends, I estimate the following equation:

$$(1) \quad \begin{aligned} P(Y_{mqi} = 1 | z_{mqi}) &= \wedge(\alpha + \sum_{t=-4}^{4} \beta_t * fence_{mqit} + X_{mqi} + \gamma_m + \lambda_q) \\ &= \frac{exp(\alpha + \sum_{t=-4}^{4} \beta_t * fence_{mqit} + X_{mqi} + \gamma_m + \lambda_q)}{1 + exp(\alpha + \sum_{t=-4}^{4} \beta_t * fence_{mqit} + X_{mqi} + \gamma_m + \lambda_q)} \end{aligned}$$

where Y_{mqi} is an indicator variable equal to '1' when individual **i** living in municipality **m** migrates to the U.S. in year-quarter **q**, $fence_{mqit}$ is an indicator variable defined by whether border fence construction has begun in municipality **m** by **t** years after year-quarter **q** (or |**t**| years before for negative-valued **t**), and X_{mqi} represent age fixed effects, years of schooling fixed effects, and controls for marital status and gender.[22] Since migration is defined only for individuals who were present in the previous year-quarter, I exclude the first observation for each household member. For a household member who has migrated, I code all subsequent observations as missing.[23] γ_m and λ_q represent municipality and year-quarter fixed effects, respectively, and standard errors are clustered at the municipality level.[24] The base specification employs a logit model which is appropriate due to the binary outcome measure and the fact that we expect the impact of fence construction to be proportional to pre-fence migration flows.[25] Panel A of Figure 1 plots estimated regression coefficients in log-odds units. The omitted year is $\mathbf{t} = -1$ (relative to the start of construction, defined by $\mathbf{t} = 0$). None of

[21] The ENE/ENOE has data for 23 of the 28 municipalities for the relevant years. The five municipalities without data available have significantly lower populations. Border fence construction took place in twelve of the 23 surveyed municipalities during the study period.

[22] In this and in subsequent equations, $\wedge(\cdot)$ is a placeholder for the sigmoid function such that $\wedge(x) = \frac{exp(x)}{1+exp(x)}$.

[23] Although it is ex-ante unclear whether the fence construction start or completion date is the point at which we expect to observe impacts on migration flows, CBP documents indicate that the probability that illegal border crossers will be detected rises once construction begins (DHS, 2010).

[24] z_{mqi} is a placeholder for the full set of control variables included in the logit specification and assigned to individual **i** in municipality **m** in year-quarter **q**.

[25] If the impact was a level effect as implied by an OLS specification, we should expect municipalities with high pre-fence migration rates to experience the same absolute change in migration rates as a result of fence construction as those with low pre-fence rates. This seems unlikely in practice.

the years before the start of fence construction exhibit coefficients significantly different from zero, and there is no visual evidence of pre-trends in migration patterns. As a robustness check, Panel B of Figure 1 plots the regression coefficients from a linear probability specification.[26]

Evidence from Figure 1 provides support for the parallel trends assumption and so suggests that the causal impact of border fence construction on migration from Mexican border municipalities to the U.S. can be estimated based on the following specification:

$$P(Y_{mqi} = 1|z_{mqi}) = \wedge(z_{mqi}) = \wedge(\alpha + \beta_1 * fence_{mqi} + \beta_2 X_{mqi} + \gamma_m + \lambda_q) \tag{2}$$

where $fence_{mqi}$ is an indicator variable defined to equal 1 if fence construction began in municipality **m** in or before year-quarter **q**, and the remaining terms (as well as the included covariates) are as defined in Equation (1). Across specifications, $fence_{mqi}$ remains equal to 1 for all subsequent periods after construction has begun in municipality **m**.[27]

To investigate the mechanisms driving any impact of fence construction on migration from Mexico to the U.S., I also test whether there are geographic spillovers in fence impacts (e.g., whether fence construction in one border municipality impacts migration by residents residing in adjacent municipalities). The nature of cross-municipality spillovers can shed light on the relative importance of fence construction in a prospective migrant's home municipality, and also reflects how (if at all) the costs faced by prospective migrants vary with the set of nearby municipalities that are fenced. The specification employed here mirrors Equation (2) but adds the following regressors: $fence_{nqi}$, a count variable that measures the number of municipalities adjacent to municipality **m** in which fence construction has begun by year-quarter **q**; $fence_{oqi}$, a count variable that measures the number of municipalities two away from municipality **m** in which fence construction has begun by year-quarter **q** and so examines how spillovers diminish with distance from a respondent's home municipality; and $fence_{mqi} * fence_{nqi}$, an interaction term characterizing how the deterrent effect of construction in adjacent municipalities varies with home municipality construction. All specifications include any fence construction that began after the introduction of the Border Protection, Antiterrorism, and Illegal Immigration Control Act of 2005, which identified those areas that were designated for fencing. In practice, this includes a small number of fence segments constructed in 2006 as part of Operation Jump Start, a mission launched by President Bush in May of 2006 that called for National Guard members to assist with border surveillance and to aid in fence construction.

Table 2 first estimates Equation (2) to calculate the impact of fence construc-

[26]Similarly, there is no evidence of differential pre-trends for alternative outcomes, including return migration and average earnings (results available upon request).

[27]The ENE/ENOE provides data on municipality of residence but not crossing location, so all related analysis is based on construction status vis-a-vis the municipality of residence of respondent i.

tion on migration from Mexican border communities to the U.S.[28] The estimated log-odds coefficient on $fence_{mqi}$ in Column (1) of Panel A suggests that fence construction has a negative impact on migration (the associated p-value is 0.014). Given binary dependent and explanatory variables, e^{β} reflects the estimated percent change in the dependent variable resulting from the explanatory variable moving from 0 to 1. Hence, for this specification (with $\beta = -0.319$), the fence is estimated to reduce migration by 27% relative to a baseline level of 4.2 migration episodes per 1,000 respondents.[29] Column (2) add controls for employment status at the time of initial observation, as well as the lagged municipality-level average outmigration rate and employment-to-population ratio. Column (3) introduces state-by-year-quarter fixed effects on top of the expanded set of controls. Estimates in Columns (2)-(3) of Panel A are roughly 45% larger than those in Column (1). Specifications with state-by-year-quarter fixed effects are not sensitive to the inclusion of the Column (2) controls, suggesting that the associated increase in point estimates is likely driven by state-specific labor market and migratory trends.[30]

The 0.27 elasticity of migration with respect to fence construction estimated in Table 2 is large in magnitude. This finding is likely explained by the increase in the risk of apprehension for those who would attempt to climb over new fencing, as well as by the increase in mortality (and perhaps apprehension) risk faced by migrants who choose to go around the fence and cross in remote, topographically inhospitable border segments where border fencing was more likely to be delayed. The estimated deterrent effect is, however, broadly consistent with the existing literature. Hanson and Spilimbergo (1999) finds that the elasticity of apprehensions with respect to CBP agent line watch hours is close to one, and Angelucci (2012) estimates the effect of agent line watch hours on illegal migration likelihood and finds an elasticity of -0.41 that she notes is consistent with the Hanson and Spilimbergo (1999) estimate. As discussed in more detail in Section V, my estimates imply that the cost per migrant deterred by fence construction is roughly equivalent to the cost per migrant deterred by increased agent line watch hours. While CBP investments are oftentimes politically-dictated and need not be efficient in equilibrium, the fact that both technologies are employed interchangeably is consistent with this finding (which is in turn derived from the estimated deterrent effects of the two technologies).[31]

[28]Since the ENE/ENOE is representative at the state but not at the municipality level, I include survey weights in subsequent non-border regressions but omit weights in border municipality regressions.

[29]Implicitly, this specification relies on the assumption that border municipality residents are more likely to cross in their home municipalities. EMIF data provide support for this assumption in spite of small border municipality sample sizes.

[30]Specifications with Additional Controls, such as Column (2), restrict the sample to those observations included in subsequent regressions that add state-by-year-quarter fixed effects to facilitate comparison (and so drop the 4% of observations corresponding to state∗year-quarter cells in which there is no observed migration).

[31]It is also notable that previous work has found that undocumented immigration flows are more sensitive to changing economic conditions than legal migration flows (Hanson, 2007). This, in turn, implies that baseline migration costs may be smaller for illegal than for legal immigrants.

Estimates of geographic spillovers in fence construction impacts are presented in the remainder of Table 2. Panel B indicates that construction in adjacent municipalities has a negative and statistically significant impact on migration (significant at 10% in Column (1) of Panel B, at 5% in Column (2) and at 1% in Column (3)); the coefficient on municipalities two away is inconsistent in sign, not statistically significant, and is notably smaller in magnitude. Panel C includes the interaction term $fence_{mqi} * fence_{nqi}$. Here, the coefficient on the interaction between construction in own and in adjacent municipalities is not statistically significant and is generally small in magnitude. The estimates in Columns (1)-(3) of Panel C represent a rejection of a model in which crossing costs (independent of fence construction) in a particular municipality are time invariant and migrants simply cross in the nearest unfenced municipality. Indeed, since it is never the case that an entire municipality border is fenced during the study period, the deterrent effect associated with fence construction in adjacent municipalities implies directly that migration costs are not simply a function of distance to nearest unfenced crossing location.[32]

Given evidence that apprehensions rise and migration declines in response to increased CBP staffing (Hanson and Spilimbergo, 1999, Angelucci, 2012), Panel A of Appendix Table 1 re-estimates Equation (2), while including a control for the log number of U.S. Border Patrol agents assigned to the adjacent Border Patrol sector. Estimates suggest that the deterrent effect of the fence is not mediated by changes in Border Patrol personnel assignments.[33] Panel B presents linear probability model estimates. The benchmark (Column (1)) specification indicates that fence construction reduces the migration rate by 0.114 percentage points (consistent with a 27% fall in migration).[34] Panel C presents Cox proportional hazards model estimates of the impact of the fence on outmigration. Estimates imply that fence construction reduces the migration hazard rate by 27-35%, consistent with the findings presented in Table 2. In sum, Appendix Table 1 estimates remain large in magnitude and statistically significant across specifications. To address the concern that the spillover effects estimated in Table 2 cannot be interpreted as proposed due to correlated construction timing across

[32]The evidence here is consistent with alternative models of border crossing costs. For instance, results could be explained by prospective migrants having private and heterogeneous information about potential crossing locations, or by individuals having knowledge of multiple potential crossing locations in the presence of unobservable time-varying costs associated with each one. The smaller deterrent effect associated with construction in adjacent municipalities relative to construction in a respondent's home municipality is consistent with border municipality residents being most likely to cross in their home municipality.

[33]Border Patrol personnel levels are available annually and there are a total of nine Border Patrol sectors that divide the U.S.-Mexico border. In additional specifications, I find that the estimated impact of fence construction on the log number of U.S. Border Patrol agents assigned to the adjacent Border Patrol sector is positive but small in magnitude and not statistically significant (the coefficient is 0.013). While endogenous agent assignment means that these estimates should be interpreted cautiously, they imply that the estimated magnitude of the deterrent effect of the fence is not significantly affected by the endogenous reassignment of agents (which would be expected to reduce migration by 1.0% based on point estimates).

