How many illegal Mexican immigrants enter the United States, where, and why?

Abstract

We model illegal immigration across the U.S.-Mexico border into Arizona, California, and Texas as an unobservable variable applying a MIMIC model. Using state-level data from 1985 to 2004, we test the incentives and deterrents influencing illegal immigration. Better labor market conditions in a U.S. state and worse in Mexico encourage illegal immigration while more intense border enforcement deters it. Estimating the inflow of illegal Mexican immigrants we find that the 1994/95 peso crisis in Mexico led to significant increases in illegal immigration. U.S. border enforcement policies in the 1990s provided only temporary relief while post-9/11 re-enforcement has reduced illegal immigration.

JEL-Classification: F22, J61, O15

Keywords: Illegal Migration, MIMIC models, U.S., Mexico

1. Introduction

This paper studies illegal immigration from Mexico to the United States (U.S.) between 1985 and 2004. We contribute to the literature in two ways. First, we explicitly consider illegal immigration as an unobservable phenomenon using a Multiple Indicators Multiple Causes (MIMIC) model. This allows us to measure the level of illegal immigration with more than one indicator variable. While the literature typically uses the number of illegal Mexican immigrants apprehended by the U.S. border control at or behind the U.S.-Mexico border (linewatch apprehensions), we additionally employ non-linewatch apprehensions as a second indicator of illegal immigration. Although the number of linewatch apprehensions is highly correlated with the actual number of illegal Mexican immigrants entering the U.S., it does not represent the number of illegal Mexican immigrants *successfully* entering the U.S. since most people who are apprehended at the border are sent back to Mexico. Using non-linewatch apprehensions as a second indicator of illegal immigration may help to improve estimations of illegal immigration as it captures the number of Mexican immigrants who *succeeded* in illegally entering the U.S. but were later apprehended somewhere in the interior. Second, we analyze illegal immigration at the state-level and examine the determinants for entering the U.S. through Arizona, California, and Texas. Using these state-specific determinants, we calculate estimates for the inflow of illegal Mexican immigrants to each state each month between 1985 and 2004.

MIMIC models are commonly applied to measure the size and development of informal economic activities which are not reported to the authorities and whose exact size can therefore not be measured precisely. The MIMIC methodology explicitly treats the object being studied as an unobservable or latent variable that can presumably be measured using appropriate observable indicator variables. Several informal economic activities have already been studied using the MIMIC approach. For example, Dell’Anno and Schneider (2003), Schneider (2005, 2006), and

Pickhardt and Sardà Pons (2006) applied MIMIC models to estimate the determinants and size of the shadow economy.[1] Farzanegan (2009) and Buehn and Eichler (2009) apply the MIMIC approach to study the determinants and development of illegal trade (smuggling) in Iran and across the U.S.-Mexico border, respectively. In this paper we argue that illegal immigration is an integral part of the informal economy since it involves breaching the law and its size is not recorded by the authorities. For this reason we study the determinants and development of illegal immigration using the MIMIC methodology which is particularly designed to deal with informal, unobservable economic activities.

Relying on previous literature, we derive hypotheses about the determinants of illegal immigration across the U.S.-Mexico border. For each of three of the four U.S. states bordering Mexico – Arizona, California, and Texas – we specify a MIMIC model to test the impact of observable causes/determinants (incentives to immigrate) specific to that state on the latent phenomenon of illegal Mexican immigration – which, in turn, is indicated by linewatch and non-linewatch apprehensions recorded in that state. Using the significant coefficients of the determinants of the MIMIC model specific to each state, we can estimate the monthly inflow of illegal Mexican immigrants to each state from 1985 to 2004.

Our results indicate that labor market conditions and the intensity of border enforcement in the U.S. states determine illegal immigration from Mexico to the U.S. For Arizona, for example, a low rate of unemployment acts as a pull factor for illegal Mexican immigrants. For California and Texas, higher real wages are the most significant labor market determinant of illegal Mexican immigration. Labor market conditions in Mexico also determine illegal immigration into the U.S.: immigrants are pushed to Arizona and California by low Mexican real wages and to Texas by a

[1] Moreover, Schneider and Enste (2000) provide an excellent overview of MIMIC studies dealing with issues on the shadow economy.

high Mexican unemployment rate. We find robust evidence that more intense border enforcement in the U.S. significantly deters illegal immigration since a higher probability of being caught at the border significantly increases the costs associated with crossing.

Using the MIMIC models, we estimate the inflow of illegal Mexican immigrants to each state per month. In general, the annual inflow of illegal Mexican immigrants is relatively stable over time. It ranged between 12,000 and 18,000 in Arizona, between 80,000 and 110,000 in California, and between 40,000 and 60,000 in Texas per year from 1985 to 2004. Several events led to abnormally large fluctuations in illegal Mexican immigration. The outbreak of the peso crisis in 1994/95, for example – which was associated with a decline in real wages and employment opportunities in Mexico – dramatically increased the number of Mexican immigrants who illegally crossed the border into the U.S. in 1995 to 20,000 in Arizona, 140,000 in California, and 70,000 in Texas. Several U.S. border enforcement operations, such as Operation Hold-the-Line in Texas, Operation Gatekeeper in California, and Operation Safeguard in Arizona, also – albeit temporarily – deterred Mexican immigrants from entering the U.S. illegally. Re-enforcement of the southern U.S. border following the terrorist attacks of September 11, 2001 resulted in a steep decline in illegal Mexican immigrants to 3,000 in Arizona, 35,000 in California, and 17,000 in Texas by the end of 2001. Since 2002, the number of illegal Mexican immigrants has recovered to normal levels but is much more volatile than in the period 1985 to 2000. In addition, our results indicate that the flow of illegal immigration shifted from the high-enforcement California border to the lower enforcement Arizona and Texas borders from 2001 to 2004.

The paper is organized as follows. Section 2 reviews the literature on illegal immigration across the U.S.-Mexico border. Section 3 discusses the indicators and determinants, i.e. the costs and benefits of illegal immigration across the U.S.-Mexico border, and derives our hypotheses for the empirical analysis. Section 4 presents the empirical analysis, explains the results, calculates long-term indices of illegal immigration from Mexico to Arizona, California, and Texas, and relates their pattern to macroeconomic events in Mexico and U.S. border enforcement policies. Section 5 concludes.

2. Literature review

The literature on illegal immigration between the U.S. and Mexico consists of two major strands.[2] The first focuses on the volume and composition of illegal Mexican immigrants entering the U.S. The second studies the determinants of illegal immigration from Mexico to the U.S.

To address the dimension of illegal immigration from Mexico to the U.S., the literature analyzes stocks, flows, and characteristics of Mexican illegal immigrants using official household surveys such as the U.S. Census of Population and Housing, the U.S. Current Population Survey, or data compiled by U.S. Customs and Border Protection. Borjas et al. (1991) estimate that by 1980 1.8 million illegal Mexicans resided in the U.S. and that the population of illegal Mexican immigrants increased to between 2.0 and 2.3 million by 1984. Based on U.S. Census data, Costanzo et al. (2001) estimate that between 1990 and 2000 an average of 581,000 immigrants entered the United States illegally each year and that 57% of these were Mexican. Passel (2005) obtains similar figures for the period 2002-2004 and estimates that a total of 5.9 million illegal Mexicans lived in the U.S. in 2004. Concerning the composition of illegal Mexican immigrants in the U.S. the literature finds ambiguous evidence. Borja (1987, 1995) presents evidence in favor of a negative selection bias finding that illegal Mexican immigrants in the U.S. earn below-average wages. Conversely, Hanson (2006) finds that illegal immigrants are drawn from the middle-wage rather than the low- (or high-)wage quartiles of the Mexican wage distribution – confirming similar findings by Feliciano (2001), Chiquiar and Hanson (2005), and Orrenius and Zavodny (2005).

[2] For excellent surveys on this topic see Espenshade (1995) and Hanson (2006).

The literature on the determinants of illegal immigration hypothesizes that immigrants will move from low-wage to high-wage labor markets if the gains – higher expected future incomes – exceed the costs, i.e. travel costs, physical risk, expected costs of apprehension, and the cost of resettling. Important pull factors affecting U.S.-Mexico immigration are differences in real wages and the unemployment rate between Mexico and the U.S. Regressing apprehensions at the U.S.-Mexico border on real wages in Mexico and the U.S. and a number of controls, Hanson and Spilimbergo (1999) find that a 10% decline in Mexican real wages is associated with a 6-8% increase in border apprehensions and that a 10% increase in U.S. real wages yields a 9-16% increase in the number of apprehensions.[3] The impact of the U.S. unemployment rate on illegal immigration is not found to be significant. Estimating a hazard rate model with data from the MMP Orrenius and Zavodny (2005) largely confirm Hanson and Spilimbergo's findings on a microeconomic level. They also find that the likelihood of immigration to the U.S. is positively correlated with U.S. wages and uncorrelated with the U.S. unemployment rate.[4] In contrast to Hanson and Spilimbergo (1999), Orrenius and Zavodny (2005) find that Mexican wages (in manufacturing) do not significantly influence the decision to immigrate to the U.S. illegally.

Another factor affecting illegal immigration is access to immigrant networks. Using MMP data, Munshi (2003) and Orrenius and Zavodny (2005) find that a larger immigrant network, i.e., more friends and family that have migrated to the U.S., raises an immigrant's ability to assimilate in the U.S. McKenzie and Rapoport (2007) show within a theoretical model that the probability of migration is higher in communities with larger networks. Larger immigrant networks also reduce

[3] Nannestad (2009) however argues that large parts of an immigrant population are usually not productively employed because domestic immigrant employment – being a substitute for low-skilled labor – reduces wages for low-skilled labor but increases wages for complementary high-skilled labor. As a result income inequality increases in the society which is against the egalitarian ethos of the welfare state and immigrants stay thus unemployed.

[4] In particular, they find that older Mexicans' decision to immigrate is driven by U.S. agricultural wages while younger Mexicans' decision to immigrate is driven by U.S. manufacturing wages. This suggests a change in the composition of illegal immigration by generation: older Mexicans seek agricultural employment in the U.S., and younger Mexicans more likely seek manufacturing jobs in the U.S.

the cost of migration, thereby decreasing the importance of financial household resources on the decision to emigrate. With growing immigrant networks, poorer members of the community become more likely to emigrate. Using MMP data and the National Survey of Population Dynamics (ENADID) of 214 rural communities in Mexico, McKenzie and Rapoport find empirical evidence supporting the model's hypotheses.

Most authors interpret illegal immigration as an unintended consequence of too lax enforcement policies. Hillman and Weiss (1999), on the contrary, show in an endogenous policy framework that median voters of countries with sufficiently large illegal immigrant populations will opt to refuse amnesty to present illegal immigrants and to permit prospective illegal immigration. U.S. politicians have however pursued policies aimed to reduce illegal immigration because of economic and national security concerns. The 1952 Immigration and Nationality Act (INA) and the 1986 Immigration Reform and Control Act (IRCA), for example, substantially increased resources for U.S. immigration authorities. The effectiveness of border enforcement to deter illegal immigrants from entering the U.S. is hotly debated in politics and in the literature.[5] Most empirical papers use data on the number of hours the U.S. border control spends patrolling the U.S.-Mexico border to measure border enforcement. Espenshade (1994), Orrenius and Zavodny (2005)[6], and Gathmann (2008) find no significant effect of border enforcement on illegal immigration. White et al. (1990), Donato et al. (1992), and Dávila et al. (2002) find that more intense border enforcement reduces illegal immigration only temporarily but has no long run deterrence effect. Hanson and Spilimbergo (1999), on the other hand, find a significantly positive relationship between apprehensions and the number of hours spent patrolling the border – which suggests that increased enforcement makes

[5] See Hanson (2006) for a detailed discussion of the success of illegal immigration enforcement.

