The paradox of Mexican migration to the US 2007-2012

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Abstract

Based on an extension of Todaro's (1976) canonical migration model, a Vector Error Correction Model (VECM) (2007Q3-2012Q3, Q indicates the corresponding quarter. Here, the period from the third quarter of 2007 until the same quarter of 2012.) was estimated. We prove that the decline in Mexican migratory flows to the United States since 2005 is related to the strengthening of the latter country's punitive actions, aimed at undocumented immigration, and also to the rise in sectorial and regional unemployment in the US relative to Mexico's unemployment rates. Some other additional and new factors, such as rising monetary costs, risks and dangers, including the death of migrants that trek through isolated areas, have also reduced attempts to cross into the United States.

Key words: Deportations, migration attempts, relative unemployment, VECM, weak exogeneity..

Resumen

La paradoja de la migración mexicana a Estados Unidos 2007-2012

Basado en una extensión del modelo de migración de Todaro (1976), se estimó un Modelo de Vector de Corrección de Error (VECM) (2007Q3-2012Q3). Se demuestra que la disminución del flujo migratorio de mexicanos a los Estados Unidos desde 2005 se relaciona con el fortalecimiento de las acciones punitivas de EU dirigido a la inmigración indocumentada, así como el aumento del desempleo sectorial y regional en los Estados Unidos en relación con las tasas de desempleo en México. Otros factores adicionales y nuevos, como el aumento de los costos monetarios, riesgos y peligros, entre ellos la muerte de los migrantes que se internan a través de zonas aisladas, también han reducido los intentos de cruzar a los Estados Unidos.

Palabras clave: Deportaciones, intentos de migrar, desempleo relativo, VECM, exogeneidad débil.

INTRODUCTION

> Remember, remember always, that all of
> us, and you and I especially, are descended
> from immigrants and revolutionary
> Franklin D. Roosevelt

Since 2005, undocumented Mexican migration to the United States has decreased considerably. The reinforcement of US punitive actions aimed at unauthorized immigration has been highly discouraging to migration intentions. Also, the increasing costs (both monetary and life-threatening circumstances), and the rise in relative unemployment rates of the US to Mexico are considered here as primary determinants.

Based on Todaro's (1976) theoretical model —extended by Massey *et al.* (1993)— a Vector Error Correction Model (VECM(2)) for quarterly data (2007Q3-2012Q3)[1] was estimated in order to prove the above-mentioned hypothesis.

We argue that there is a high elasticity of migration intentions to anti-immigration measures, and unit elasticity with respect to the relative unemployment rate (US unemployment divided by unemployment in Mexico).

Although, as explained below, we recognize that migration depends on social, cultural and many other factors, we target this article at economic variables that follow from an extension of Todaro's (1976) seminal model, to explore the possibility that migration is a rational decision, based on the expectation of improving the quality of life, and where implicit costs and risks are considered. The hypotheses put forth are supported by both correct specification and an adequate historical simulation.

The remainder of this article is organized as follows. In Section 2 we discuss estimations on the historical migratory flows of unauthorized Mexican immigrants, immigration policies and their effects on migratory flows. In section 3 the economics of migration are analyzed. In section 4 the econometric issues are presented, as well as the empirical results. Section 5 concludes.

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[1] Despite the huge importance of the subject, this is the only available historical sample.

Mexican migration to the United States. Recent facts

In the 2000's, undocumented Mexican immigrants represented little more than 60 per cent of the total population residing unlawfully in the U.S., and the number of unauthorized Mexicans was close to 6.6 million (Table 1, Hoefer *et al.,* 2011). Since 2005 there has been a considerable decline in new arrivals.

Table 1. Unauthorized immigrants residing in the U.S. (thousands)

Years	January estimates		Absolute variation		Percentage
	Total	Mexico	Total	Mexico	Mexico
2000	8 460	4 680	-	-	55.3
2005	10 490	5 970	2 030	1 290	56.9
2006	11 310	6 570	820	600	58.1
2007	11 780	6 980	470	410	59.3
2008	11 600	7 010	-180	30	60.4
2009	10 750	6 650	-850	-360	61.9
2010	10 790	6 640	40	-10	61.5

Source: Hoefer *et al.* (2011).

Different methods have been used in estimating the number of unauthorized immigrants in the U.S. Some of these estimates are summarized by Hanson (2006). For example, in 2000 the Immigration and Naturalization Services (INS) estimated 4 million, while Passel (2005) had estimated 5.9 million. By using both estimations, we found that the average rate of immigration during 2000-2004 had increased by 5.2 per cent, which suggests that every year little more than 250 000 undocumented immigrants were added to the total.

Since the turn of the century, undocumented Mexican migration to the U.S. has declined in relative terms compared to the previous decade. However, it continued to increase in absolute terms.