[34]Given the relatively low number of clusters in my sample, the p-values associated with OLS estimates are constructed using the wild bootstrapping procedure outlined in Cameron, Gelbach and Miller (2008).

adjacent municipalities, Appendix Table 2 tests whether fence construction in a given municipality predicts the timing of construction in adjacent municipalities or whether construction ever occurs. Across specifications, point estimates are statistically insignificant and inconsistent in sign, implying that I cannot reject that construction is undertaken independently across municipalities.[35]

B. Non-Border Effects in Mexico: Border Crossing Location Choice (EMIF)

To explore how border fence construction impacts migration for non-border municipality residents, I employ EMIF data that identify the intended crossing location of surveyed individuals who have arrived to the Mexican border region and intend to cross to the U.S. illegally. I first estimate the following discrete choice specification to test whether fence construction reduces migration through a given municipality:

$$(3) \qquad P(M_{mqi} = 1 | z_{mqi}) = \wedge(z_{mqi}) = \wedge(\alpha + \beta * fence_{mqi} + \gamma_m + \lambda_q)$$

Here, the unit of observation is the respondent-by-border crossing municipality. M_{mqi} is an indicator for whether individual **i**, who is surveyed in year-quarter **q**, plans to migrate through municipality **m**, and the remaining variables are as defined in Equations (1) and (2). Standard errors are clustered by border crossing municipality.

Column (1) of Table 3 estimates Equation (3). The point estimate is consistent with a large (43%) reduction in crossings through fenced municipalities. In Column (3), I include independent variables characterizing the number of adjacent and two-away municipalities that have been fenced. Point estimates imply that fence construction reduces migration through a given municipality by 57%, while construction in adjacent municipalities further increases migration through a given municipality.

Since the contemporaneous EMIF sample is restricted to individuals who have already traveled to the border region with the intention of crossing into the U.S., Table 3 specifications cannot provide evidence on the deterrent effect of the fence. However, the finding that fence construction reduces crossings through a given municipality helps to explain the deterrent effect identified in Table 2. Among those who choose to cross in spite of fence construction, there is an increased likelihood of substitution towards geographically close (unfenced) crossing locations. Given this evidence that fence construction influences border crossing behavior for non-border residents, I next exploit variation across interior Mexican states in preferred crossing locations to investigate deterrent effects away from the border. Before doing so, however, I investigate whether geography is the primary deter-

[35] Although wide confidence intervals mean I cannot rule out sizable spatial correlations, correlated construction across adjacent municipalities will only bias estimates if there is heterogeneity in fence effectiveness and fence effectiveness is itself predictive of adjacent construction. It is not clear that we would expect this to be the case in practice.

minant of substitution across border crossing municipalities in response to fence construction.

To do so, for each respondent, I classify municipalities based on the share of migrants from the same Mexican state who crossed through that municipality in 2000 or before. I then ask how migrant crossing location choice responds when the municipality most commonly crossed by historical migrants from the same home state is fenced. Specifically, I construct an indicator, defined at the home state-by-municipality level and termed "Adjacent to Most Common Crossing," for whether a municipality is adjacent to the most common historic crossing location. In Column (5) of Table 3, I separately construct an indicator, defined at the home state-by-municipality level and termed "Second through Fourth Most Common Crossing," for whether a municipality is among the next three most common historical crossing locations. In Column (6), I instead employ a continuous measure of the share of historical migrants from the same home state who crossed through a given municipality ("Historical Crossing Share").

Since the aim of the exercise is to estimate the share of migrants substituting towards alternative crossing municipalities, I employ OLS specifications and include municipality-by-home state and year-quarter-by-home state fixed effects. I then compare the magnitude on the "Adjacent to Most Common Crossing*Most Common Crossing Fenced" interaction to the magnitude on the "Second through Fourth Most Common Crossing*Most Common Crossing Fenced" interaction term (in Column (5)) and to the "Historical Crossing Share*Most Common Crossing Fenced" interaction term (in Column (6)). In both models, estimates suggest that historical crossing frequency is a notably stronger determinant of substitution patterns than geographic proximity.

C. Effects of Fence Construction on Migration by Non-Border Residents (ENE/ENOE)

I next investigate whether border fence construction impacts migration for non-border municipality residents based on historical border crossing patterns. To do so, I employ the following specification:

$$P(Y_{sqi} = 1|z_{sqi}) = \wedge(z_{sqi}) = \wedge(\alpha + \beta * AvgFence_{sqi} + \gamma_s + \lambda_q) \tag{4}$$

$$AvgFence_{sqi} = \sum_{m=1}^{19} P_{sm} * fence_{mqi} \tag{5}$$

where γ_s are state fixed effects, λ_q are year-quarter fixed effects, P_{sm} is the share of migrants from 2000 or before surveyed in the EMIF who were born in state **s** and who crossed in municipality **m**, and the remaining variables are as defined in

Equations (1) and (2).[36] The municipalities **m** are the 19 border municipalities with crossings recorded in the EMIF (there are a total of 10,925 observations).[37] By relying on historical migration patterns to predict likely crossing locations, this approach ensures that the set of border municipalities assigned to non-border residents as potential crossing locations is not endogenously affected by fence construction patterns.

Column (1) of Table 4 estimates Equation (4). The point estimate implies that fence construction reduces out-migration from non-border municipalities by 35%. Since this coefficient reflects the change in migration associated with fence being constructed in all municipalities through which past migrants from a given state had crossed, it is unsurprising that point estimates are somewhat larger than those presented in Table 2 (Panel A of Table 2, in contrast, identifies the deterrent effect associated with fence construction in only the respondent's home municipality). Column (2) and the remaining even-numbered columns in Table 4 show robustness to the inclusion of additional controls. Column (3) of Table 4 makes use of EMIF data on crossing location choice by re-running Equation (4) with a term that interacts fence construction with the state-level fraction of historical migrants who chose their crossing location based on "ease of crossing." I find that the effect of the fence is driven by residents of states in which past migrants most frequently identify "ease of crossing" (rather than distance to crossing location, for instance) as the reason for their crossing location choice.[38] This finding is consistent with individuals who cite "ease of crossing" experiencing the largest increase in crossing costs in response to fence construction in a given location. In Column (5) of Table 4, I add a lead measure of weighted average fence construction to the Equation (4) specification. Positive and statistically insignificant lead term coefficients suggest that Table 4 estimates are not driven by differential pre-trends in outmigration.

One limitation of the ENE/ENOE data used to study how out-migration responds to fence construction is that these data do not capture instances in which whole households migrate in the same year-quarter. To mitigate sample selection concerns, in Appendix Table 3 I construct an artificial balanced panel at the household$*$year-quarter level such that each household appears for five survey rounds. If a household does not appear in all five survey rounds in the original data, I classify the household as exiting the sample in the first year-quarter after which the household last appears in the original data. I then use the artificial

[36]For border states, I exclude border municipalities when constructing historical migration networks. Four states are excluded because the data includes fewer than 25 migrants from each state.

[37]For this analysis, I include only data for those returning voluntarily from the U.S. by land. Data on crossing municipality for those intending to cross from Mexico to the U.S. is not available prior to 2003, and data on those returning by airplane is not available prior to 2009. Data on Mexicans deported by land is excluded since these respondents are significantly less likely to report living in their birth state, and so it is unlikely that their previous migration episodes actually started in their state of birth.

[38]I use crossings through 2005 to construct this state-level measure given that data on reason for crossing are not available for those surveyed prior to 2005, and so the number of individuals with non-missing responses is otherwise quite limited.

panel to re-estimate Equation (2) (in Panel A) and Equation (4) (in Panel B) at the household∗year-quarter level, replacing the dependent variable with an indicator for household exit. Small and statistically insignificant point estimates suggest that differential attrition is unlikely to significantly influence my findings.

D. *Net Effects on the Stock of Mexicans in the U.S.*

The effect of fence construction on return migration is theoretically ambiguous. While migrants already in the U.S. may respond to fence construction by forgoing planned trips back to Mexico between work episodes in the U.S., it could also be the case that migrants are made more likely to return if family members who had originally planned to join them in the U.S. prove unable to do so. Given the structure of the ENE/ENOE data, however, estimating the impact of the fence on in-migration is problematic since the potential set of migrants returning from the U.S. to surveyed households in Mexico is unknown.[39] Nonetheless, for completeness, Appendix Table 4 presents return migration estimates for border and non-border municipality residents based on alternative proxies for the non-resident population. Estimates are consistently positive, but the imprecision of associated estimates is unsurprising given the noisiness of the available proxy measures.[40]

As an alternative approach aimed at producing more precise estimates, I use ACS data to investigate changes in return migration patterns and to examine how fence construction impacts the share of the population that is potentially undocumented. The potentially undocumented population is defined as those aged 16-65 who were born in Mexico and have no post-secondary education.[41] The benchmark logit model employed is as follows:

$$P(Y_{pyi} = 1|z_{pyi}) = \wedge(z_{pyi}) = \wedge(\alpha + \beta * fence_{pyi} + \gamma_p + \lambda_y) \quad (6)$$

where Y_{pyi} is an indicator variable equal to '1' if individual **i** in PUMA **p** in year **y** is characterized as potentially undocumented. There are a total of 21 PUMAs adjacent to the border that are included in the sample. $fence_{pyi}$ is an indicator variable defined by whether border fence construction has begun in PUMA

[39]In particular, suppose that individual **i** is listed as living in her household in year-quarter **q**. Then, this individual cannot be listed as returning to Mexico in year-quarter **q+1**. For the out-migration case, the parallel is that an individual who is already in the U.S. in year-quarter **q** cannot migrate to the U.S. in year-quarter **q+1**. However, in the out-migration case, this individual would typically not be included in the ENE/ENOE dataset in either year-quarter **q** or year-quarter **q+1**, so the data structure does not lead to biased estimates of migration to the U.S. when specifications are estimated at the individual∗year-quarter level.

[40]Columns (1)-(2) estimate return migration rates based on the number of 2006 Matrícula applications from a given municipality/state, Columns (3)-(4) present Poisson quasi-maximum likelihood estimates of changing return migration counts, and Columns (5)-(6) estimate return migration at the household level.

[41]In supplementary specifications, self-reported citizenship status is also used to define potentially undocumented status.

p in or before year **y**, and γ_p and λ_y represent PUMA and year fixed effects, respectively. Standard errors are clustered at the PUMA level and the sample includes all respondents aged 16-65.[42] Column (1) of Panel A in Table 5 fails to reject that the share of potentially undocumented migrants in U.S. border PUMAs is unchanged by fence construction. Column (2) re-estimates Equation (6), but restricts the sample to include only those characterized as potentially undocumented and replaces the dependent variable with an indicator for whether the respondent is a recent migrant (arrived in the U.S. in the past year). Combining estimates of the change in the potentially undocumented population share with estimates of the change in migrants' time in the U.S. since arrival provides an alternative framework for identifying changes in migration to and from U.S. border PUMAs.[43] Results indicate that fence construction reduces the share of potentially undocumented migrants who arrived in the past year by 38%. This estimate, paired with the lack of a significant impact on the share of potentially undocumented migrants residing in U.S. border PUMAs, is consistent with fence construction increasing the likelihood that migrants postpone either temporary or permanent return migration to Mexico. Finally, Column (3) indicates that fence construction has a negative but statistically insignificant effect on employment levels among the potentially undocumented population.