[6] Interacting border enforcement with the education level of immigrants attempting to cross the border Orrenius and Zavodny (2005) find that the deterrent effect is greater the less educated the illegal Mexican immigrants are. This suggests that increasing border enforcement reduces the flow of uneducated illegal Mexican immigrants to the U.S.

crossing the border more difficult. Hanson et al. (2002) study the indirect effect of border enforcement regressing wages in U.S.-Mexico border regions on border control hours. They find only a small impact of tighter border enforcement on wages in border regions in California and Texas, suggesting that policymakers tend to inflate the success of border enforcement to deter illegal immigration. Dávila et al. (1999) study whether U.S. enforcement strategies have changed after the IRCA in 1986. They find that the INS increased the ratio of hours spent patrolling the border to hours spent patrolling the interior of the U.S. from 9.59 to 12.25 after the ICRA came into effect. The shift in enforcement policies towards border enforcement suggests that the INS acts like an agency whose aim is to maximize its budget rather than to combat illegal immigration.

To counteract border enforcement and to increase the probability of successfully crossing the border, illegal immigrants often hire professional smugglers known as coyotes. Using MMP data, Orrenius (2001) reports that 69% of illegal Mexican immigrants hired a coyote between 1978 and 1996 and that prices varied between $385 and $715 per person and crossing (measured in 2000 U.S. dollars). Gathmann (2008) also analyzes the effects of tighter border enforcement on the coyote market using MMP data. She finds that the massive build-up in border enforcement from around 6,000 linewatch hours per border mile in 1986 to around 10,000 linewatch hours per border mile in 2005 has raised coyote prices by 16.5%, or $68. The price elasticity of coyote demand is around -0.5 – which suggests that the rise in coyote prices may have decreased the demand for coyotes. However, tighter enforcement at popular ports of entry, such as San Diego, CA and El Paso, TX, has shifted immigrants to find more remote – and more difficult – entry points, such as through the Sonoran Desert in Arizona. Gathmann (2008) concludes that the changing geography of illegal immigration increases health risks and time costs of crossing the border and reduces the effectiveness of border enforcement.

3. Theoretical reasoning

3.1. Indicators of illegal immigration

The MIMIC approach builds on the idea that the latent variable (illegal immigration) can be measured using *more than one* indicator. We argue that the development of illegal immigration can be measured more precisely using several indicators together rather than one dependent variable.[7] While the literature employs only one variable as an indicator of the development of illegal immigration – linewatch apprehensions – (see, for example, Espenshade, 1994; Hanson and Spilimbergo, 1999; and Hanson, 2006), we employ two and include both linewatch and non-linewatch apprehensions in our analysis. Instead of regressing a single dependent variable on the supposed determinants of illegal immigration, the MIMIC model employs a measurement model where two indicators are regressed on a – per se undefined – latent variable which is, in turn, determined by a set of determinants. Accounting for more than one factor affecting illegal immigration using this type of model improves the estimation of illegal immigration across the U.S.-Mexico border as explained below.

3.1.1. Linewatch apprehensions

Linewatch apprehensions record the number of individuals apprehended by U.S. Border Control shortly after crossing the U.S.-Mexico border illegally. Data on linewatch apprehensions at the U.S.-Mexico border[8] is available from unpublished records of the U.S. Immigration and Naturalization Service (INS) provided by Gordon Hanson. This is the same data used in Hanson et al. (2002), Hanson (2006), and Gathmann (2008). We aggregate the sector-wide data to obtain the

[7] Although the indicators are often only imperfectly linked to the latent variable (Bollen, 1989), as explained below, it is reasonable to assume that they at least partly reflect the latent variable – the development of illegal Mexican immigration – and that a change in the incentive to enter the U.S. illegally transmits uniformly to the indicators.
[8] Data for New Mexico is not recorded by the INS.

number of linewatch apprehensions for each state of Arizona, California, and Texas.[9]

Given the effectiveness of border enforcement – which implies, for example, that a fixed share of illegal immigrants is captured by the U.S. Border Control – a higher number of linewatch apprehensions indicates a higher inflow of illegal Mexican immigrants to that state.[10] Our first hypothesis is:

Hypothesis 1: A higher number of linewatch apprehensions in a state indicates more illegal immigration from Mexico to that state, *ceteris paribus*.

There are advantages and disadvantages to using linewatch apprehensions as an indicator of illegal immigration. One advantage is that linewatch apprehensions provide data on the timing of illegal border crossing which can easily be matched with data on the determinants of illegal immigration recorded. The disadvantage, however, is that linewatch apprehensions record only the number of *unsuccessful* attempts to immigrate illegally. Nevertheless, a positive correlation between linewatch apprehensions and the extent of (successful) illegal immigration is reasonable (Hanson, 2006).

3.1.2. Non-linewatch apprehensions

We use non-linewatch apprehensions as a second indicator of illegal immigration. Non-linewatch apprehensions – the number of illegal immigrants apprehended by U.S. Border Control in the interior of the U.S. – proxy the number of Mexican immigrants that, in the first place, successfully enter the U.S. state illegally. Non-linewatch apprehensions can result during the border control's

[9] State data are compiled using data for the following U.S. Customs and Border Protection (CBP) sectors: Tucson and Yuma (Arizona), El Centro and San Diego (California), and Del Rio, El Paso, Laredo, Marfa, and McAllen (Texas).

[10] The overwhelming majority (99%) of individuals apprehended at the U.S.-Mexico border by the U.S. Border Control are Mexican citizens (Hanson et al., 2002). We therefore assume that individuals apprehended at the U.S.-Mexico border are Mexican nationals.

regular patrols of the U.S. interior, at traffic checkpoints, and during raids on businesses. Hanson and Spilimbergo (1999) argue that – unlike linewatch apprehensions – non-linewatch apprehensions do not provide information on the exact date when illegal immigrants entered the U.S. This makes it difficult to match the timing of non-linewatch apprehensions with the determinants of illegal immigration.

We include non-linewatch apprehensions for two reasons. First, it is reasonable to assume that many illegal immigrants will be apprehended within one month of entering the U.S. state illegally. Newly arrived illegal immigrants typically do not (yet) possess false documents nor have they (yet) got into contact with local immigrant networks. This makes it more difficult for them to hide from U.S. authorities and increases the probability of being apprehended within a short period of time. Second, illegal Mexican immigrants most likely do not stay in the county in which they entered the U.S. for very long. Rather, they continue on to non-border counties where the risk of being apprehended is lower due to less intense enforcement[11] and/or more extensive immigrant networks. As the INS data on non-linewatch apprehensions explicitly refer to counties at the U.S.-Mexico border it seems reasonable to assume that these illegal Mexican immigrants are apprehended shortly after (probably often within the same month when) they have crossed the U.S.-Mexico border. Thus, considering non-linewatch apprehensions as a second indicator accounts for the number of illegal immigrants who newly arrived in the U.S. and thus complements the picture of the latent phenomenon of illegal immigration. Thus, our second hypothesis is:

Hypothesis 2: A higher number of non-linewatch apprehensions in a state indicates more illegal immigration from Mexico to that state, *ceteris paribus*.

[11] U.S. enforcement policies focus on patrolling the border rather than policing non-border counties or monitoring the employment practices of U.S. businesses.

3.2. Determinants of illegal immigration

3.2.1. Labor market conditions

The decision of Mexicans to enter the U.S. illegally theoretically should be driven by better labor market perspectives in the U.S. compared to Mexico. That is, since illegal immigration is associated with costs – as described below – entering the U.S. illegally only pays off if the expected real wages earned in the U.S. exceed the expected real wages in Mexico. The expected real wage in the U.S. equals the average real wage times the probability of finding a job. The expected real wage earnings of an illegal Mexican immigrant working in a U.S. state are thus higher, the higher the average real wage and the lower the unemployment rate in that state. Higher expected real wages in Mexico, i.e., higher average real wages and a lower unemployment rate in Mexico, on the other hand, reduce the incentive to enter the U.S. illegally. Better labor market conditions in the U.S. thus act as a pull factor for Mexicans to immigrate illegally while worse labor market conditions in Mexico act as a push factor. Our third hypothesis is:

Hypothesis 3: Higher average real wages and a lower unemployment rate in a state increase the incentive for Mexicans to enter that state illegally, *ceteris paribus*. Lower average real wages and a higher unemployment rate in Mexico increase the incentive to immigrate to any U.S. state illegally, *ceteris paribus*.

3.2.2. Costs of crossing the border: enforcement, coyote prices, and temperature

There are several costs associated with crossing the U.S.-Mexico border illegally. For example, illegal immigrants face the risk of being apprehended, arrested, and/or deported by U.S. Border Control. If apprehended, detention and/or deportation cost the immigrant time and, thus, income that could have been earned. There are also psychological effects associated with being caught. Even if an illegal immigrant successfully avoids apprehension, there are costs associated with crossing the border itself, such as coyote prices and health risks. We concentrate on three components of the expected costs associated with attempts to cross the U.S.-Mexico border illegally: border enforcement, coyote prices and the average temperature in the border area. More intense border enforcement, i.e., more man-hours spent patrolling the U.S.-Mexico border, increases the probability of apprehension, *ceteris paribus*. Since a higher risk of being apprehended increases the expected costs of illegal immigration, more intense border enforcement should reduce illegal immigration. Thus, our fourth hypothesis is:

Hypothesis 4: More intense border enforcement, i.e., more man-hours spent patrolling the border, decreases the incentive to immigrate illegally, *ceteris paribus*.

To reduce the risk of being apprehended, illegal Mexican immigrants often hire smugglers, known as coyotes. Coyotes know the best – least patrolled – places to cross the border (Gathmann, 2008). Given the expected benefits of working in the U.S., higher coyote prices may make it unprofitable for some illegal Mexican immigrants to hire a coyote. This may also prevent those Mexicans from illegally immigrating who do not want to risk crossing the border without the help of a coyote. Our fifth hypothesis is:

Hypothesis 5: Higher coyote prices – by increasing the expected costs of immigrating illegally – decrease the incentive to immigrate illegally, *ceteris paribus*.

Temperature should also affect an immigrant's decision to cross the U.S.-Mexico border illegally. Many Mexicans enter the U.S. in the summer since U.S. labor demands increase during the harvest season. In order to reduce the probability of being caught, some illegal Mexican immigrants cross the border in relatively unguarded desert areas, such as the Sonoran Desert in southwestern Arizona and southeastern California. We test whether higher temperatures in the border region of the U.S. states have a negative impact on illegal immigration. We expect that higher (summer) temperatures increase the risk of dehydration and/or death when crossing the border illegally and, in turn, decrease the illegal immigration. Thus, our sixth hypothesis is:

Hypothesis 6: Higher average temperatures in U.S.-Mexico border regions decrease the incentive to immigrate illegally, *ceteris paribus*.