Panel B of Table 5 employs a specification that parallels Equation (4) to investigate border fence impacts in the interior U.S. Specifically, I estimate the following model:

$$P(Y_{s_uyi} = 1|z_{s_uyi}) = \wedge(z_{s_uyi}) = \wedge(\alpha + \beta * AvgFence_{s_uyi} + \gamma_{s_u} + \lambda_y) \tag{7}$$

$$AvgFence_{s_uyi} = \sum_{m=1}^{19} P_{s_um} * fence_{myi} \tag{8}$$

where γ_{s_u} are U.S. state fixed effects, λ_y are year fixed effects, P_{s_um} is the share of migrants from 2005 or before who were surveyed upon returning from living in U.S. state s_u and who last crossed to the U.S. through municipality **m**, and $fence_{myi}$ characterizes the share of year **y** in which municipality **m** was fenced (based on the year-quarter in which fence construction began).[44] The municipalities **m** are the 19 border municipalities with crossings recorded in the EMIF. Estimates presented in Columns (1)-(6) of Panel B of Table 5 closely mirror Panel

[42] I restrict the sample to 2003-2011 to maintain consistent PUMA boundaries, although estimates are similar if I extend the sample period using (aggregated) consistent PUMA boundaries.

[43] Figure 2 shows no evidence of differential pre-trends for these outcomes, based on an estimation approach that parallels Equation (1).

[44] The sixteen states with fewer than 25 surveyed migrants are excluded. If I alternatively rely only on migrants returning in 2000 or before, estimates are similar in magnitude and more precise, but the sample of included U.S. states falls to 25.

A estimates. While there is no evidence of a significant change in the potentially undocumented population share, there is again a significant decline in the likelihood that potentially undocumented respondents were abroad one year before.

ACS measures of the likely undocumented Mexican population are noisily estimated due to the imperfect proxy employed for undocumented status, the availability of only a 1% population sample, and concerns about response rates among the undocumented population. Consequently, I turn to the Mexican Matrícula data to obtain more precise estimates of how the stock of likely undocumented Mexicans living in the U.S. responds to border fence construction. I first re-estimate Equation (4), but replace the dependent variable with the log number of Matrícula applications from a given Mexican state in a given year. Mexican migrants do not typically apply for Matrícula identification cards immediately after arrival. Indeed, a survey of applicants found that only 11% of applicants had arrived to the U.S. within the previous year (Suro, 2005). Given the uncertainty associated with application timing, I include a series of lag terms in Column (1) of Table 6. Estimates indicate that fence construction is associated with a delayed decline in Matrícula applications.

Given the challenges associated with interpreting estimated short-run Matrícula application responses to fence construction, Column (2) estimates longer-run changes in applications by regressing the change in Matrícula applications on aggregate exposure to fence construction. Here, the dependent variable is the normalized change in applications, defined as the 2007-2012 total number of applications divided by six times the 2006 number of applications (Matrícula data is only available starting in 2006), and the independent variable is the 2006-2012 sum of the year-specific Average Weighted Fence Construction values (as defined in Equation (4)).[45] Estimates imply that an additional year of fence construction exposure reduces applications by 9.6%-12.9% over this longer time horizon.

Columns (4)-(6) present estimates from parallel specifications that examine changes in applications by U.S. state of residence, based on Equation (7). Findings mirror those from Columns (1)-(3): fence construction induces a lagged decline in applications, with a net decrease of 17.8%-22.8% over the 2007-2012 period. For comparison, Columns (7)-(8) estimate specifications that parallel Columns (5)-(6) using ACS data and replacing the dependent variable with the ratio of the 2012 to the 2005 potentially undocumented Mexican population in a given state. Point estimates imply a 4.2-5.0% decline in the potentially undocumented population in response to an additional year of fence construction exposure.

The difference in magnitudes across Matrícula and ACS estimates is explained partly by the fact that the ACS-based measure of the potentially undocumented population overstates the true size of the population by 50% (Caballero, Cadena and Kovak, 2018). Moreover, undocumented Mexicans who have been living in the

[45]To allow for the possibility that 2006 Matrícula levels are affected by construction in 2006 (the first year of construction), Column (3) alternatively includes two separate regressors: the 2007-2012 sum of Average Weighted Fence Construction values and the 2006 Average Weighted Fence Construction value.

U.S. for many years are under-represented in the Matrícula sample and are also the subpopulation that is presumably least likely to respond to fence construction (the median Matrícula applicant has been in the U.S. for roughly five years while the median potentially undocumented ACS respondent has been in the U.S. for fifteen years). The larger Matrícula estimates based on U.S. state of residence (as opposed to Mexican state of origin) could potentially be explained by changes in migrant destinations driven by fence construction that generate spillover effects and thereby inflate estimated impacts.

E. *Heterogeneous Effects*

While the overall elasticity of migration with respect to fence construction estimated in previous specifications can be used to calculate the number of migrants deterred by the fence, the sociodemographic characteristics of those deterred have potentially important implications for both sending and receiving communities. Individual income and educational attainment are the observable characteristics usually examined to determine the nature of migrant selection (positive selection corresponds to higher migration rates among highly-educated and high-earning respondents). To estimate the baseline type of selection observed in my context and to investigate how selection changes in response to fence construction, Column (1) of Table 7 re-estimates the base specification outlined in Equation (4), but adds interactions between included covariates (age, gender, marital status, and educational attainment) and the weighted average fence construction measure. The sample includes all non-border municipality residents who are employed when first interviewed. Column (2) includes log income instead of educational attainment, and Column (3) includes both educational attainment and log income. The uninteracted coefficients can be roughly interpreted as characterizing the baseline nature of migrant selection. The interaction terms reflect how migrant selection changes in response to an exogenous increase in the cost of migration (namely, construction of the fence).[46]

These three specifications, along with corresponding OLS estimates presented in Columns (4)-(6), identify negative baseline selection on both education and earnings, consistent with recent work examining cross-sectional selection patterns (Moraga, 2011).[47] Estimates from both logit and OLS models indicate that selection based on educational attainment becomes less negative after fence construction. Turning to selection based on pre-migration earnings, Columns (2)-(3) show a positive but imprecisely estimated change in selection, while the OLS estimates from Columns (5)-(6) imply that fence construction essentially eliminates

[46]Since demographic characteristics are missing once an individual has exited the household, I rely on the first response provided by each household member to construct relevant measures.

[47]Logit estimates can be interpreted as percentage changes, while linear probability model estimates reflect absolute changes.

negative selection based on pre-migration earnings.[48] [49] In the next section, I interpret these findings in the context of a migration choice model.

IV. A Model of Migration Selection

The nature of impact heterogeneity based on the attributes of potential migrants can be used to characterize the induced change in the distribution of migration costs. To guide thinking, consider a simple model in which an individual migrates if:

$$log(W_{us}) - log(W_m) > \pi \tag{9}$$

Here, W_{us} is the wage that the individual will receive in the U.S., W_m is the wage received in Mexico, and π is the time-equivalent cost of migration. Suppose initially that migration cost $\pi = C + \epsilon_c$, such that time-equivalent migration costs are independent of wages. I further parameterize wage determination equations such that $log(W_{us}) = \mu_{us} + \delta_{us}x$ and $log(W_m) = \mu_m + \delta_m x$, where x represents personal productivity, μ represents the wage intercept and δ represents the return to productivity. I follow the literature (see, for example, Moraga, 2011) in assuming that the return to personal productivity is higher in Mexico (i.e. $\delta_m > \delta_{us}$) but that the base wage is higher in the U.S. (i.e. $\mu_{us} > \mu_m$). Prior to fence construction, the model implies that individuals chose to migrate if $\epsilon_c < \mu_{us} - \mu_m + (\delta_{us} - \delta_m)x - C$. Assuming that residual migration costs, ϵ_c, are normally distributed, this in turn implies that the probability of migration is given by the expression $P = \Phi(\mu_{us} - \mu_m + (\delta_{us} - \delta_m)x - C)$, where $\Phi(\cdot)$ represents the cumulative distribution function of the normal distribution. This expression rationalizes the evidence from Table 7 of negative baseline selection based on both educational attainment and earnings.

To interpret the Table 7 finding that negative selection on education is weakened and negative selection on income is weakened or even eliminated in response to fence construction, I make the additional assumption that changing migration costs do not affect the income gains associated with migration to the U.S. This assumption appears reasonable given that the size of migrant flows is small relative to migrant stocks in most U.S. destinations, so changes in equilibrium labor market opportunities will be limited. Under this assumption, changes in migration rates can be attributed to changes in migration costs.[50]

[48] Selection results related to gender and marital status are omitted, but patterns suggest lower baseline migration rates for females and unmarried respondents. Dynamic selection results indicate that females and unmarried respondents are, however, weakly less deterred by fence construction.

[49] Fence construction induces weakly stronger negative selection on respondent earnings when unemployed respondents are included in the sample, reflecting the fact that the unemployed appear particularly unresponsive to fence construction.

[50] This parametric model does not incorporate selection on unobserved dimensions (for examples of semiparametric and nonparametric approaches, see, for instance, Dahl (2002) and Adao (2016)). As a result, my approach cannot be used to accurately estimate returns to skill across origin and destination

Now, suppose that fence construction shifts up the expected cost of migration, C (for instance, by increasing mortality risk). The change in the probability of migration as a function of C is as follows:

$$dP/dC = -\phi(\mu_{us} - \mu_m + (\delta_{us} - \delta_m)x - C) < 0 \quad (10)$$

where $\phi(\cdot)$ represents the probability density function of the normal distribution. Thus, the model offers the basic prediction that rising migration costs will reduce migration. Next, I consider how changing migration costs differentially affect migration propensity as a function of income in Mexico, while maintaining the assumption that migration costs do not vary with pre-migration earnings. To do so, I first define the change in the probability of migration with respect to C, relative to the baseline migration propensity of individuals with productivity x (which is positively correlated with income by construction):

$$\frac{dP/dC}{P(x)} = -\frac{\phi(\mu_{us} - \mu_m + (\delta_{us} - \delta_m)x - C)}{\Phi(\mu_{us} - \mu_m + (\delta_{us} - \delta_m)x - C)} \quad (11)$$

Since the ratio of the probability density function to the cumulative distribution function is decreasing in its argument (Hayashi, 2000) and since evidence of negative selection at baseline implies that the argument is in turn decreasing in x, I can conclude that $\frac{dP/dC}{P(x)}$ is decreasing in x. Intuitively, migrants' likelihood of being close to the margin at which the returns to migration are zero is increasing in initial income, so this mechanism would be expected to induce a larger deterrent effect for higher-income residents given a constant shift in migration costs. Turning to evidence from Table 7 on dynamic migration selection, this simple parameterization of the migration cost distribution cannot explain the observed declines in the magnitude of negative selection based on education and earnings in response to fence construction.

In contrast, a differential increase in migration costs for low-skilled potential migrants would be expected to contribute to less negative selection after fence construction. While I lack detailed information on factors affecting migration choice that would be needed to explore the mechanisms underlying this finding, increasing nominal crossing costs that differentially raise time-equivalent costs for low earners, the presence of credit constraints, and differences in access to legal migration opportunities offer potential explanations.

The fact that changing migration patterns are explained by a disproportionate increase in crossing costs for less-educated and lower-earning prospective migrants is not itself informative about the magnitude of the change in crossing costs. The large reduction in migration to the U.S. in response to fence construction can

locations. An advantage of this approach, however, is that it aligns closely with the existing literature on emigrant selection, including recent work, such as Moraga (2011).

potentially be explained by either large crossing cost increases, or by small cost increases combined with low perceived benefits of migration. However, two pieces of evidence suggest that the former interpretation is the correct one. First, the deterrent effect of the fence is large relative to the 11-20% decrease in migration associated with a one log point increase in income.[51] Second, the number of crossing deaths per migration episode has roughly doubled from 0.0005 to 0.0010 in the years since the start of fence construction (Haddal, 2010). Using the $6.0 million value of a statistical life estimate provided by a 2011 Department of Transportation review of the relevant research (Rivkin, R. and P. Trottenberg, 2011), the implied increase in the cost of crossing from the increased risk of death alone is $3,000, which is larger than the average cost of hiring a smuggler.[52] Taken together, these findings provide evidence that the rise in crossing costs associated with fence construction is likely quite large.

V. Discussion

In this paper, I have estimated the impact of border fence construction on migration from Mexico to the United States and on the stock of Mexicans living in the U.S. Before concluding, a worthwhile exercise is to estimate the implicit cost paid by DHS per migrant deterred. Given working-aged populations of 5.0 million in Mexican border regions and 59.8 million in non-border regions, baseline migration rates of 0.42% and 0.41% per quarter, and estimated migration declines of 27% and 35%, roughly 5,670 border municipality migrants and 85,810 non-border migrants would be deterred each quarter if the entire border was fenced.

Given that the passage of the Secure Fence Act was followed by fence construction in 18 of Mexico's 38 municipalities adjacent to the border, and given an estimated total cost of $6.5 billion and a fence lifespan of 20 years (Stana, 2010), I estimate a cost of $13.7 billion to fence the border for 20 years. This cost estimate in turn implies a total cost of approximately $1,870 per deterred migrant. To conduct this analysis, I can instead rely on the 11% estimated decline in Matrícula applications associated with an additional year of fence construction exposure. Given the 4.7 million valid Matrícula applications imputed from 2006 baseline data, this would imply that 129,250 migrants are deterred per quarter and that the total cost per migrant deterred is $1,325. This difference in cost estimates is potentially explained by various factors, including changes in return migration and whole-household migration that are not captured in the ENE/ENOE-based estimates. Given the endogeneity of the Matrícula application decision and the fact that Matrícula counts are not available in the pre-period, however, estimates

[51] For comparison, MMP data identify a 300% average earnings gain associated with migration to the U.S. for a given individual.

[52] This value of a statistical life estimate is for U.S. residents. Hersch and Viscusi (2010) studies immigrants' wage compensation for fatality risks, but finds that Mexican migrants do not receive wage compensation for the risks they face. Given an implied value of a statistical life that is zero (or even negative), I rely on the more well-established estimates available for the native U.S. population.

based on the ENE/ENOE are likely more credible.

In any case, these figures are also sensitive to assumptions along a number of dimensions. First, it is likely the case that construction in remaining unfenced areas is more costly than was construction in initially fenced areas, which at least partly explains why some areas were fenced before others. Second, while I have assumed a constant deterrent effect over the next 20 years, the fact that the fence was only recently constructed means that I cannot distinguish delayed from permanently deterred migration in my analysis.

Support for construction of the U.S.-Mexico border fence has been partly justified by demands for improved national security and increased enforcement of the rule of law (Fletcher and Weisman, 2006). While the welfare gains associated with security improvements and strengthened rule of law are difficult to measure, a secondary argument in support of the fence asserts that undocumented immigrants have imposed substantial costs on taxpayers by collecting healthcare, housing, welfare, and education benefits, and by harming jobseekers (Trump, 2015). Estimates of the net economic cost of undocumented immigration imply that undocumented immigration in the early 2000s was associated with only a small decline in annual incomes of U.S. residents that is not is likely to be statistically distinguishable from zero (Hanson, 2007). More recently, even ignoring construction costs, Allen, Dobbin and Morten (2019) concludes that 2007-2010 border fence construction harmed high-skill U.S. workers while increasing the per capita welfare of low-skill workers by the equivalent of only \$0.28 per year. These estimates suggest that fence construction is unlikely to generate fiscal savings relative to a counterfactual without additional border enforcement.

An additional policy question is whether fence construction is more cost effective than alternative border security tools already available. Based on the impact of CBP personnel levels on migration propensity estimated in Appendix Table 1 specifications, I calculate that a 48% increase in personnel levels would deter migration as effectively as fence construction in a given municipality. Summing up across the entire border, this figure represents 5,120 CBP personnel, which would cost the U.S. government \$746.1 million per year (in 2006 USD) to employ (Congressional Budget Office, 2013). This figure in turn implies that the cost per migrant deterred by increasing CBP staffing would be comparable to the cost per migrant deterred by fence construction for the twenty year timespan being considered. Thus, the border fence is likely no more cost effective than simply increasing the number of CBP agents.

VI. Concluding Remarks

My analysis demonstrates that fence construction significantly reduces migration from Mexico to the U.S. I find that there are spillover effects of construction, as border municipality residents are deterred by construction in both their home municipalities and in adjacent ones, and as migrants from the interior of Mexico adjust the crossing locations chosen based on fence construction patterns. Non-border municipality residents, especially those who historically relied on particularly low-cost crossing locations, are significantly less likely to migrate to the U.S. after the start of fence construction. I argue that these findings are not consistent with a model in which fence construction simply increases mean migration costs by increasing the expected distance that each migrant must travel to cross the border. I do not find that the stock of potentially undocumented Mexicans residing in the U.S. immediately responds to fence construction, but I do identify a significant decline in the stock of potentially undocumented Mexicans over a longer (six-year) horizon. Lastly, I show that border fence construction reduces the extent of negative selection of migrants based on both pre-migration earnings and educational attainment. Evidence on dynamic selection patterns has important welfare implications for both sending and receiving communities and implies that lower-skilled prospective migrants experienced the largest increase in crossing costs in response to fence construction.

This paper raises several policy-relevant avenues for future research. I have shown that the deterrent effect of the fence is driven by its impact on those with lower earnings and lower educational attainment, and this compositional change may have implications for local economic activity. In ongoing research, I find that fence construction significantly reduces earnings of border municipality residents, seemingly due to the contraction of local migration-related economic activity. This negative impact on local economies may increase instability in a region that already represents a significant security threat to communities on both sides of the border. In an era when international migration flows have motivated destination country governments to enact policies aimed at deterring migration by raising its cost, a greater research emphasis on the mechanisms and subpopulations driving estimated impacts, and on the costs imposed on non-migrants, can help shed light on the efficacy of such efforts.

REFERENCES

Adao, Rodrigo. 2016. "Worker Heterogeneity, Wage Inequality, and International Trade: Theory and Evidence from Brazil." Working Paper.

Adserà, A., and M. Pytliková. 2015. "The Role of Language in Shaping International Migration." *The Economic Journal*, 125(586): F49–F81.

Allen, Treb, Cauê Dobbin, and Melanie Morten. 2019. "Border Walls." NBER Working Paper No. 25267.

Angelucci, Manuela. 2012. "U.S. Border Enforcement and the Net Flow of Mexican Illegal Migration." *Economic Development and Cultural Change*, 60(2): 311–357.

Belot, M., and S. Ederveen. 2012. "Cultural Barriers in Migration between OECD Countries." *Journal of Population Economics*, 25(3): 1077–1105.

Borjas, George J. 1987. "Self-Selection and the Earnings of Immigrants." *American Economic Review*, 77(4): 531–553.

Borjas, George J. 1989. "Economic Theory and International Migration." *International Migration Review*, 23(3): 457–485.

Caballero, Maria Esther, Brian Cadena, and Brian K. Kovak. 2018. "Measuring Sub-National Migration Patterns using Matriculas Consulares." *Demography*, 55(3): 1119–1145.

Cadena, Brian, and Brian Kovak. 2016. "Immigrants Equilibrate Local Labor Markets: Evidence from the Great Recession." *American Economic Journal: Applied Economics*, 8(1): 257–290.

Cameron, Colin, Jonah Gelbach, and David Miller. 2008. "Bootstrap-Based Improvements for Inference with Clustered Errors." *Review of Economics and Statistics*, 90: 414–427.

Castaneda, Leonardo, and Brandon Quester. 2017. "America's Wall." *https://border.inewsource.org/.*

Chiquiar, Daniel, and Gordon Hanson. 2005. "International Migration, Self-Selection and the Distribution of Wages: Evidence from Mexico and the United States." *Journal of Political Economy*, 113(2): 239–281.

COLEF (El Colegio de la Frontera Norte). 2018. "EMIF: Surveys of Migration at Mexico's Northern and Southern Borders [dataset]." *https://www.colef.mx/emif/eng/index.php.*

Congressional Budget Office. 2013. "S. 744 Border Security, Economic Opportunity, and Immigration Modernization Act."

Dahl, Gordon B. 2002. "Mobility and the Return to Education: Testing A Roy Model with Multiple Markets." *Econometrica*, 70(6): 2367–2420.

Davis, Julie Hirschfeld. 2017. "Trump Orders Mexican Border Wall to Be Built and Plans to Block Syrian Refugees." *https://www.nytimes.com/2017/01/25/us/politics/refugees-immigrants-wall-trump.html*, The New York Times.

del Bosque, Melissa. 2008. "Holes in the Wall: Homeland Security won't Say Why the Border Wall is Bypassing the Wealthy and Politically Connected." *http://www.texasobserver.org/archives/item/15288-2688-holes-in-the-wall*, The Washington Times.

Fletcher, Michael A., and Jonathan Weisman. 2006. "Bush Signs Bill Authorizing 700-Mile Fence for Border." *http://www.washingtonpost.com/wp-dyn/content/article/2006/10/26/AR2006102600120.html*, The Washington Post.

Gambler, R. 2017. "Border Security: Additional Actions Could Strengthen DHS Efforts to Address Subterranean, Aerial, and Maritime Smuggling." GAO.

Gambler, Rebecca. 2015. "Progress and Challenges in DHS's Efforts to Implement and Assess Infrastructure and Technology." Government Accountability Office (GAO).

Gathmann, Christina. 2008. "Effects of Enforcement on Illegal Markets: Evidence from Migrant Smuggling along the Southwestern Border." *Journal of Public Economics*, 92: 1926–1941.

Haddal, Chad C. 2010. "Border Security: The Role of the U.S. Border Patrol." Congressional Research Service (CRS).

Hanson, G. 2007. "The Economic Logic of Illegal Immigration." Council on Foreign Relations.

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.

Hayashi, Fumio. 2000. *Econometrics.* Princeton, NJ:Princeton University Press.

Hersch, Joni, and W. Kip Viscusi. 2010. "Immigrant Status and the Value of Statistical Life." *Journal of Human Resources*, 45(3): 749–771.

Ibarraran, Pablo, and Darren Lubotsky. 2007. "Mexican Immigration and Self-Selection: New Evidence from the 2000 Mexican Census." University of Chicago Press.

INEGI (Instituto Nacional de Estadística y Geografía). 2018. "ENE/ENOE: National Survey of Occupation and Employment [dataset]." *https://www.inegi.org.mx/programas/enoe/15ymas/*.

Janes, Jared. 2009. "The Border Fence Doesn't Deter Everyone." *https://www.themonitor.com/news/local/article_bc9b736c-8e0f-53c8-aaa9-2394c706b4dd.html*, The Monitor.