3.2.3. Political business cycles: presidential and gubernatorial elections

When deciding whether to attempt to enter the U.S. illegally, potential Mexican immigrants may anticipate the effects of a political business cycle on U.S. immigration policies. In a U.S. gubernatorial or presidential election year, the sitting governor or president may implement more restrictive immigration policies than in non-election years. This can include increasing the number of man-hours spent policing the border, detaining apprehended persons for longer, or reducing the number of Mexicans admitted to the U.S. as described below. If Mexican immigrants anticipate this political business cycle, they may wait until a non-election year to try entering the U.S. illegally. Our seventh hypothesis is:

Hypothesis 7: Illegal immigration is higher in non-election years than in gubernatorial and/or presidential election years, *ceteris paribus*.

3.2.4. Political party bias: party affiliation of the governor

We test whether illegal Mexican immigrants anticipate the preferences of political parties with respect to immigration policies. It seems reasonable to assume that – due to (ideological) preferences and practical political considerations[12] – Republican governors will implement more restrictive immigration policies than Democratic governors. We therefore expect that Mexicans will enter the U.S. via states with Democratic governors rather than via states with Republican governors. Thus, our eighth hypothesis is:

Hypothesis 8: We expect that illegal Mexican immigrants prefer to enter the U.S. via states with Democratic governors rather than Republican governors, *ceteris paribus*.

3.2.5. Governance in Mexico

Potential Mexican immigrants may take the quality of macroeconomic management in Mexico into account when deciding whether to stay in Mexico. Mexico has frequently experienced prolonged periods of high inflation in which real wages declined – probably due to nominal rigidities. Accelerating inflation rates in Mexico may therefore be interpreted as a sign of falling Mexican real wages in the future and may thus increase the incentive to immigrate to the U.S. illegally. Our ninth hypothesis is:

[12] Democrats may be more lenient towards illegal immigrants because most Mexican voters in the U.S. are Democrats. These Mexicans may not want their (illegal) friends and family to be deported. As members of the Democratic party, they can influence the party platform. Also, Democrats don't want to lose Mexican voters by being too harsh on immigration.

Hypothesis 9: Higher inflation in Mexico increases the incentive to immigrate illegally, *ceteris paribus*.

3.2.7 Number of admissions

The number of Mexicans permitted to enter/stay in the U.S. *legally* may influence an immigrant's decision to enter the U.S. illegally. Under U.S. law, Mexicans can apply for a legal permanent status in the U.S. If a Mexican citizen obtains legal status to live in the U.S., relatives can also apply for admission. As Espenshade (1994) points out, this process often takes up several years. In order to reunify the family soon, relatives who do not yet have an admission to live permanently in the U.S., may opt to enter the U.S. illegally while their application is being processed (Hanson and Spilimbergo, 1999). Thus, an increase in the legal quota for Mexican immigrants may lead to an increase in illegal immigration. Our tenth and final hypothesis is:

Hypothesis 10: A higher number of Mexican admissions increases the incentive for Mexican immigrants to enter the U.S. illegally, *ceteris paribus*.

4. Empirical analysis

4.1. Methodology

We use a MIMIC model to explain the relationships between observable variables and illegal immigration. This model allows us to consider the multiple economic causes/determinants of illegal immigration and to use more than one indicator to make illegal immigration across the U.S.-Mexico border "visible". Formally, the MIMIC model consists of two parts: the structural equation model and the measurement model. The structural equation model describes the relationship between illegal immigration and its causes. It is given by:

$$\eta = \gamma'\mathbf{x} + \varsigma \quad , \tag{1}$$

where η denotes illegal immigration, $\boldsymbol{x}' = (x_1, x_2, \ldots, x_q)$ is the vector of potential causes, $\gamma' = (\gamma_1, \gamma_2, \ldots, \gamma_q)$ is a vector of regression coefficients, and ς is a white noise error term. The measurement model links the latent variable to its indicators and is specified by:

$$\boldsymbol{y} = \lambda\eta + \boldsymbol{\varepsilon} \quad , \tag{2}$$

where $\boldsymbol{y}' = (y_1, y_2, \ldots, y_p)$ is the vector of several indicator variables, $\lambda' = (\lambda_1, \lambda_2, ..., \lambda_p)$ is the vector of regression coefficients, and ε is a vector of white noise error terms. Using Eq. (1) in Eq. (2) yields a reduced form multivariate regression model:

$$\boldsymbol{y} = \boldsymbol{\Pi x} + \boldsymbol{z} \quad , \tag{3}$$

where the endogenous variables y_j , $j = 1, \ldots, p$ are the latent variable $\eta' s$ indicators and the exogenous variables x_i , $i = 1, \ldots, q$ its determinants, $\boldsymbol{\Pi} = \boldsymbol{\lambda\gamma}'$ is a matrix with rank equal to 1, and $\boldsymbol{z} = \boldsymbol{\lambda}\zeta + \boldsymbol{\varepsilon}$ is a vector of linear combinations of the white noise error terms of the structural equation and the measurement models.[13]

In the first step we estimate MIMIC models for Arizona, California, and Texas. Figure 1 shows the path diagram of the benchmark specification (Specification 1) using the indicators (linewatch and non-linewatch apprehensions) and core determinants of illegal immigration (border enforcement, the state's unemployment rate, the state's real wages, the Mexican unemployment rate, and Mexican real wages). In the next step, we use the estimation results to calculate an index of the latent variable for each state and point in time. Applying a benchmarking procedure, these indices are transformed into "real world figures" which finally provide the development of illegal

[13] Since the covariance matrix of $\boldsymbol{z} = \boldsymbol{\lambda}\zeta + \boldsymbol{\varepsilon}$ is constrained like $\boldsymbol{\Pi}$, the estimation of the model requires the normalization of one of the elements of the vector $\boldsymbol{\lambda}$ to an *a priori* value. A comprehensive description of this methodology is for example presented in Bollen (1989).

immigration from Mexico to the U.S. over time.

[Insert Fig. 1 about here]

4.2. Data

To estimate the MIMIC models, we use monthly data from 1985 to 2004. Our sample is restricted to this period for two reasons. First, monthly data on the unemployment rate in Mexico is only available from 1985. Second, monthly data on linewatch and non-linewatch apprehensions is only available through September 2004. Table A.1 in Appendix A presents the empirical identification, data sources, and definitions for each of the variables.

Since MIMIC models with non-stationary time series produce misleading estimates, we test for unit roots. We examine each time series under the null hypothesis of a unit root against the alternative of stationarity using the Augmented Dickey Fuller (ADF) test. We find that most of the variables – except for the variables measuring average temperatures at the U.S.-Mexico border and coyote prices in Arizona – are not stationary in levels. Consequently, the non-stationary variables are transformed into first differences and re-tested. As the null hypothesis can now be rejected, we use the first difference of all variables except for average temperatures and coyote prices in Arizona – which enter the MIMIC model estimations in levels.[14]

4.3. Estimation results

Tables 1, 2, and 3 present the results of our MIMIC model estimations for illegal immigration from

[14] Testing stationarity against the alternative of the presence of a unit root using the Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) test confirms the results obtained by the ADF test. The results of the unit roots tests are not reported but available upon request. We also tested for cointegration between I(1) indicators and the corresponding determinants but could not confirm any unambiguous cointegration relation.

Mexico to Arizona, California, and Texas, respectively.[15] For each state, we estimate the same set of eight different MIMIC model specifications. Specification 1 is our benchmark specification. Specifications 2 to 8 include one additional causal variable each, as explained in Section 3. As already mentioned, the estimation of a MIMIC model requires the normalization of one of the latent variable's indicators. The indicator chosen also determines the unit of measurement of the latent variable (Bollen, 1989). In our estimations, we set the coefficient of linewatch apprehensions to 1.[16]

[Insert Tables 1, 2, and 3 about here]

The MIMIC model estimations show that labor market conditions and border enforcement are the major determinants of illegal immigration from Mexico to the U.S. Although the results are heterogeneous among the states, we find some similarities: the expected revenues (determined by better labor market conditions, i.e., higher real wages and a lower unemployment rate in the U.S. state than in Mexico) and the expected costs (border enforcement) significantly influence the decision to immigrate to the U.S illegally. In addition, both pull factors – higher real wages and a lower unemployment rate in the U.S. state – as well as push factors –lower real wages and a higher unemployment rate in Mexico – are significant determinants of illegal immigration, although to different degrees.

With respect to the labor market variables, the estimation results reveal some heterogeneity among the determinants of illegal immigration. While in Arizona the state unemployment rate is the key pull factor, state-specific real wages is the key pull factor in California and Texas. With regard to push factors in Mexico – the Mexican real wage and the Mexican unemployment rate – the results are also interesting. Illegal immigration to Arizona and California, for example, is driven

[15] All calculations have been carried out with $\text{LISREL}_{®}$ Version 8.80. Tables 1, 2, and 3 show the unstandardized coefficients used in sub-section 4.4 to calculate the state-specific illegal immigration indices. As a robustness check, we also calculate these indices using standardized coefficients. Neither the estimation results nor the calculated indices is sensitive to the choice of coefficients.

[16] The choice of the indicator to fix the scale of the latent variable does not affect the results.

by Mexican real wages. Illegal immigration to Texas, on the other hand, is sensitive to changes in the Mexican unemployment rate.

In the following we discuss the different empirical findings concerning the labor market determinants of illegal immigration to Arizona, California, and Texas. Our results suggest that the decision to immigrate illegally to which U.S. border state is driven by differences in employment opportunities. Our results also suggest that Arizona, California, and Texas attract different types of illegal immigrants who likely differ in their labor market characteristics. We examine each state's industrial structure, average weekly wages, employment opportunities, and border enforcement policies to explain what types of illegal Mexican immigrants might migrate to the states along the U.S. Southern Border.

Hanson et al. (2002) find that immigrants are prevalent in industries requiring unskilled labor such as the apparel, textile, food, and furniture industries.[17] Based on their observations, we calculate the share of employees in high-immigrant industries relative to total employment in Arizona, California, and Texas to proxy potential employment opportunities for illegal Mexican immigrants. The employment shares together with the corresponding annual average weekly wages in each industry in each state are presented in Table 4.

[Insert Table 4 about here]

Table 4 reveals that the share of employment in high-immigrant industries to total employment is similar among the states – with some exceptions. The construction and retail industries make up a slightly smaller share of total employment in California compared to Arizona and Texas. In Texas, agriculture by far comprises the highest share of employment compared to agriculture in Arizona and California. On average, California pays the highest wages, except in the agricultural and

[17] According to Hanson et al. (2002), 32% of employees working in these industries in California's border regions in 1990 were Mexican immigrants.

apparel industries – where the wages are highest in Texas.

Fig. 2 displays the number of man-hours spent patrolling the border per border mile in Arizona, California, and Texas. It demonstrates that – although the extent of border enforcement has converged between the states since 1985 – the risk of apprehension and, thus, the expected costs of crossing the border illegally is highest in California and lowest in Texas. Fig. 3 shows the development of the unemployment rate in Arizona, California, and Texas. Unemployment has been lower in Arizona than in California and Texas for almost the entire observation period and especially in the last two decades.

[Insert Figs. 2 and 3 about here]

Given more intense border enforcement in California and Arizona, the expected costs for illegal Mexican immigrants are higher when crossing the border into these states. Since the higher expected costs of illegal immigration to California and Arizona must be compensated by higher expected wages, it is reasonable to assume that illegal immigrants entering California and Arizona are driven more by wage incentives than illegal immigrants entering Texas. The higher wages in California and the lower unemployment rate in Arizona thus off-set the higher risk of apprehension in these states. This suggests that better-educated immigrants will cross the border into these states. Since well-educated immigrants most likely had jobs and faced a lower risk of unemployment risk in Mexico compared to less-educated Mexicans, low real Mexican wages is the determining push factor for illegal immigration from Mexico to California and Arizona. This suggests that California may attract higher-skilled immigrants who can benefit from the high wage level. Arizona offers better access to employment as demonstrated by the significant negative correlation between the unemployment rate in Arizona and illegal immigration from Mexico to Arizona.

Our results confirm similar findings by Orrenius and Zavodny (2005). They point out that more intense border enforcement leads to better educated illegal immigrants. Thus, the average skill level of illegal immigrants in Arizona and California (where border enforcement is much higher than in Texas) should be higher than the average skill level of illegal immigrants in Texas. Less-educated immigrants – who are more likely affected by higher rates of unemployment in Mexico – may more actively respond to changes in the unemployment rate in Mexico than better-educated immigrants. Likewise, the relatively low expected costs of illegal immigration in Texas suggest that less-educated illegal immigrants will cross the border into this state. The relatively high importance of agriculture – as indicated by the higher share of agricultural to total employment in that state compared to Arizona and California – further ensures adequate employment opportunities for these types of illegal Mexican immigrants.

In addition to labor market conditions, border enforcement is a major determinant of illegal immigration. We find that more intense border enforcement significantly deters illegal immigration for all states and all specifications. That is, the higher the probability of being caught at the border, the higher the expected costs for illegal immigrants and, thus, the lower the rate of illegal immigration, *ceteris paribus*. This result confirms the findings of Hanson and Spilimbergo (1999) and Dávila et al. (2002).

For Specifications 2 to 8, we include another variable additional to the labor market variables and border enforcement. Specification 2 tests the impact of coyote prices on illegal immigration across the U.S.-Mexico border. For none of the states do we find significant evidence that higher coyote prices decrease the incentive to immigrate illegally.

Specification 3 tests whether higher than average temperatures in U.S.-Mexico border regions reduces illegal immigration as outlined in Hypothesis 6. We cannot confirm this hypothesis for any of the three states. This suggests that illegal Mexican immigrants do not take the health risks of high temperatures (particularly in summer) into account when deciding when and where to cross the U.S.-Mexico border. This supports anecdotal evidence that Mexicans would rather risk dehydration and/or death rather than apprehension and therefore cross the border in less-patrolled, higher temperature regions like the Sonoran Desert.

Specifications 4 to 6 test the effect of gubernatorial elections, party affiliation of the governor, and presidential elections on illegal immigration, respectively. In general, we cannot confirm that illegal immigrants anticipate the effects of political business cycles on U.S. immigration policies with one exception. In California, illegal immigration is significantly lower during presidential election years than during non-presidential election years, which may partly support our hypothesis. Apparently, illegal Mexican immigrants anticipate more restrictive immigration policies in California during presidential election years.

Specifications 7 and 8 examine the influence of Mexican inflation and admissions. In none of the states do we find significant evidence to support our hypotheses. Instead, it appears that the decision whether to immigrate illegally to the U.S. is influenced solely by labor market conditions and the intensity of border enforcement.

Turning to the indicators, we find a highly significant, positive relationship between illegal immigration and the number of non-linewatch apprehensions in each U.S. state for all specifications. This confirms our hypothesis that the number of successful attempts to cross the border is a valid indicator of the level of illegal immigration. We also find a positive relationship between illegal immigration and linewatch apprehensions, which supports our hypothesis that the number of linewatch apprehensions is a valid indicator of illegal Mexican immigration. According to the MIMIC model's identification rule explained in sub-section 4.1, this indicator has been fixed and, thus, has no z-statistic.

All of the MIMIC models estimated show satisfactory overall goodness-of-fit statistics as shown in Tables 1 to 3. The models fit the data fairly well, and the q-plots[18] demonstrate a sufficiently normal distribution of the standardized residuals, i.e., the difference between the observed and the fitted covariance matrices. We therefore accept the validity of the MIMIC models estimated and calculate long-term illegal immigration indices for Arizona, California, and Texas, as explained in the next sub-section.

4.4. Long-term trends in illegal immigration from Mexico to the southern U.S. Border States

The MIMIC coefficients estimated allow us to calculate monthly estimates of the number of illegal Mexican immigrants entering Arizona, California, and Texas between 1985 and 2004. First, we derive an exogenous base value for the average inflow of illegal Mexican immigrants using expert estimates. Second, we apply a benchmarking procedure to the base value and calibrate a time series of illegal Mexican immigration.

The residual approach is the most common procedure used in the literature to estimate numbers of illegal immigrants. It is calculated by subtracting the number of immigrants with permanent or temporary legal status in the U.S. from the *total* number of (legal and illegal) foreign-born individuals residing in the U.S.[19] The accuracy of estimates of the number of illegal immigrants depends on the accuracy of estimates of mortality rates, immigration rates, and the total immigrant population. For these reasons, this paper does therefore attempt to provide exact estimates of illegal immigration but rather to estimate the development of illegal immigration to the U.S. Southern Border States from Mexico over time. Table 5 presents five expert estimates of the annual inflow of illegal Mexican immigrants to the U.S. The highest estimate – 398,000 per year between 1995 and 2006 – comes from Passel (2007). The average is estimated to be 350,000 per year.

[18] Available upon request.
[19] See Hanson (2006) for a more detailed discussion.

[Insert Table 5 about here]

We use expert estimates of the state of residence of illegal immigrants in the U.S. – presented in Table 6 – to estimate the number of illegal Mexican immigrants in each of the border states Arizona, California, and Texas,. These shares refer to foreign-born illegal immigrants of all nationalities. We assume that the choice of residence of all illegal immigrants applies to illegal Mexican immigrants as well.[20] The most popular spot is California – where 26.4% of all illegal immigrants in the U.S. reside. This comes as no surprise given the relatively high wages and large labor market in California. Texas and Arizona account for 13.5% and 4.3% of all illegal immigrants, respectively.

[Insert Table 6 about here]

To calculate the average base value of the inflow of illegal Mexican immigrants into each state, we multiply the expert estimates of illegal Mexican immigrants to the U.S. as a whole presented in Table 5 by the mean expert estimates of the regional allocation of illegal immigrants presented in Table 6. Table 7 reports the results. According to these calculations, between 13,000 and 17,000 Mexican immigrate to Arizona illegally each year. The number of illegal Mexican immigrants to California and Texas varies – depending on the expert estimate – between 79,000 and 105,000 each year and between 41,000 and 54,000 each year, respectively. These base values allow us to calculate time series for illegal immigration using the benchmarking procedure promoted by Dell'Anno and Schneider (2006), Dell'Anno (2007), and Dell'Anno and Solomon (2008).

[Insert Table 7 about here]

We first calculate the MIMIC model index of illegal immigration by multiplying the coefficients of the significant causal variables by the respective time series. Given the five base value estimates for

[20] This assumption may be justified given the fact that 57% of all undocumented foreign-born individuals in 2002 were Mexican (Passel, 2005).

each state presented in Table 7, we calculate five MIMIC indices for Arizona (AZ), California (CA), and Texas (TX) using benchmark Specification 1. According to the MIMIC model's identification rule, the number of illegal Mexican immigrants is measured in apprehensions of illegal Mexican immigrants in the same period from which the base value is derived.[21] Hanson's (2006) base value, for example, represents the number of illegal Mexican immigrants as measured by the annual average number of illegal Mexican immigrants apprehended between 1996 and 2001. The MIMIC indices are calculated as outlined in Eqs. (4), (5), and (6) for Arizona, California, and Texas, respectively:

$$\frac{\tilde{\eta}_t^{AZ}}{Immigrants_{Base\ period}^{AZ}} = -0.51 \cdot \Delta Enforcement_t^{AZ} - 0.21 \cdot \Delta Unemployment_t^{AZ} - 0.12 \cdot \Delta Wage_t^{MEX}\,, \quad (4)$$

$$\frac{\tilde{\eta}_t^{CA}}{Immigrants_{Base\ period}^{CA}} = -0.39 \cdot \Delta Enforcement_t^{CA} + 0.12 \cdot \Delta Wage_t^{CA} - 0.30 \cdot \Delta Wage_t^{MEX}\,, \quad (5)$$

$$\frac{\tilde{\eta}_t^{TX}}{Immigrants_{Base\ period}^{TX}} = -0.55 \cdot \Delta Enforcement_t^{TX} + 0.14 \cdot \Delta Wage_t^{TX} + 0.15 \cdot \Delta Unemployment_t^{MEX}\,. \quad (6)$$

We aggregate the monthly values of the MIMIC index over the last 12 months in order to relate the monthly MIMIC index to the average annual base value and obtain annualized estimates for illegal immigration. Eq. (7) presents the aggregation for Arizona:

$$\frac{\tilde{H}_t^{AZ}}{Immigrants_{Base\ period}^{AZ}} = \sum_{i=0}^{11} \frac{\tilde{\eta}_{t-i}^{AZ}}{Immigrants_{Base\ period}^{AZ}}\,, \quad (7)$$

where $\tilde{H}_t^{AZ}$ is the annualized MIMIC index of Eq. (4). The aggregated values for California and Texas are similarly obtained using Eqs. (5) and (6), respectively.

We then convert the annualized MIMIC index into a time series of illegal immigration which

[21] As outlined in sub-section 4.3, linewatch apprehensions are used as an index variable in order to identify the MIMIC model. The denominator of the index thus equals the number of linewatch apprehensions in the base period. As the latent variable is measured in units of the fixed indicator, illegal immigration is measured in apprehensions of illegal immigrants at the border in the base period.

takes the average base value in the base period as listed in Table 7. For Arizona, the annualized number of illegal immigrants $\tilde{H}_t^{AZ}$ at time t is given by:

$$\tilde{H}_t^{AZ} = \frac{\tilde{H}_t^{AZ}}{Immigrants_{Base\ period}^{AZ}} \frac{Immigrants_{Base\ period}^{AZ}}{\tilde{H}_{Base\ period}^{AZ}} \tilde{H}_{Base\ period}^{AZ}, \qquad (8)$$

where $\tilde{H}_t^{AZ} / Immigrants_{Base\ period}^{AZ}$ denotes the value of the annualized MIMIC index at month t according to Eq. (7), $\tilde{H}_{Base\ period}^{AZ} / Immigrants_{Base\ period}^{AZ}$ is the average value of this index in the period from which the expert estimate is taken, and $\tilde{H}_{Base\ period}^{AZ}$ is the exogenous average annual expert estimate of illegal Mexican immigrants entering Arizona in the base period. The base period for Hanson's (2006) expert estimate, for example, is 1996 to 2001, and the exogenous average annual inflow of illegal Mexican immigrants to Arizona, $\tilde{H}_{1996\text{-}2001}^{AZ}$, is 17,000. The calibrated MIMIC indices for California and Texas are similarly derived using the annualized uncalibrated MIMIC indices and the corresponding base values reported in Table 7.

Figs. 4 to 6 show the calibrated MIMIC indices for Arizona, California, and Texas, respectively. Each figure displays four different indices to show how the base value affects the estimated size of illegal immigration.[22] A first inspection of the calibrated indices reveals that the indices with base values including the 1990s, i.e., Hanson (2006) and Passel (2007), exceed those with base values in the 2000s only, i.e. Passel (2006) and Hoefer et al. (2008)/Passel and Cohn (2008), (see also Tables 5 and 7). In the 1985 to 2000 period, illegal immigration from Mexico shows no clear time trend but rather exhibits large fluctuations.