Kaestner, Robert, and Ofer Malamud. 2014. "Self-Selection and International Migration: New Evidence from Mexico." *The Review of Economic Studies*, 96(1): 78–91.

Martinez, Jose, and Christopher Woodruff. 2007. "Selectivity of Migrants from Mexico: What Does Net Migration Tell Us?" Working Paper.

Massey, Douglas S., Jacob S. Rugh, and Karen A. Pren. 2010. "The Geography of Undocumented Mexican Migration." *Mexican Studies/Estudios Mexicanos*, 26(1): 129–152.

Mayda, A. 2010. "International Migration: A Panel Data Analysis of the Determinants of Bilateral Flows." *Journal of Population Economics*, 23(4): 1249–1274.

McKenzie, David, and Hillel Rapoport. 2010. "Self-Selection Patterns in Mexico-U.S. Migration: The Role of Migration Networks." *The Review of Economics and Statistics*, 92(4): 811–821.

Michael Baker Jr., Inc. 2013. "Border Fence Locations."

Moraga, Jesús Fernńdez-Huertas. 2011. "New Evidence on Emigrant Selection." *The Review of Economics and Statistics*, 93(1): 72–96.

Napolitano, Janet. 2011. "Remarks on Border Security at the University of Texas at El Paso." *http://www.dhs.gov/ynews/releases/pr_1296496548700.shtm.*

Nuñez-Neto, B. and S. Viña. 2006. "Border Security: Barriers Along the U.S. International Border." Congressional Research Service (CRS).

Orrenius, Pia M., and Madeline Zavodny. 2005. "Self-Selection among Undocumented Immigrants from Mexico." *Journal of Development Economics*, 40(1): 1–24.

Ortega, F., and G. Peri. 2013. "The Effect of Income and Immigration Policies on International Migration." *Migration Studies*, 1: 1–28.

Preston, Julia. 2013. "Beside a Path to Citizenship, a New Path on Immigration." *http://www.nytimes.com/2013/04/17/us/senators-set-to-unveil-immigration-bill.html*, The New York Times.

Princeton University and the University of Guadalajara. 2018. "MMP161: Mexican Migration Project [dataset]." *mmp.opr.princeton.edu.*

Rendall, Michael, Peter Brownell, and Sarah Kups. 2010. "Declining Return Migration from the United States to Mexico in the late-2000s Recession." RAND Working Paper.

Rivkin, R. and P. Trottenberg. 2011. "Treatment of the Economic Value of a Statistical Life in Departmental Analyses- 2011 Interim Adjustment." Department of Transportation.

Rosenzweig, M. 2007. "Education and Migration: A Global Perspective." Mimeo, Yale University.

Roy, Andrew. 1951. "Some Thoughts on the Distribution of Earnings." *Oxford Economic Papers*, 3: 135–146.

Ruggles, Steven, Sarah Flood, Ronald Goeken, Josiah Grover, Erin Meyer, Jose Pacas, and Matthew Sobek. 2018. "Integrated Public Use Microdata Series: Version 8.0 [dataset]." *http://doi.org/10.18128/D010.V8.0*, Minneapolis: University of Minnesota.

Sjaastad, Larry A. 1962. "Individual-level Evidence for the Causes and Consequences of Social Capital." *Journal of Political Economy*, 70(5): 80–93.

Stana, Richard M. 2010. "DHS Has Faced Challenges Deploying Technology and Fencing Along the Southwest Border." Government Accountability Office (GAO).

Stana, Richard M., Susan Quinlan, and Jeanette Espinola. 2009. "Secure Border Initiative Fence Construction Costs." Government Accountability Office (GAO).

Suro, Robert. 2005. "Survey of Mexican Migrants." Pew Hispanic Center, Technical Report.

The Border Protection, Antiterrorism, and Illegal Immigration Control Act of 2005. n.d.. "H.R. 4437 (109th)."

The Secure Fence Act of 2006. n.d.. "H.R. 6061 (109th)."

Trump, Donald J. 2015. "Positions: Immigration Reform." *https://www.donaldjtrump.com/ positions/immigration-reform.*

United Nations, Department of Economic and Social Affairs, Population Division. 2013. "Trends in International Migrant Stock: The 2013 Revision - Migrants by Age and Sex." *United Nations database, POP/DB/MIG/Stock/Rev.2013/Age.*

U.S. Customs and Border Protection. 2007. "Environmental Assessment: Pedestrian Fence Near Sasabe, Arizona."

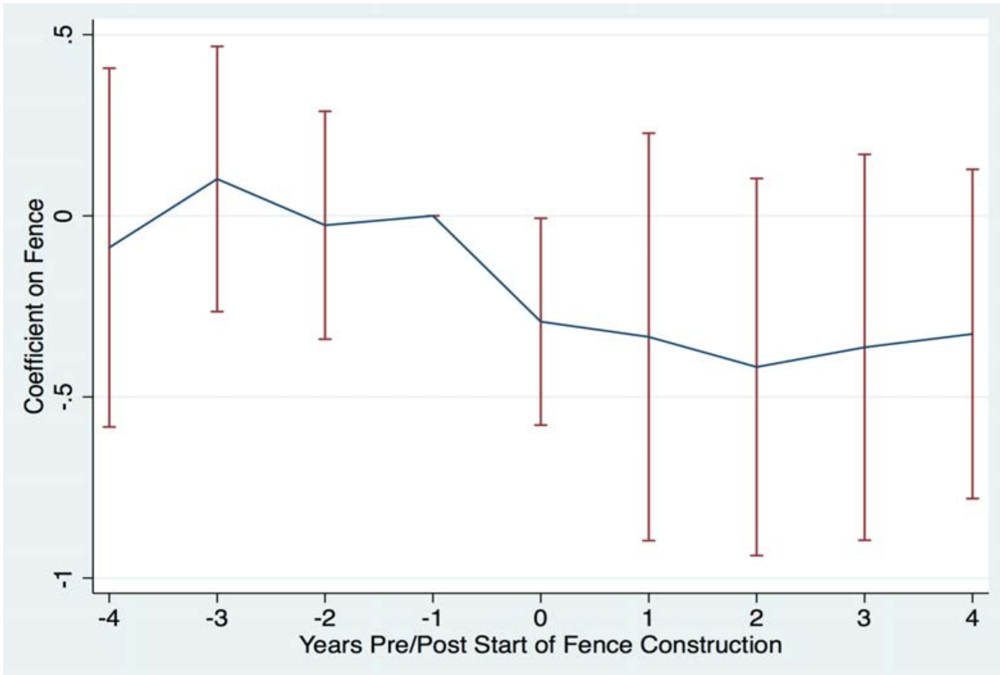
U.S. Customs and Border Protection. 2015. "U.S. Border Patrol Fiscal Year Budget Statistics (FY 1990 - FY 2014)."

U.S. Department of Homeland Security. 2007. "U.S. Customs and Border Patrol: Regarding Border Fence."

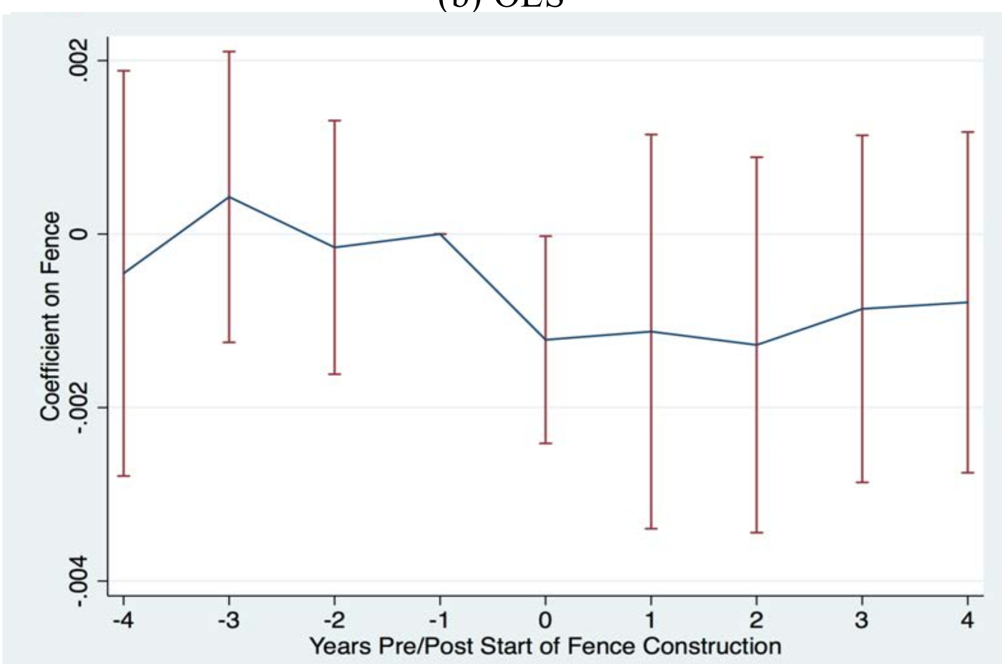
U.S. Department of Homeland Security. 2008. "PF225 Operational Justification."

Figure 1: Out-Migration Trends

(a) Logit



(b) OLS

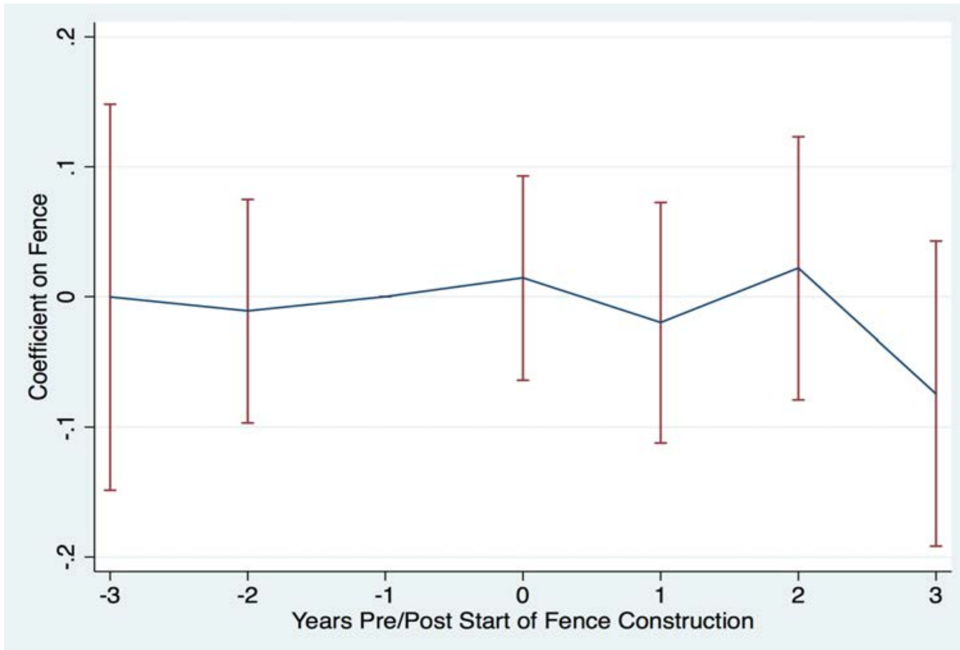


1 Figure 1 uses data on migration of border municipality residents from the Mexican ENE/ENOE. Panel A plots coefficients and 95% confidence intervals from a logit regression of migration on a set of dummies for years pre- and post- fence construction. t=0 represents the start of fence construction and t=-1 is the omitted year (with the coefficient set equal to "0"). The regression includes municipality and year-quarter fixed effects, and clusters standard errors by municipality. Panel B presents corresponding OLS estimates.