[Insert Figs. 4, 5, and 6 about here]

Between 1985 and 1993, the annualized inflow of illegal Mexican immigrants to California

[22] Since both Passel and Cohn (2008) and Hoefer et al. (2008) estimate the annual inflow of illegal Mexican immigrants to the U.S to be 330,000, we display only one index.

fluctuated around the mean relatively closely, exhibiting a slight downward trend between 1985 and 1989. The outbreak of a financial crisis and subsequent devaluation of the peso in 1994/95 led to a severe Mexican recession: real wages fell by 25% and the unemployment rate rose by 2% within one year after the outbreak of the crisis in December 1994. These adverse labor market conditions acted as a push factor for illegal immigration, resulting in a 60% increase in the number of illegal Mexican immigrants to California between 1994 and 1995.

On October 1, 1994, a new border patrol plan to combat illegal immigration – Operation Gatekeeper – was launched at Imperial Beach station in the San Diego sector of the border. Its purpose was to better equip the station with, for example, four wheel drive vehicles and infrared night scopes in order to shift illegal immigrants eastwards – where the Border Patrol believed it had a strategic advantage.[23] Over time, the same operational concepts have been implemented at the remaining border stations in an easterly progression along the California-Mexico border. Gatekeeper Phases II (June 1995 to May 1996) and III (October 1997) sent resources to East County and Imperial County to address increases in illegal immigration traffic in these areas. Fig. 5 shows that the strengthening of the border patrol and the recovery of the Mexican economy brought illegal immigration back to pre-crisis levels in 1996. Illegal immigration remained at these levels until 2001.

Figure 4 shows the pattern of illegal immigration from Mexico to Arizona. The level of illegal immigration was relatively stable from 1985 to 2000 with temporary fluctuations attributable to changes in the intensity of border enforcement. Following the launch of Operation Gatekeeper in California on October 1, 1994 illegal immigration shifted eastwards from southern California to Arizona – leading to relatively large inflows of illegal immigrants into Arizona in the fall of 1994. Consequently, Operation Safeguard was launched in the Tucson Sector in late 1994. The operation

[23] For details on the INS's Southwest Border Strategy, see General Accounting Office (2001).

was intended to complement the enforcement activities in California and make illegal immigration into Arizona more difficult. Fig. 4, however, shows that the first phase of Operation Safeguard did not have the expected impact on illegal border crossings – with the exception of a minor decrease in 1995/96. In 1999, Operation Safeguard was intensified, resulting in heavy declines in 2000 and 2001.

Figure 6 presents the development of illegal immigration from Mexico to Texas. It shows that the first major impact of U.S. border patrol policies on illegal immigration to Texas occurred in 1993. Operation Hold-the-Line – launched on September 19, 1993 along the border between El Paso, Texas and Juarez, Mexico – initially significantly reduced illegal immigration. Because of the financial crisis and subsequent economic downturn in Mexico in 1994/95, however, the effect was only temporary.

Fig. 7 presents the average of the MIMIC indices for each state calculated as the arithmetic mean of the four indices used in Fig. 4 to 6, respectively. This enables us to compare the patterns of illegal Mexican immigration for Arizona, California, and Texas. For example, illegal immigration is highest in California and lowest in Arizona. There are erratic fluctuations in illegal immigration to both California and Texas until 1993. Illegal immigration then declined in both states as result of Operations Hold-the-Line (in Texas in 1993) and Gatekeeper (in California in 1994) and then increased sharply following the financial crisis in Mexico in 1994/95. Following the economic recovery in Mexico, illegal immigration fell to pre-crisis levels in both states. Illegal immigration from Mexico to Arizona remained fairly stable until 2000 when the reinforced Operation Safeguard began successfully to deter immigrants from entering the U.S. illegally.

The U.S. further tightened enforcement of the U.S.-Mexico border following the 9/11 terrorist attacks as officials feared that al-Qaida operatives or other terrorist groups might try to enter the U.S. illegally via the border to Mexico. This new era in U.S. (southern) border policies had a significant impact on illegal Mexican immigration in each of the three border states. The inflow of illegal Mexican immigrants fell substantially in the last quarter of 2001, recovered in 2002, and fell again in 2003. Overall, the post- 9/11 border policies may have contributed to higher volatility in illegal immigration from Mexico to Arizona, California, and Texas compared to the 1980s and 1990s.

[Insert Fig. 7 about here]

The indices presented in this paper are – to our knowledge – the first state-specific time series estimates of illegal immigration from Mexico to Arizona, California, and Texas. This makes it difficult to assess the accuracy of our estimates. We can, however, compare them to the expert estimates for the U.S as a whole. We have therefore aggregated the individual indices shown in Fig. 7 to provide an overall index of illegal Mexican immigration. This index, presented in Fig. 8, illustrates total illegal immigration from Mexico to Arizona, California, and Texas.

[Insert Fig. 8 about here]

As a simple robustness check, we compare the estimates of the index presented in Fig. 8 with the expert estimates of illegal Mexican immigrants residing in the U.S. as a whole between 2000 and 2008 presented in Passel and Cohn (2008, p. 3). According to Passel and Cohn, the number of illegal Mexican immigrants to the U.S. increased by 100,000 from 2000 to 2001, by 400,000 from 2001 to 2002, by 200,000 from 2002 to 2003, and by 500,000 from 2003 to 2004. Considering that approximately 50% of all illegal Mexican immigrants reside in Arizona, California, and Texas, the expert estimates in Passel and Cohn (2008) are consistent with our estimation of illegal immigration from Mexico to these border states. Passel and Cohn (2008) also find a similar pattern of volatility in illegal Mexican immigration as presented in Fig. 8. This suggests that the indices of illegal Mexican immigration to Arizona, California, and Texas presented in this paper are reasonably accurate.

5. Summary and conclusions

We analyze illegal immigration from Mexico to Arizona, California, and Texas between 1985 and 2004 using a MIMIC model. We explicitly consider the unobservable nature of illegal immigration using non-linewatch *and* linewatch apprehensions. This accounts for both successful and unsuccessful attempts to enter the U.S. illegally. Estimating a distinct MIMIC model for each state, we identify the determinants of illegal Mexican immigration to each state. The significant determinants are then used to calculate estimates for the inflow of illegal Mexican immigrants to Arizona, California, and Texas.

We find that labor market conditions in Mexico and the U.S. state and the intensity of border enforcement in that state significantly affect illegal Mexican immigration to that state. The MIMIC indices calculated reveal that – in general – illegal Mexican immigration is relatively stable over time. Several events caused fluctuations in this otherwise stable level. The outbreak of the peso crisis in Mexico in December 1994, for example, resulted in a decline in real wages and a rise in the unemployment rate in Mexico, leading to a massive increase in illegal immigration in 1995. Several border enforcement operations, such as Operation Hold-the-Line in Texas, Operation Gatekeeper in California, and Operation Safeguard in Arizona, enjoyed brief success in deterring illegal immigration. The estimation results also show that, in principle, an increase in border enforcement – as measured by man-hours spent patrolling the border – reduces illegal immigration. The attacks of September 11, 2001 induced a fundamental change in U.S. border enforcement policy: the Southern border has been scrutinized as a potential port of entry for terrorists. As a result, increases in the number of man-hours spent patrolling the borders have led both to massive declines and to increased volatility in illegal immigration.

Our results have significant implications for policymakers. Our findings suggest that more intense border enforcement effectively deters Mexican immigrants from entering the U.S. illegally. The recent shift of illegal border crossings form the highly guarded California-Mexico border to the relatively unguarded and hazardous Arizona-Mexico and Texas-Mexico borders might also be interpreted as evidence in favor of an effective deterrence effect. This implies that further intensification of border enforcement could reduce illegal immigration. To achieve convergence in the risk of apprehension at the border, additional resources should be channeled to Arizona and Texas and, thus, to reduce the number of deaths of Mexicans trying to cross the border at unguarded but hazardous spots like the Sonoran Desert in Arizona.

A second implication concerns potential U.S. financial support for Mexico in times of financial and economic crisis. The Mexican peso crisis in 1994/95, for example, demonstrates that a severe financial crisis – and the resulting adverse effects on Mexican labor market conditions – increases illegal immigration to the U.S. U.S. financial support could help the Mexican government cope with the crisis and its adverse effects on Mexican labor market conditions, thereby avoiding an increase in illegal immigration in the U.S. This could be a useful policy to pursue in light of the recent subprime crisis. In the long run, it might be cheaper for the U.S. to provide financial help to Mexico than to bear the costs of an increase in the labor supply – caused by illegal Mexican immigration – especially considering the now record levels of unemployment in the U.S.

References

Bean, F.D., Corona, R., Tuiran, R., Woodrow-Lafield, K.A., van Hook, J., 2001. Circular, invisible, and ambiguous migrants: components of difference in estimates of the number of unauthorized Mexican migrants in the United States. Demography 38, 411–422.

Bollen, K.A., 1989. Structural Equations with Latent Variables. Wiley, New York, N.Y.

Borjas, G.J., 1987. Self-selection and the earnings of immigrants. American Economic Review 77, 531–553.

Borjas, G.J., 1995. Assimilation and changes in cohort quality revisited: what happened to immigrant earnings in the 1980s?. Journal of Labor Economics 13, 201–245.

Borjas, G.J., Freeman, R.B., Lang, K., 1991. Undocumented Mexican-born workers in the United States: how many, how permanent?, in: Abowd, J.M., Freeman, R.B., (Eds.), Immigration, Trade, and the Labor Market. The University of Chicago Press, Chicago, pp. 77–100.

Browne, M.W., Cudeck, R., 1993. Alternative ways of assessing model fit, in: Bollen, K.A., Long, J.S. (Eds.), Testing Structural Equation Models. Sage, Newbury Park, CA, pp. 136–162.

Chiquiar, D., Hanson, G.H., 2005. International migration, self selection, and the distribution of wages: evidence from Mexico and the United States. Journal of Political Economy 113, 239–281.

Costanzo, J., Davis, C., Irazi, C., Goodking, D., Ramirez., R., 2001. Evaluating components of international migration: the residual foreign born population. U.S. Bureau of the Census Working Paper No. 61.

Dávila, A., Pagán, J.A., Grau, M.V., 1999. Immigration reform, the INS, and the distribution of interior and border enforcement resources. Public Choice 99, 327–345.

Dávila, A., Pagán, J.A., Soydemir, G., 2002. The short-term and long-term deterrence effects of INS border and interior enforcement on undocumented immigration. Journal of Economic Behavior & Organization 49, 459–472.

Dell' Anno, R., 2007. The shadow economy in Portugal: an analysis with the MIMIC approach. Journal of Applied Economics 10, 253–277.

Dell' Anno, R., Schneider, F., 2003. The shadow economy of Italy and other OECD countries: what do we know?. Journal of Public Finance and Public Choice 21, 97–120.

Dell' Anno, R., Schneider, F., 2006. Estimating the underground economy: a response to T.

Breusch's critique. Johannes Kepler University Linz, Department of Economics Working Paper 06/07.

Dell' Anno, R., Solomon, O.H., 2008. Shadow economy and unemployment rate in USA: is there a structural relationship? An empirical analysis. Applied Economics 40, 2537–2555.

Donato, K.M., Durand, J., Massey, D.S., 1992. Stemming the tide? Assessing the deterrent effects of the Immigration Reform and Control Act. Demography 29, 139–157.

Espenshade, T., 1994. Does the threat of border apprehension deter undocumented US immigration. Population and Development Review 20, 871–892.

Espenshade, T., 1995. Unauthorized immigration to the United States. Annual Review of Sociology 21, 195–216.

Farzanegan, M.R., 2009. Illegal trade in the Iranian economy: Evidence from a structural model. European Journal of Political Economy 25, 489–507.

Feliciano, Z.M., 2001. The skill and economic performance of Mexican immigrants from 1910 to 1990. Explorations in Economic History 38, 386–409.

Gathmann, C., 2008. Effects of enforcement on illegal markets: evidence from migrant smuggling along the southwestern border. Journal of Public Economics 92, 1926–1941.

General Accounting Office, 2001. INS' Southwest Border Strategy, Washington, D.C.

Hanson, G.H., 2006. Illegal migration from Mexico to the United States. Journal of Economic Literature 44, 869–924.

Hanson, G.H., Spilimbergo, A., 1999. Illegal immigration, border enforcement, and relative wages: evidence from apprehensions at the U.S.-Mexico border. American Economic Review, 89, 1337–1357.

Hanson, G.H., Robertson, R., Spilimbergo, A., 2002. Does border enforcement protect U.S. workers from illegal immigration? Review of Economics and Statistics 84, 73–92.

Hillman, A.L., Weiss, A., 1999. A theory of permissible illegal immigration. European Journal of Political Economy 15, 585–604.

Hoefer, M., Rytina, N., Baker, B.C., 2008. Estimates of the unauthorized immigrant population residing in the United States: January 2007. Office of Immigration Statistics, Policy Directorate, U.S. Department of Homeland Security, Washington, D.C.

McKenzie, D., Rapoport, H., 2007. Network effects and the dynamics of migration and inequality: theory and evidence from Mexico. Journal of Development Economics 84, 1–24.

Mulaik, S.A., James, L.R., Van Alstine, J., Bennett, N., Lind, S., Stilwell, C.D., 1989. Evaluation of goodness-of-fit indices for structural equation models. Psychological Bulletin 105, 430–445.

Munshi, K., 2003. Networks in the modern economy: Mexican migrants in the U.S. labor market. Quarterly Journal of Economics 118, 549–599.

Nannestad, P., 2009. Unproductive immigrants: A socially optimal policy for rational egalitarians. European Journal of Political Economy 25, 562-566.

Orrenius, P.M., 2001. Illegal immigration and enforcement along the U.S.-Mexico border. Economic and Financial Policy Review, 1st quarter, 2-11, Federal Reserve Bank of Dallas.

Orrenius, P.M., Zavodny, M., 2005. Self-selection among undocumented immigrants from Mexico. Journal of Development Economics 78, 215–240.

Passel, J.S., 2005. Estimates of the size and characteristics of the undocumented population. Pew Hispanic Center Report, Washington, D.C.

Passel, J.S., 2006. The size and characteristics of the unauthorized migrant population in the U.S.: estimates based on the March 2005 Current Population Survey. Pew Hispanic Center Report, Washington, D.C.

Passel, J.S., 2007. Unauthorized migrants in the United States: estimates, methods, and characteristics. OECD Social, Employment and Migration Working Papers No. 57.

Passel, J.S., Cohn, D., 2008. Trends in unauthorized immigration: undocumented inflow now trails legal inflow. Pew Hispanic Center Report, Washington, D.C.

Pickhardt, M., Sardà Pons, J., 2006. Size and scope of the underground economy in Germany. Applied Economies 38, 1707–1713.

Schneider, F., 2005. Shadow economies around the world: what do we really know? European Journal of Political Economy 21, 598–642.

Schneider, F., 2006. Shadow economies and corruption all over the world: new estimates for 145 countries. Economics: The Open-Access, Open-Assessment E-Journal, 1, 2007–2009.

Schneider, F., Enste, D., 2000. Shadow economies: size, causes, and consequences. The Journal of Economic Literature 38, 77–114.

U.S. Department of Homeland Security, *various issues*. Yearbook of Immigration Statistics. Government Printing Office, Washington, D.C.

U.S. Immigration and Naturalization Service, 2001. Estimates of the Unauthorized Immigrant Population Residing in the United States: 1990-2000, Washington, D.C.

White, M.J., Bean, F.D., Espenshade, T.J., 1990. The US 1986 Immigration Reform and Control Act and undocumented migration to the United States. Population Research and Policy Review 9, 93–116.

Table 1

Illegal immigration to Arizona

Determinants	Specification							
	1	2	3	4	5	6	7	8
Border enforcement	-0.51***	-0.51***	-0.52***	-0.52***	-0.52***	-0.51***	-0.51***	-0.51***
	(9.50)	(9.71)	(9.92)	(10.08)	(9.96)	(9.76)	(9.60)	(9.73)
Arizona	-0.21***	-0.20***	-0.21***	-0.22***	-0.21***	-0.21***	-0.20***	-0.20***
unemployment rate	(2.70)	(2.76)	(2.86)	(2.81)	(2.76)	(2.74)	(2.72)	(2.81)
Arizona real wage	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.05
	(0.93)	(0.99)	(1.12)	(0.97)	(0.95)	(0.87)	(0.85)	(0.94)
Mexican	0.03	0.03	0.04	0.03	0.03	0.04	0.03	0.03
unemployment rate	(1.07)	(1.11)	(1.24)	(1.16)	(1.15)	(1.24)	(1.11)	(1.10)
Mexican real wage	-0.12***	-0.12***	-0.11**	-0.12***	-0.12***	-0.12***	-0.12***	-0.12***
	(2.52)	(2.56)	(2.17)	(2.54)	(2.50)	(2.46)	(2.38)	(2.61)
Coyote prices		0.02						
		(0.32)						
Temperature			-0.03					
			(0.59)					
Governor election				-0.01				
year dummy				(0.10)				
Governor party					-0.02			
dummy					(0.24)			

Presidential election						-0.14		
year dummy						(1.18)		
Mexican inflation							0.03	
rate							(1.28)	
Mexican admissions								-0.01
								(0.46)
Indicators								
Linewatch	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
apprehensions								
Non-linewatch	0.96***	0.96***	0.94***	0.92***	0.93***	0.96***	0.96***	0.96***
apprehensions	(6.44)	(6.70)	(6.81)	(6.93)	(6.91)	(6.53)	(6.61)	(6.83)
Statistics								
Chi-squared	11.13	11.43	12.40	13.14	12.09	11.45	11.50	11.50
Degrees of freedom	19	26	26	26	26	26	26	26
GFI	0.98	0.98	0.99	0.98	0.99	0.98	0.98	0.98
RMSEA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note: Absolute z-statistics in parentheses; *, **, *** denote significance at the 10%, 5%, and 1% level, respectively. If the model fits the data perfectly and the parameter values are known, the sample covariance matrix equals the covariance matrix implied by the model, i.e. $\boldsymbol{S} = \boldsymbol{\Sigma}(\theta)$. The null hypothesis of perfect fit corresponds to high values of the Goodness-of-Fit Index (GFI) (Mulaik et al. 1989). The root mean squared error of approximation (RMSEA) measures the model's fit based on the difference between the estimated and the actual covariance matrix. RMSEA values smaller than 0.05 indicate a good fit (Browne and Cudeck 1993).

Table 2

Illegal immigration to California

Determinants	Specification							
	1	2	3	4	5	6	7	8
Border enforcement	-0.39***	-0.39***	-0.39***	-0.39***	-0.39***	-0.39***	-0.39***	-0.38***
	(11.76)	(11.82)	(11.87)	(11.72)	(11.80)	(12.12)	(11.87)	(11.77)
California	-0.02	-0.02	-0.02	-0.02	-0.02	-0.03	-0.02	-0.01
unemployment rate	(0.21)	(0.21)	(0.24)	(0.22)	(0.22)	(0.32)	(0.30)	(0.16)
California real wage	0.12*	0.12*	0.13**	0.12**	0.12*	0.10*	0.12*	0.11*
	(1.90)	(1.96)	(2.18)	(1.98)	(1.88)	(1.66)	(1.92)	(1.72)
Mexican	-0.01	-0.02	-0.02	-0.01	-0.01	-0.02	-0.01	-0.01
unemployment rate	(0.22)	(0.33)	(0.28)	(0.20)	(0.26)	(0.38)	(0.21)	(0.25)
Mexican real wage	-0.30***	-0.31***	-0.31***	-0.30***	-0.31***	-0.30***	-0.29***	-0.32***
	(4.24)	(4.28)	(4.40)	(4.34)	(4.35)	(4.14)	(4.04)	(4.49)
Coyote prices		-0.00						
		(0.14)						
Temperature			-0.02					
			(0.29)					
Governor election				-0.11				
year dummy				(0.84)				
Governor party					0.00			
dummy					(0.02)			

Presidential election						-0.23**		
year dummy						(2.19)		
Mexican inflation							0.04	
rate							(0.86)	
Mexican admissions								-0.03
								(0.57)
Indicators								
Linewatch	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
apprehensions								
Non-linewatch	0.25***	0.24***	0.25***	0.25***	0.25***	0.24***	0.25***	0.23***
apprehensions	(4.56)	(4.82)	(4.81)	(4.71)	(4.60)	(4.55)	(4.78)	(4.32)
Statistics								
Chi-squared	8.20	8.92	9.25	10.40	8.39	9.64	8.75	13.75
Degrees of freedom	19	26	26	26	26	26	26	26
GFI	0.98	0.98	0.99	0.98	0.99	0.98	0.98	0.97
RMSEA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note: Absolute z-statistics in parentheses; *, **, *** denote significance at the 10%, 5%, and 1% level, respectively. If the model fits the data perfectly and the parameter values are known, the sample covariance matrix equals the covariance matrix implied by the model, i.e. $\boldsymbol{S} = \boldsymbol{\Sigma}(\theta)$. The null hypothesis of perfect fit corresponds to high values of the Goodness-of-Fit Index (GFI) (Mulaik et al. 1989). The root mean squared error of approximation (RMSEA) measures the model's fit based on the difference between the estimated and the actual covariance matrix. RMSEA values smaller than 0.05 indicate a good fit (Browne and Cudeck 1993).