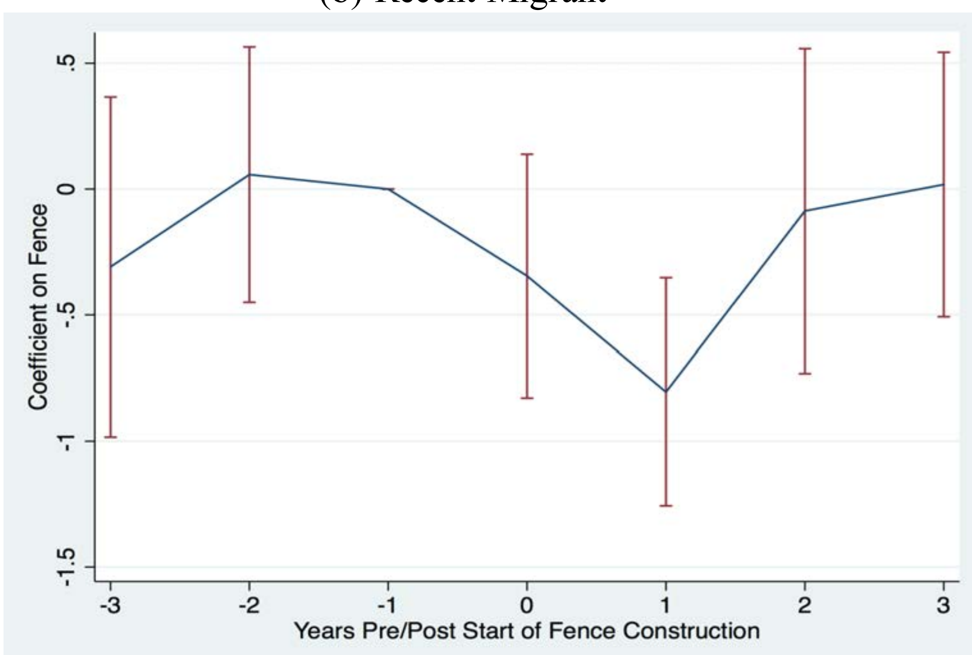
2 All regressions restrict the sample to those aged 15-65 and control for respondent age fixed effects, years of completed schooling fixed effects, whether the respondent is married at the time of initial observation, and respondent gender.

Figure 2: U.S. Border Region Trends

(a) Probabilistically Undocumented



(b) Recent Migrant



1 Figure 2 uses data from the American Community Survey (ACS). Panel A plots coefficients and 95% confidence intervals from a logit regression of an indicator for being probabilistically undocumented on a set of dummies for years pre- and post- fence construction. t=0 represents the start of fence construction and t=-1 is the omitted year (with the coefficient set equal to "0"). The regression includes PUMA and year fixed effects, and clusters standard errors by PUMA. Panel B presents corresponding estimates with a dependent variaible indicating whether the respondent was abroad one year before.

2 All regressions restrict the sample to those aged 16-65. The sample in Panel B is restricted to probabilistically undocumented Mexican-born respondents.

Table 1. Summary Statistics

	(1)	(2)	(3)	(4)
	Panel A: ENE/ENOE Data			
	Border Municipality Sample		*Non-Border Municipality Sample*	
	Non-Migrants	*Migrants*	*Non-Migrants*	*Migrants*
Age	35.11	30.55	35.14	29.74
	[13.59]	[12.43]	[13.88]	[11.53]
Female	0.51	0.37	0.53	0.20
	[0.50]	[0.48]	[0.50]	[0.40]
Married	0.58	0.40	0.59	0.53
	[0.49]	[0.49]	[0.49]	[0.50]
Years of Schooling	9.21	9.58	8.83	8.13
	[4.10]	[3.92]	[4.52]	[3.86]
Employed	0.62	0.60	0.61	0.73
	[0.49]	[0.49]	[0.49]	[0.45]
Monthly Earnings (2005 Pesos)	5,337	5,764	3,933	3,303
	[5,986]	[5,921]	[4,583]	[4,361]
Observations	330,027	1,064	7,140,419	16,563
	Panel B: EMIF and MMP Data			
	EMIF		*MMP*	
	2000 and before	*Post fence construction*		
Undocumented	0.39	0.50	0.63	
	[0.49]	[0.50]	[0.48]	
Duration Last Migration Episode	52.0	-	71.6	
(Months)	[73.2]	-	[89.5]	
Used Smuggler	0.43	0.75	0.82	
	[0.50]	[0.43]	[0.38]	
Smuggler Price (2005 Pesos)	12,482	19,716	17,790	
	[8,414]	[10,822]	[8,788]	
Crossing Location Chosen Based on	0.30	0.14	-	
Distance to Origin or Destination	[0.46]	[0.35]	-	
Crossing Location Chosen Based on Ease	0.41	0.60	-	
of Crossing	[0.49]	[0.49]	-	
Observations	30,488	40,364	24,408	

Notes:

1 Each column presents means and standard deviations for the relevant respondent characteristics. Panel A employs data from the Mexican Encuesta Nacional de Ocupación y Empleo (ENOE) and its precursor, the Mexican Encuesta Nacional de Empleo (ENE). Columns (1)-(2) of Panel B rely on data from the Mexican Encuesta sobre Migración en la Frontera Norte de México (EMIF), and Column (3) of Panel B uses data from the Mexican Migration Project, a binational data source. All ENE/ENOE measures are constructed based on the respondent's initial survey response, since characteristics data is not recorded once an individual has migrated and a household member cannot be recorded as migrating during the initial survey round. Monthly Earnings is the average for the employed subsample. EMIF and MMP measures refer to the respondent's most recent completed crosing from Mexico to the United States. All Panel B variables other than Smuggler Price and Duration Last Migration Episode are indicators for the relevant outcome and all Panel B summary statistics (other than Undocumented) are conditional on Undocumented status. Observation numbers reflect the maximum number of observations across outcome measures.

Table 2. Impact of Fence Construction on Border Municipality Migration

	Migrate to United States		
	(1)	(2)	(3)
		Panel A	
Fence Construction	-0.319	-0.476	-0.447
	(0.129)	(0.132)	(0.192)
		Panel B	
Fence Construction	-0.283	-0.398	-0.548
	(0.136)	(0.158)	(0.168)
Number of Adjacent Municipalities Fenced	-0.164	-0.181	-0.318
	(0.0891)	(0.0909)	(0.110)
Number of Fenced Municipalities Two Away	0.0389	-0.0490	-0.0216
	(0.0708)	(0.0933)	(0.135)
		Panel C	
Fence Construction	-0.319	-0.438	-0.665
	(0.178)	(0.212)	(0.242)
Number of Adjacent Municipalities Fenced	-0.192	-0.211	-0.401
	(0.120)	(0.129)	(0.193)
Number of Fenced Municipalities Two Away	0.0440	-0.0443	0.0164
	(0.0752)	(0.0961)	(0.153)
Fence Construction*Number of Adjacent Municipalities Fenced	0.0520	0.0566	0.167
	(0.118)	(0.132)	(0.171)
Observations	330,503	316,591	316,591
Municipality Fixed Effects	X	X	X
Year-Quarter Fixed Effects	X	X	X
Additional Controls		X	X
State * Year-Quarter Fixed Effects			X
Mean of Non-Fenced		0.00420	
		[0.0647]	
Sample		All municipalities with proposed fence	

Notes:

1 All regressions use data on migration of border municipality residents from the Mexican Encuesta Nacional de Ocupación y Empleo (ENOE) and its precursor, the Mexican Encuesta Nacional de Empleo (ENE). All regressions employ logit specifications and drop the first observation for each household member since the format of the survey means that a household member cannot be listed as out-migrating at the time of initial interview. Fence Construction is an indicator variable equal to "1" if border fence construction has begun in a given municipality.

2 All regressions control for respondent age fixed effects, years of completed schooling fixed effects, whether the respondent is married at the time of initial observation, and respondent gender. All regressions restrict the sample to those aged 15-65. Additional controls include controls for employment status at the time of initial observation, the lagged municipality-level migration rate, and the lagged municipality-level employment-to-population ratio.

3 Standard errors are clustered by municipality.

Table 3. Impact of Fence Construction on Border Crossing Location

	Migrated through Municipality		Migrated through Municipality		Migrated through Municipality	
	(1)	(2)	(3)	(4)	(5)	(6)
Fence Construction	-0.564	-0.568	-0.835	-0.776	-0.00600	-0.00228
	(0.180)	(0.166)	(0.246)	(0.172)	(0.00438)	(0.00471)
Number of Adjacent Municipalities Fenced			0.797	0.648		
			(0.272)	(0.227)		
Number of Fenced Municipalities Two Away			-0.0123	0.00585		
			(0.269)	(0.229)		
Adjacent to Most Common Crossing*Most Common Crossing Fenced					0.00693	0.00343
					(0.0105)	(0.0107)
Second through Fourth Most Common Crossing*Most Common Crossing Fenced					0.0251	
					(0.00858)	
Historical Crossing Share*Most Common Crossing Fenced						0.173
						(0.0661)
Observations	1,373,700	1,373,700	1,373,700	1,373,700	1,373,700	1,373,700
Municipality Fixed Effects	X	X	X	X		
Year-Quarter Fixed Effects	X	X	X	X		
Additional Controls		X		X		
Municipality*Home State Fixed Effects					X	X
Year-Quarter*Home State Fixed Effects					X	X
Specification	Logit		Logit		OLS	
Unit of Analysis	Individual*Border crossing municipality		Individual*Border crossing municipality		Individual*Border crossing municipality	

Notes:

1 All regressions include one observation per individual*border crossing municipality and employ data from the Mexican Encuesta sobre Migración en la Frontera Norte de México (EMIF). The dependent variable is an indicator variable equal to "1" if an indivdual plans to migrate illegally through a given municipality. Fence Construction is an indicator variable equal to "1" if border fence construction has begun in a given municipality. Columns (5)-(6) also include "Adjacent to Most Common Crossing*Fence Construction". In addition, Column (5) includes "Second through Fourth Most Common Crossing*Fence Construction" and Column (6) includes "Historical Crossing Share*Fence Construction". Corresponding coefficients are omitted for the sake of exposition. Additional controls include controls for the lagged municipality-level migration rate, the lagged municipality-level employment-to-population ratio, the lagged state-level migration rate, and the lagged state-level employment-to-population ratio (where municipality and state are defined by crossing location).

2 Standard errors are clustered by municipality.

Table 4. Impact of Fence Construction on non-Border Municipality Migration

	Migrate to United States					
	(1)	(2)	(3)	(4)	(5)	(6)
Weighted Avg. Fence Construction	-0.430	-0.417	0.189	0.277	-0.511	-0.500
	(0.161)	(0.166)	(0.337)	(0.323)	(0.153)	(0.154)
Weighted Avg. Fence Construction*			-1.416	-1.585		
Fraction Low Crossing Cost			(0.606)	(0.542)		
First Lead of Weighted Avg. Fence					0.109	0.116
Construction					(0.155)	(0.157)
Observations	7,148,484	7,148,484	7,148,484	7,148,484	6,977,879	6,977,879
State Fixed Effects	X	X	X	X	X	X
Year-Quarter Fixed Effects	X	X	X	X	X	X
Additional Controls		X		X		X
Pre-Fence Mean of Dependent Variable	0.00412		0.00412		0.00412	
	[0.0640]		[0.0640]		[0.0640]	

Notes:

1 All regressions use data on migration of non-border municipality residents from the Mexican Encuesta Nacional de Ocupación y Empleo (ENOE) and its precursor, the Mexican Encuesta Nacional de Empleo (ENE). All regressions employ logit specifications and drop the first observation for each household member since the format of the survey means that a household member cannot be listed as out-migrating at the time of initial interview. Weighted Average Fence Construction is a state-level average generated by weighting the Fence Construction values of border municipalities in proportion to the share of migrants from 2000 and before born in a given state who crossed in that municipality. These migrant crossing shares are constructed using data from the Mexican Encuesta sobre Migración en la Frontera Norte de México (EMIF). Fraction Low Crossing Cost is defined based on all crossings from 2005 and before included in the EMIF as the state-level fraction of migrants who report having chosen their crossing location primarily due to "ease of crossing" (additional years are included as this measure is unavailable for surveys conducted prior to 2005). Columns (5)-(6) test for differential changes in migration in response to fence construction in the subsequent year-quarter by including both contemporaneous and lead Weighted Average Fence Construction terms.

2 All regressions control for respondent age fixed effects, years of completed schooling fixed effects, whether the respondent is married at the time of initial observation, and respondent gender. All regressions restrict the sample to those aged 15-65. Additional controls include controls for employment status at the time of initial observation, the lagged state-level migration rate, and the lagged state-level employment-to-population ratio.

3 Standard errors are clustered by state.

Table 5. Impact of Fence Construction on Probabilistically Undocumented Population in U.S. (ACS Estimates)

	Undocumented (Probabilistic)	Recent Migrant	Employed	Undocumented (Probabilistic)	Recent Migrant	Employed
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Border PUMA Residents					
Fence Construction	0.0172	-0.472	-0.0241	0.0486	-0.542	0.0302
	(0.0400)	(0.243)	(0.0391)	(0.0550)	(0.249)	(0.0546)
Observations	147,040	30,306	30,306	147,040	20,998	20,998
PUMA Fixed Effects	X	X	X	X	X	X
Year Fixed Effects	X	X	X	X	X	X
Mean of Dependent Variable	0.220	0.0198	0.534	0.159	0.0263	0.518
	[0.414]	[0.139]	[0.499]	[0.366]	[0.160]	[0.500]
	Panel B: All U.S. Residents					
Weighted Avg. Fence Construction	0.00524	-0.689	-0.130	-0.0314	-0.698	-0.130
	(0.0985)	(0.213)	(0.080)	(0.0871)	(0.194)	(0.096)
Observations	15,370,761	571,240	571,240	15,370,761	439,117	439,117
State Fixed Effects	X	X	X	X	X	X
Year Fixed Effects	X	X	X	X	X	X
Mean of Dependent Variable	0.0476	0.0207	0.660	0.0379	0.0253	0.652
	[0.213]	[0.142]	[0.474]	[0.191]	[0.157]	[0.476]
Specification	Logit	Logit	Logit	Logit	Logit	Logit
Probabilistically Undocumented Measure	Aged 16-65, non-college educated, Mexican-born			Aged 16-65, non-college educated, Mexican-born, non-naturalized		

Notes:

1 All regressions use data from the American Community Survey (ACS). Fence Construction is an indicator variable equal to "1" if border fence construction has begun in a given PUMA. All regressions in Panel A include only U.S. PUMAs with fence proposed in the 2006 Secure Fence Act. Weighted Average Fence Construction is a U.S. state-level average generated by weighting the Fence Construction values of border municipalities in proportion to the share of migrants from 2005 and before returning from a given U.S. state who last crossed in that municipality. These migrant crossing shares are constructed using data from the Mexican Encuesta sobre Migración en la Frontera Norte de México (EMIF).

2 Recent Migrant is defined as an indicator variable for whether an individual arrived in the United States within the past year.

3 Standard errors are clustered by PUMA in Panel A and by state in Panel B.

Table 6. Long-Run Impact of Fence Construction on Population of Mexicans Living in U.S.

	Log Matricula	Matricula Growth		Log Matricula	Matricula Growth		Undocumented Pop Growth (ACS)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Weighted Avg. Fence	0.204			0.220				
Construction	(0.145)			(0.239)				
Lagged Weighted Avg.	-0.0753			-0.125				
Fence Construction	(0.0996)			(0.253)				
Second Lag of Weighted	-0.387			-0.869				
Avg. Fence Construction	(0.1210)			(0.177)				
2006-2012 Sum Weighted		-0.0961			-0.178		-0.0422	-0.0502
Avg. Fence Construction		(0.0513)			(0.0477)		(0.0241)	(0.0228)
2007-2012 Sum Weighted			-0.129			-0.228		
Avg. Fence Construction			(0.0660)			(0.0609)		
Observations	196	28	28	238	34	34	34	34
Mexican State Fixed Effects	X							
Year Fixed Effects	X			X				
U.S. State Fixed Effects				X				
	10.578	0.957		11.139	0.913		1.013	1.001
Mean of Dependent Variable	[0.791]	[0.123]		[1.451]	[0.271]		[0.122]	[0.125]
Unit of Analysis	Mex State *Year	Mexican State		U.S. State *Year	U.S. State		U.S. State	
Probabilistically Undocumented Definition							A	B

Notes:

1 All regressions employ OLS specifications. Regressions in Columns (1)-(6) use Mexican Matricula data on Mexicans residing in the United States. Regression in Columns (7)-(8) use data from the American Community Survey (ACS). In Columns (1)-(3), Weighted Avg. Fence Construction is a state-level average that weights the Fence Construction values of border municipalities in proportion to the share of migrants from 2000 and before born in a given Mexican state who crossed in that municipality. In Columns (4)-(6), this measure is based on the share of migrants from 2005 and before returning from a given U.S. state who last crossed in each municipality. Across columns, migrant crossing shares are constructed using data from the Mexican Encuesta sobre Migración en la Frontera Norte de México (EMIF).

2 Columns (1) and (4) include one observation per state*year. The dependent variable in Column (1) is the log number of Mexicans registered in that year from a given Mexican state (living in a given U.S. state in Column (4)). Columns (2)-(3) and (5)-(6) include one observation per state. The dependent variable is the total number of Matricula registrations during the 2007-2012 period from a given Mexican state (in Columns (2)-(3)) or living in a given U.S. state (in Columns (5)-(6)), divided by six times the number of Matricula registrations in 2006 (to facilitate comparison). Observations are weighted by the number of pre-period EMIF respondents from a given Mexican state (in Columns (1)-(3)) or returning from a given U.S. state (in Columns (4)-(6)). Columns (7)-(8) employ a dependent variable constructed as the 2012 potentially undocumented population divided by the 2005 potentially undocumented population. In Columns (7)-(8), Definition A refers to respondents aged 16-65, non-college educated, and Mexican-born, and Definition B refers to respondents aged 16-65, non-college educated, Mexican-born, and non-naturalized.

3 Standard errors are clustered by Mexican state in Column (1) and by U.S. state in Column (4). Heteroskedasticity-robust standard errors are presented in the remaining columns.

Table 7. Heterogeneous Impacts of Fence Construction on non-Border Municipality Migration

	Migrate to United States					
	(1)	(2)	(3)	(4)	(5)	(6)
Weighted Avg. Fence Construction	-0.957	-1.066	-0.993	-10.7	-14.9	-12.7
	(0.219)	(0.404)	(0.430)	(0.733)	(1.21)	(1.25)
Years of Schooling	-0.0687		-0.0603	-0.294		-0.257
	(0.00417)		(0.00475)	(0.0144)		(0.0192)
Log(Income)		-0.219	-0.113		-1.05	-0.386
		(0.0219)	(0.0266)		(0.0946)	(0.120)
Weighted Avg. Fence Construction *	0.0213		0.0204	0.253		0.223
Years of Schooling	(0.00855)		(0.00918)	(0.0185)		(0.0238)
Weighted Avg. Fence Construction *		0.0386	0.00464		0.884	0.293
Log(Income)		(0.0451)	(0.0513)		(0.118)	(0.147)
Observations	3,363,617	3,363,617	3,363,617	3,363,617	3,363,617	3,363,617
State Fixed Effects	X	X	X	X	X	X
Year-Quarter Fixed Effects	X	X	X	X	X	X
Specification	Logit	Logit	Logit	OLS	OLS	OLS

Notes

1 All regressions use data on migration of non-border municipality residents from the Mexican Encuesta Nacional de Ocupación y Empleo (ENOE) and its precursor, the Mexican Encuesta Nacional de Empleo (ENE). All regressions drop the first observation for each household member since the format of the survey means that a household member cannot be listed as out-migrating at the time of initial interview. All regressions include only individuals aged 15-65 who were employed when first surveyed. Weighted Average Fence Construction is a state-level average generated by weighting the Fence Construction values of border municipalities in proportion to the share of pre-2000 migrants born in a given state who crossed in that municipality. These migrant crossing shares are constructed using data from the Mexican Encuesta sobre Migración en la Frontera Norte de México (EMIF).

2 All regressions control for respondent age, whether the respondent is married at the time of initial observation and respondent gender, as well as the interactions between each covariate and the Weighted Average Fence Construction measure. All OLS coefficients are scaled by 10^3.

3 Standard errors are clustered by state.

Appendix Table 1. Impact of Fence Construction on Border Municipality Migration (Robustness Checks)

	Migrate to United States		
	(1)	(2)	(3)
		Panel A	
Fence Construction	-0.309	-0.464	-0.447
	(0.120)	(0.121)	(0.192)
Observations	330,503	316,591	316,591
		Panel B	
Fence Construction	-1.14	-1.27	-2.05
	(0.507)	(0.536)	(0.766)
P-value (Wild Bootstrap)	*0.060*	*0.050*	*0.092*
Observations	330,915	330,915	330,915
		Panel C	
Fence Construction	0.731	0.693	0.648
	(0.094)	(0.101)	(0.122)
P-value (Null=1)	*0.015*	*0.012*	*0.021*
Observations	331,087	331,087	331,087
Municipality Fixed Effects	X	X	X
Year-Quarter Fixed Effects	X	X	X
Additional Controls		X	X
State * Year-Quarter Fixed Effects			X
Mean of Non-Fenced		0.00420	
		[0.0647]	

Notes:

1 All regressions use data on migration of border municipality residents from the Mexican Encuesta Nacional de Ocupación y Empleo (ENOE) and its precursor, the Mexican Encuesta Nacional de Empleo (ENE). Fence Construction is an indicator variable equal to "1" if border fence construction has begun in a given municipality. Columns (1)-(3) of Panel A include the log of the sectorwise number of U.S. Border Patrol personnel as an additional independent variable. Columns (1)-(3) of Panel A employ logit specifications, Columns (1)-(3) of Panel B employ OLS specifications, and Columns (1)-(3) of Panel C employ Cox proportional hazards models and present hazard ratios associated with Fence Construction.

2 All OLS coefficients are scaled by 10^3. All regressions control for respondent age fixed effects, years of completed schooling fixed effects, whether the respondent is married at the time of initial observation, and respondent gender. All regressions restrict the sample to those aged 15-65. Additional controls include controls for employment status at the time of initial observation, the lagged municipality-level migration rate, and the lagged municipality-level employment-to-population ratio.