Table 3

Illegal immigration to Texas

Determinants	Specification							
	1	2	3	4	5	6	7	8
Border enforcement	-0.55***	-0.55***	-0.54***	-0.55***	-0.55***	-0.55***	-0.54***	-0.55***
	(11.29)	(12.79)	(11.38)	(11.62)	(11.40)	(11.39)	(11.26)	(11.37)
Texas	0.02	0.01	0.01	0.03	0.03	0.01	0.01	0.02
unemployment rate	(0.21)	(0.31)	(0.33)	(0.83)	(0.70)	(0.30)	(0.40)	(0.47)
Texas real wage	0.14**	0.13*	0.14**	0.14**	0.15**	0.14**	0.14**	0.14**
	(1.99)	(1.91)	(2.15)	(2.11)	(2.23)	(2.05)	(2.12)	(2.05)
Mexican	0.15***	0.15***	0.14***	0.15***	0.15***	0.15***	0.15***	0.15***
unemployment rate	(2.81)	(2.74)	(2.70)	(2.92)	(2.91)	(2.83)	(2.90)	(2.86)
Mexican real wage	-0.09	-0.08	-0.09	-0.08	-0.07	-0.08	-0.03	-0.08
	(0.91)	(0.86)	(0.89)	(0.95)	(0.75)	(0.83)	(0.29)	(0.88)
Coyote prices		0.06						
		(1.04)						
Temperature			0.07					
			(1.13)					
Governor election				-0.19				
year dummy				(1.43)				
Governor party					-0.13			
dummy					(1.17)			

Presidential election						0.00		
year dummy						(0.04)		
Mexican inflation							-0.00	
rate							(0.03)	
Mexican admissions								0.01
								(0.32)
Indicators								
Linewatch	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
apprehensions								
Non-linewatch	0.67***	0.67***	0.67***	0.67***	0.68***	0.67***	0.66***	0.67***
apprehensions	(11.55)	(11.75)	(11.70)	(11.79)	(11.82)	(11.57)	(11.37)	(11.80)
Statistics								
Chi-squared	3.97	4.13	5.95	4.36	4.97	4.74	11.36	4.21
Degrees of freedom	19	26	26	26	26	26	26	26
GFI	0.99	0.99	0.99	0.99	0.99	0.99	0.98	0.99
RMSEA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note: Absolute z-statistics in parentheses; *, **, *** denote significance at the 10%, 5%, and 1% level, respectively. If the model fits the data perfectly and the parameter values are known, the sample covariance matrix equals the covariance matrix implied by the model, i.e. $\boldsymbol{S} = \boldsymbol{\Sigma}(\theta)$. The null hypothesis of perfect fit corresponds to high values of the Goodness-of-Fit Index (GFI) (Mulaik et al. 1989). The root mean squared error of approximation (RMSEA) measures the model's fit based on the difference between the estimated and the actual covariance matrix. RMSEA values smaller than 0.05 indicate a good fit (Browne and Cudeck 1993).

Table 4

Employment shares and annualized average weekly wages

Industry	Arizona	California	Texas	Arizona	California	Texas
	Employment share (1990-2004)			Weekly average wage (2001-2004)		
Agriculture	0.85%	1.63%	2.51%	341	381	399
Apparel	0.09%	0.70%	0.41%	428	446	458
Construction	6.79%	4.96%	6.30%	671	821	713
Food	0.38%	0.93%	0.86%	586	663	634
Furniture	0.34%	0.40%	0.27%	544	585	547
Restaurant	5.71%	5.13%	5.30%	243	275	253
Retail trade	11.92%	10.45%	11.48%	487	542	465
Textile	0.09%	0.19%	0.12%	583	535	499
Wood	0.32%	0.25%	0.30%	543	636	584

Source: Employment share by industry: Bureau of Economic Analysis; weekly average wages: Bureau of Labor Statistics.

Table 5

Average estimated inflow of illegal Mexican immigrants to the U.S. per year

Study	Period considered	Average estimated inflow of illegal Mexican immigrants into the U.S. per year
Hanson (2006, p.875)	1996 to 2001	393,000
Passel (2006, p.5)	2000 to 2005	300,000
Passel (2007, p.24)	1995 to 2006	398,000
Passel and Cohn (2008, p.3)	2000 to 2007	330,000
Hoefer et al. (2008, p.4)	2000 to 2007	330,000

Note: To calculate the 2001 stock of illegal Mexicans, Hanson (2006) uses the median undercount rate of 20% used in Bean et al. (2001).

Table 6

Illegal foreign-born population by U.S. state of residence in percentage of total illegal foreign-born population in the U.S.

Study	Period considered	Arizona	California	Texas	Other states
INS (2001, p.15)	2000	4%	31.6%	14.9%	49.5%
Passel (2005, p.6)	2002 to 2004	5%	24%	14%	47%
Passel (2007, p.25)	2006	3.5%[a]	22.4%	11.6%	62.5%
Hoefer et al. (2008, p.4)	2000	4%	30%	13%	43%
	2007	5%	24%	14%	47%
Mean value		4.3%	26.4%	13.5%	

Note: [a] Share calculated by the authors. Passel (2007, p. 13) estimates that around 400,000 illegal foreign-born individuals resided in Arizona in 2005. Using the total number of undocumented foreign-born individuals in the U.S. estimated at 11,532,000 (Passel 2007, p. 25) this yields a share of around 3.5% for Arizona.

Table 7

Average estimated inflow of illegal Mexican Immigrants by state of residence per year

Study	Arizona	California	Texas	Other states	U.S.
Hanson (2006, p.875)	17,000	104,000	53,000	219,000	393,000
Passel (2006, p.5)	13,000	79,000	41,000	167,000	300,000
Passel (2007, p.24)	17,000	105,000	54,000	222,000	398,000
Passel and Cohn (2008, p.3)	14,000	87,000	45,000	184,000	330,000
Hoefer et al. (2008, p.4)	14,000	87,000	45,000	184,000	330,000

Note: Estimates have been calculated by using the average inflow of illegal Mexican immigrants per year (Table 5) times the mean estimate for the share of illegal foreign-born immigrants residing in the particular U.S. state (Table 6). Results are rounded to 1000.

Figures

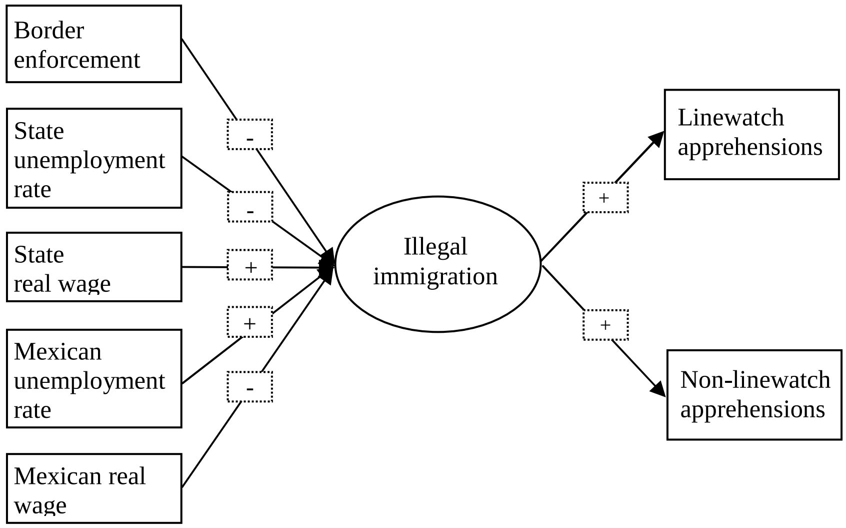

Fig. 1. Path diagram for illegal immigration

Note: The squares attached to the arrows indicate the expected signs for the relationships between the determinants and indicators and the latent variable as hypothesized in Section 3.