3 Standard errors are clustered by municipality.

Appendix Table 2. Geographic Spillovers in Fence Construction Impacts

	# Adjacent Municipalities with Fence Construction			Max # Adjacent Fenced	
	(1)	(2)	(3)	(4)	(5)
Fence Construction	0.081	0.067	-0.394		
	(0.290)	(0.286)	(0.411)		
Max Fence Construction				0.280	-0.142
				(0.339)	(0.368)
Observations	744	744	744	23	23
Municipality Fixed Effects	X	X	X		
Year-Quarter Fixed Effects	X	X	X		
Additional Controls		X	X		
State * Year-Quarter Fixed Effects			X		
State Fixed Effects					X
Mean of Non-Fenced	0.293			0.636	
	[0.662]			[0.924]	
Sample	One observation per municipality-quarter			One observation per municipality	

Notes:

1 All regressions use data on municipality-level fence construction collected by the author. Fence Construction is an indicator variable equal to "1" if border fence construction has begun in a given municipality, and Max Fence Construction is the municipality-level maximum of the Fence Construction variable.

2 Additional controls include controls for the lagged municipality-level migration rate and the lagged municipality-level employment rate.

3 Standard errors are clustered by municipality in Columns (1)-(3) and heteroskedasticity-robust standard errors are presented in Columns (4)-(5).

Appendix Table 3. Impact of Fence Construction on Household-Level Attrition

	Household Not Present			
	(1)	(2)	(3)	(4)
	Panel A: Border Municipality Residents			
Fence Construction	0.0400	0.0675	0.000868	0.00198
	(0.0941)	(0.0846)	(0.00450)	(0.00422)
Observations	202,073	202,073	210,214	210,214
Mean of Non-Fenced	0.0408		0.0408	
	[0.198]		[0.198]	
Municipality Fixed Effects	X	X	X	X
Year-Quarter Fixed Effects	X	X	X	X
Additional Controls		X		X
	Panel B: Non-Border Municipality Residents			
Weighted Avg. Fence Construction	-0.034	-0.028	-0.000816	-0.000678
	(0.114)	(0.110)	(0.00291)	(0.00279)
Observations	3,759,315	3,759,315	3,810,926	3,810,926
Pre-Fence Mean of Dependent Variable	0.0270		0.0270	
	[0.162]		[0.162]	
State Fixed Effects	X	X	X	X
Year-Quarter Fixed Effects	X	X	X	X
Additional Controls		X		X
Specification	Logit		OLS	
Unit of Analysis	Household*year-quarter		Household*year-quarter	

1 Panel A uses data on border municipality residents from the Mexican Encuesta Nacional de Ocupación y Empleo (ENOE) and its precursor, the Mexican Encuesta Nacional de Empleo (ENE). Panel B uses data from the same sources on non-border municipality residents. Fence Construction is an indicator variable equal to "1" if border fence construction has begun in a given municipality. Weighted Average Fence Construction is a state-level average generated by weighting the Fence Construction values of border municipalities in proportion to the share of migrants from 2000 and before born in a given state who crossed in that municipality. These migrant crossing shares are constructed using data from the Mexican Encuesta sobre Migración en la Frontera Norte de México (EMIF).

2 To estimate these specifications, a balanced panel is first created at the household level such that each household appears in five consecutive survey rounds. Household Not Present is equal to "1" in the first year-quarter after which a household last appears in the original data for those households that do not appear in all five survey rounds in the original data (and is otherwise equal to "0"). Additional controls include controls for the lagged municipality-level migration rate and the lagged municipality-level employment rate in Panel A and for the lagged state-level migration rate and the lagged state-level employment rate in Panel B.

3 Standard errors are clustered by municipality in Panel A and by state in Panel B.

Appendix Table 4. Impact of Fence Construction on Migration from U.S. to Mexico (ENE/ENOE Estimates)

	In-Migration Rate		Number Inmigrants		Any Inmigrant in Household	
	(1)	(2)	(3)	(4)	(5)	(6)
			Panel A: Border Municipality Residents			
Fence Construction	0.0117	0.0114	0.254	0.253	0.197	0.217
	(0.0124)	(0.0122)	(0.235)	(0.235)	(0.228)	(0.231)
Municipality Fixed Effects	X	X	X	X	X	X
Year-Quarter Fixed Effects	X	X	X	X	X	X
Additional Controls		X		X		X
Observations	744	744	735	735	144,476	144,367
Mean of Non-Fenced	0.0000291		0.379		0.0024	
	[0.0000644]		[0.842]		[0.0491]	
Specification	WLS		Poisson QMLE		Logit	
Unit of Analysis	Municipality*year-quarter		Municipality*year-quarter		Household*year-quarter	
			Panel B: Non-Border Municipality Residents			
Weighted Avg. Fence Construction	0.769	0.746	0.210	0.208	0.187	0.191
	(1.069)	(1.002)	(0.194)	(0.181)	(0.201)	(0.186)
State Fixed Effects	X	X	X	X	X	X
Year-Quarter Fixed Effects	X	X	X	X	X	X
Additional Controls		X		X		X
Observations	1,148	1,148	1,148	1,148	2,849,148	2,849,148
Pre-Fence Mean of Dependent Variable	0.00465		2039		0.00367	
	[0.00415]		[2428]		[0.0604]	
Specification	WLS		Poisson QMLE		Logit	
Unit of Analysis	State*year-quarter		State*year-quarter		Household*year-quarter	

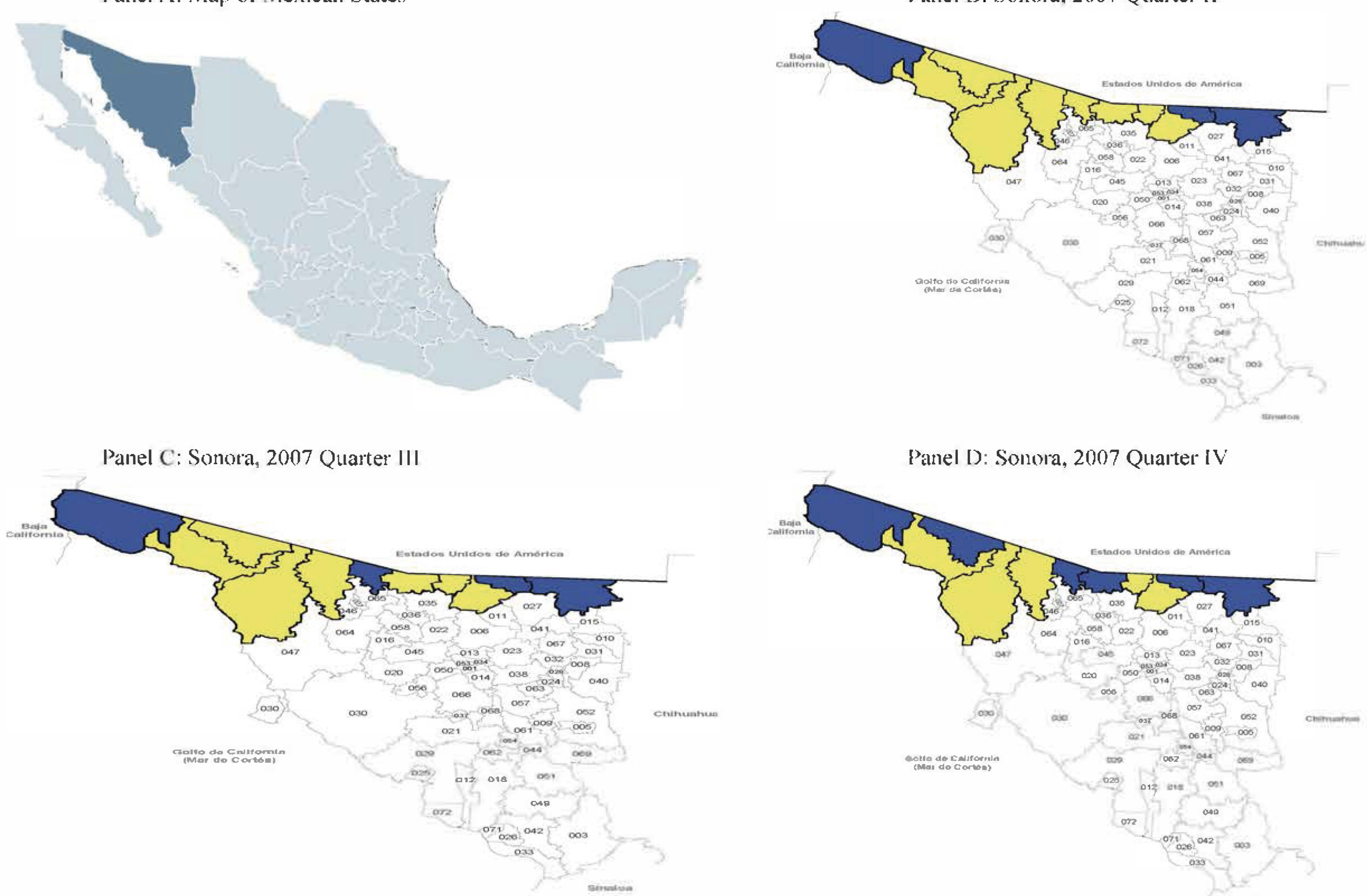
Notes:

1 Panel A uses data on inmigration of border municipality residents from the Mexican Encuesta Nacional de Ocupación y Empleo (ENOE) and its precursor, the Mexican Encuesta Nacional de Empleo (ENE). Panel B uses data from the same sources on inmigration of non-border municipality residents. Fence Construction is an indicator variable equal to "1" if border fence construction has begun in a given municipality. Weighted Average Fence Construction is a state-level average generated by weighting the Fence Construction values of border municipalities in proportion to the share of migrants from 2000 and before born in a given state who crossed in that municipality. These migrant crossing shares are constructed using data from the Mexican Encuesta sobre Migración en la Frontera Norte de México (EMIF). In Columns (1)-(2), In-Migration Rate is calculated as the number of inmigrants divided by the estimated undocumented population residing in the U.S. in 2006 (based on Mexican Matricula data).

2 Columns (1)-(2) employ weighted least squares (WLS) specifications. In Panel A, specifications include one observation per municipality*year-quarter with observations weighted by the 2006 number of Matricula applications for Mexicans from the given municipality. In Panel B, specifications include one observation per state*year-quarter with observations weighted by the 2006 number of Matricula applications for Mexicans from the given state. Columns (3)-(4) present Poisson quasi-maximum likelihood estimates from specifications in which the dependent variable is the number of in-migrants in a given year-quarter (unweighted in Panel A and using survey weights in Panel B). Columns (5)-(6) use a household*year-quarter-level specification with an indicator variable for whether any household member in-migrated in a given year-quarter as the dependent variable (regardless of where the household member resided in the previous year-quarter). All WLS coefficients are scaled by 10^3.

3 Standard errors are clustered by municipality in Panel A and by state in Panel B.

Appendix Figure 1: Sample Fence Map



Notes: Panel A highlights the border state of Sonora. Panels B-D depict border municipalities within Sonora in subsequent quarters of 2007. Fenced municipalities are shaded blue and unfenced municipalities are shaded yellow.

Source: Mexican Instituto Nacional de Estadística y Geografía