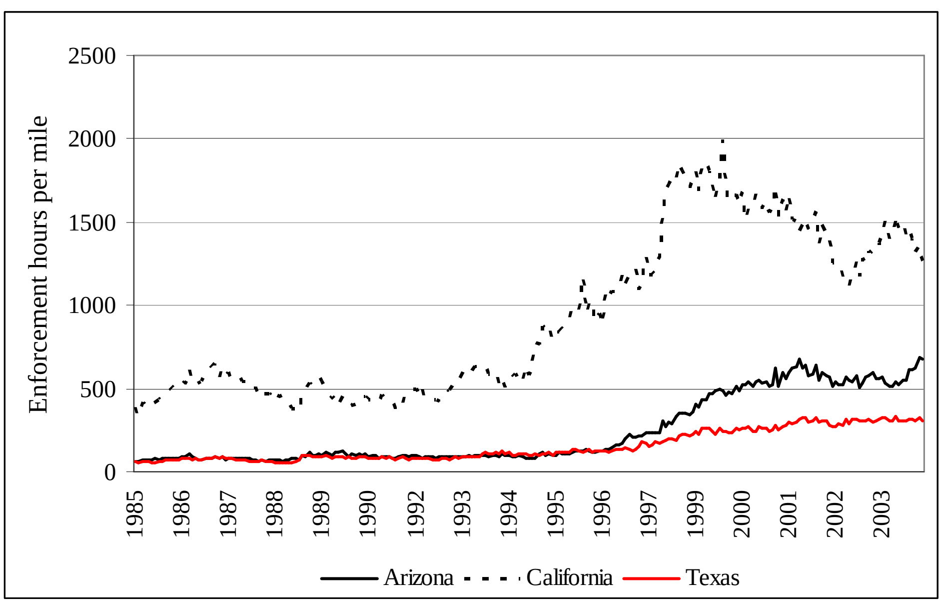

Fig. 2. Enforcement hours per mile along the U.S.-Mexico border

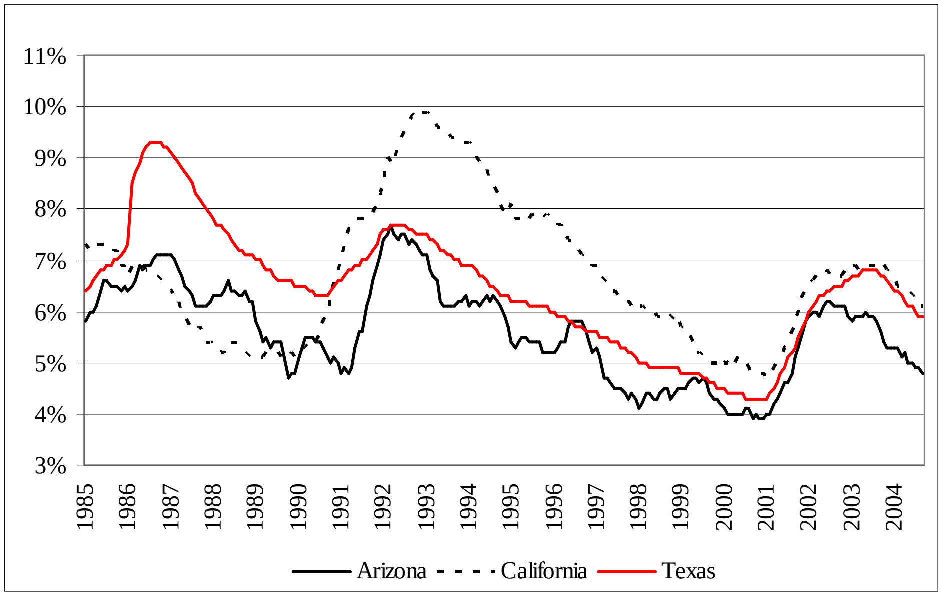

Fig. 3. Unemployment rates

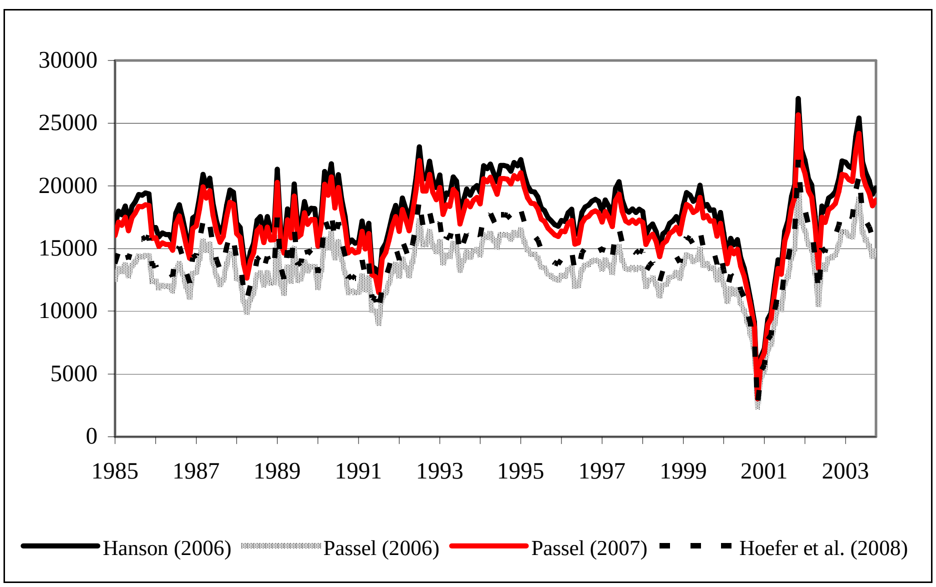

Fig. 4. Long-term illegal immigration to Arizona

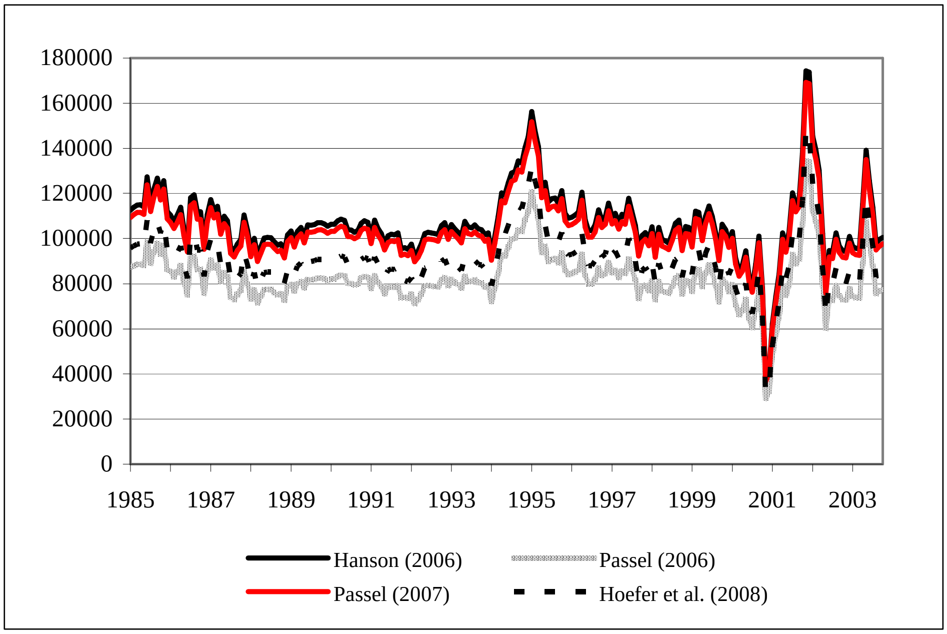

Fig. 5. Long-term illegal immigration to California

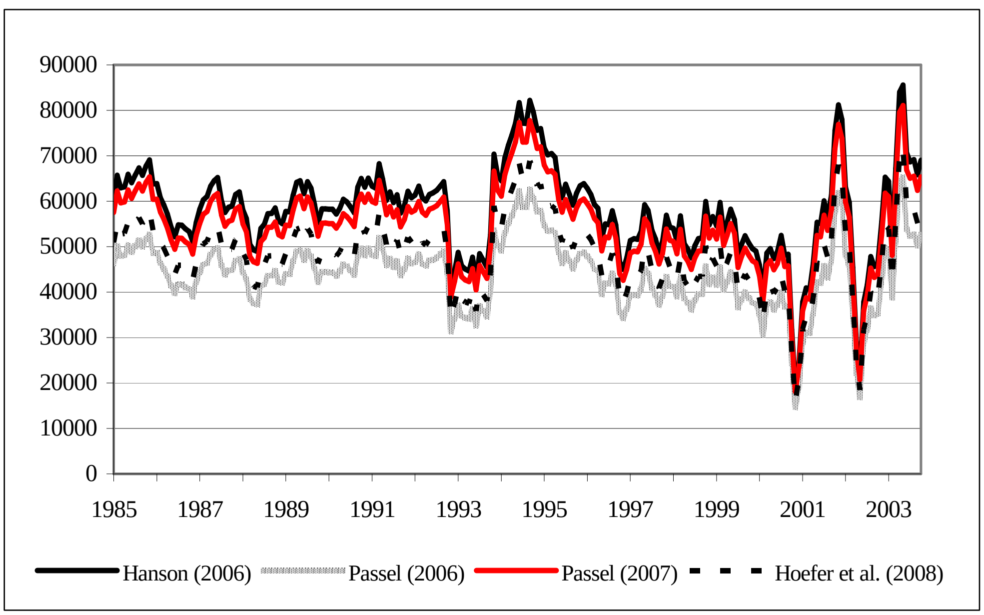

Fig. 6. Long-term illegal immigration to Texas

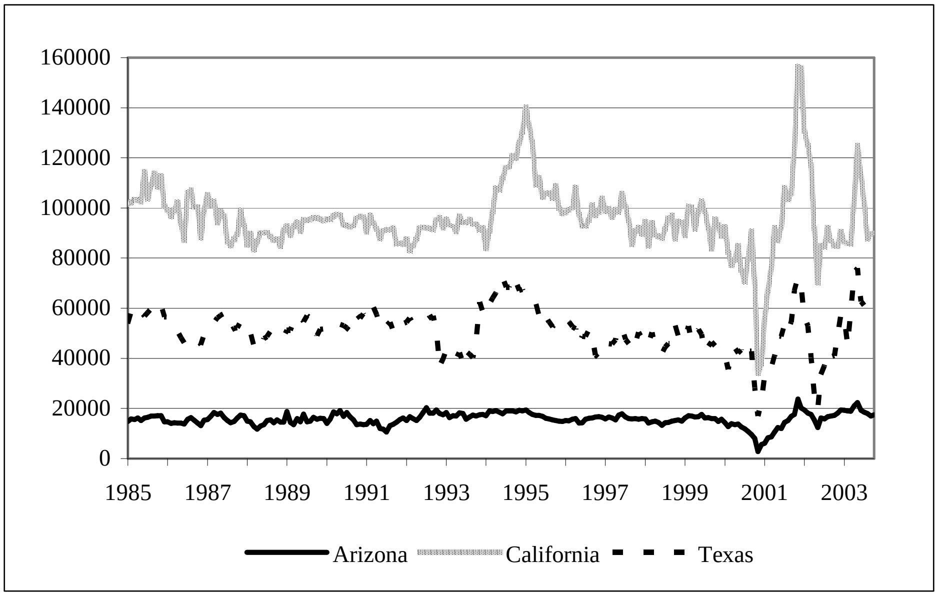

Fig. 7. Comparison of long-term illegal immigration trends

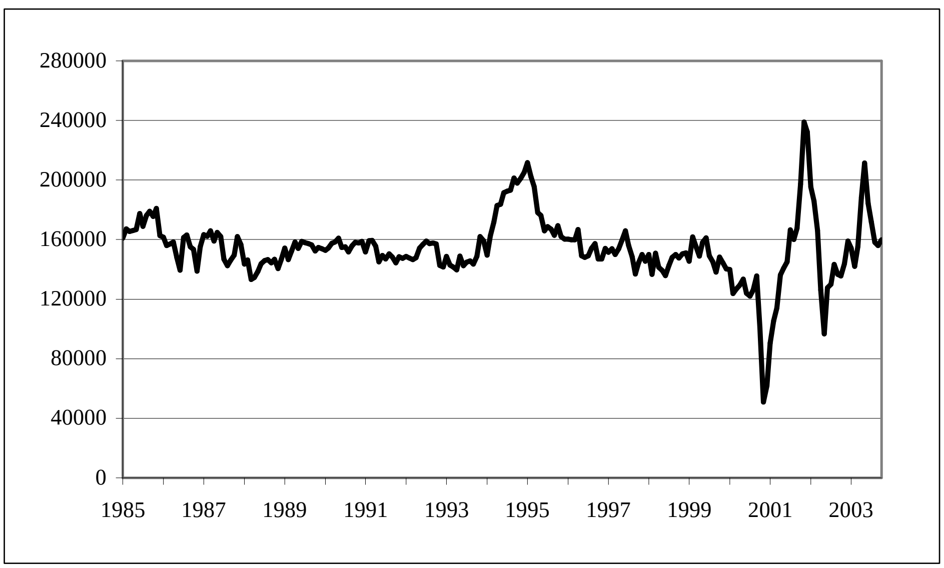

Fig. 8. Illegal immigration from Mexico into the U.S.-Mexico border states

Appendix A. Data sources and definitions

Table A.1. Data sources and definitions

Variable	Definition	Source
Determinants		
Border enforcement (in U.S. state)	P person-hours spent by the U.S. Customs and Border Patrol (CBP) at the Arizona-, California-, or Texas-Mexico border divided by total apprehensions in that state	Unpublished records of the U.S. Immigration and Naturalization Service (INS), Hanson (2006)
Unemployment rate (in U.S. state)	Unemployed persons in percent of the total labor force, seasonally adjusted	Bureau of Labor Statistics (BLS)
Real wage (in U.S. state)	Real average manufacturing hourly earnings in constant U.S dollars, deflator: consumer price index (CPI) in the state-specific metropolitan areas of Los Angeles (AZ and CA), Houston-Galveston-Brazoria (TX)	Average hourly earnings: current employment survey of the BLS; CPI of metropolitan area: BLS
Mexican unemployment rate	Unemployed persons in percent of the total labor force, seasonally adjusted	OECD Main Economic Indicators
Mexican real wage	Real average hourly wage in manufacturing, seasonally adjusted; index	OECD Main Economic Indicators
Coyote prices (in U.S. state)	Real average coyote price in each state in constant U.S. dollars; deflator: CPI in the metropolitan areas of Los Angeles (AZ and CA), Houston-Galveston-Brazoria (TX)	Average coyote price: compiled from MMP survey data; CPI of metropolitan area: BLS

Temperature (in U.S. state)	Average temperature in the border counties of each state	United States Historical Climatology Network (USHCN)
Governor election year dummy	Dummy variable taking the value one if governor election year in the respective U.S. state, zero otherwise	
Governor party dummy	Dummy variable: one if the governor in the respective U.S. state is member of the Democratic party, zero otherwise	
Presidential election year dummy	Dummy variable: one if U.S. presidential election year, zero otherwise	
Mexican inflation rate	Percentage change of the Mexican CPI	Banco de Mexico
Mexican admissions (U.S. federal level)	Number of Mexican citizens obtaining legal permanent status	Yearbook of Immigration Statistics (various issues), U.S. Department of Homeland Security
Indicators		
Linewatch apprehensions (in U.S. state)	Individuals apprehended by the CBP at the Arizona-, California-, or Texas-Mexico border, seasonally adjusted	Unpublished records of the INS, Hanson (2006)
Non-linewatch apprehensions (in U.S. state)	Individuals apprehended by the CBP inside Arizona, California, or Texas at traffic checkpoints, raids on businesses or interior patrols, seasonally adjusted	Unpublished records of the INS, Hanson (2006)