These figures are partially consistent with the Northern Border Migration Survey (COLEF, Encuesta de Migración de la Frontera Norte, EMIF 2004) where migratory attempts were placed at 270 000 per year during 2000-2004. These numbers have an upward trend differing from the 1990's, where figures show an increase in both relative and absolute terms. Taking into account migrants with authorized entry (an average of 160 000) makes a total of 440 000 in 2000-2004.

However, migration intentions (PEAC)[2] persistently declined from 4.7 per thousand in 2005Q1 to 1.7 in 2010Q4. In absolute terms, the ENOE reported a 70 per cent decline; from 343 000 in 2005Q1 to 102,190 in 2014Q1 (INEGI, 2014) (Figure 1).

The disadvantage of using ENOE (Encuesta Nacional de Ocupación y Empleo) data is that, up until now, no proven methodology has been able to calculate the magnitude of migratory flows. However, it can be used as a time series for migratory flow, which is not the case with the population census, the Mexican Migration Projector (MMP), the EMIF or any other records for that matter.

According to Hanson (2006), unauthorized Mexican immigration primarily depends on total migratory volumes (flows) and the number of attempts to cross the border and border apprehensions. This author argues that after being stable in the first half of the 1990's, intentions to migrate started to decline, and by 2005 they had reached the level of the mid-1970s. This can be attributed to border officials reinforcing surveillance and toughening punitive actions that dissuaded migration.

Recent evidence, both in migration intentions (PEAC) as well as estimations of unauthorized immigrants residing in the U.S., appears to confirm this drastic decline, but adds some other crucial factors.
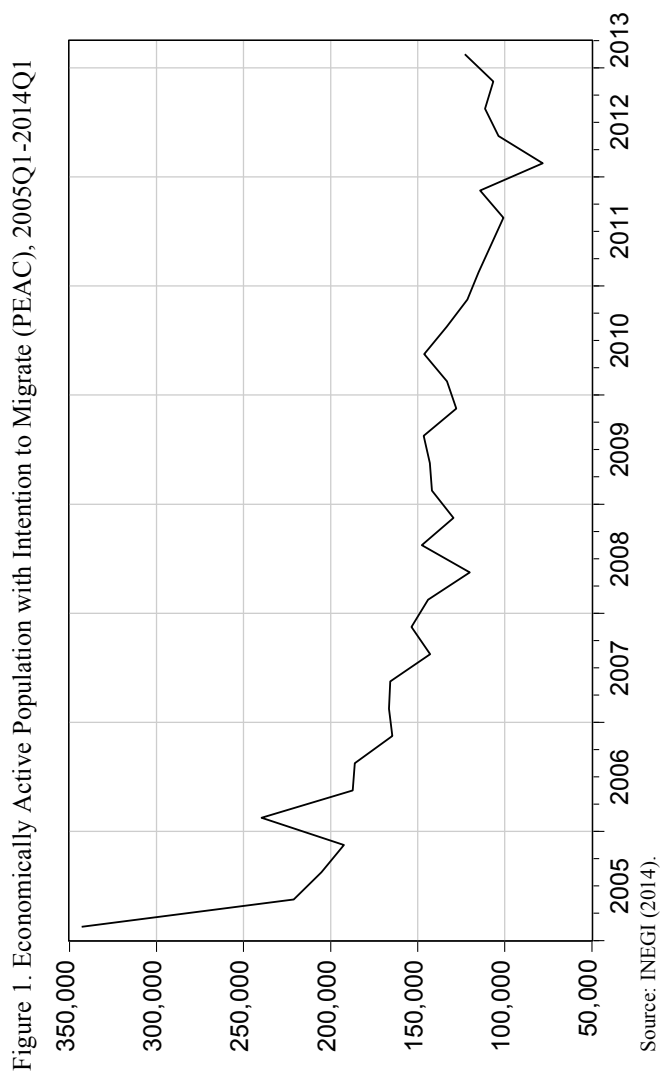
ECONOMIC CAUSES OF MIGRATION

Many factors can drive the decision to migrate. Some of the first to be studied by Ravenstein (1885) were climate, overpopulation and legal restrictions.

More recently, De los Ríos and Rueda (2005) suggest that international migration flows, which originate primarily in poor countries, are related to the low capital intensity of these regions vis-à-vis advanced markets with higher intensity. As such, this gap incites migrants with the guarantee of higher productivity and wage levels.

To understand the migratory issue between Mexico and the United States we part from a variation of the model developed by Massey *et al*. (1993), which is a cost/benefit model that estimates the probability to emigrate. The model yields a numerical value ER, (the expected return from emigrating), for *t* periods at the moment of departure (0). The higher the ER, the higher the PEAC. According to Massey *et al*. (1993), the decision to migrate can be derived from the following equation:

[2] From here on, the variable PEAC, Economically Active Population with Intention to Migrate, is crucial in the analysis and is the one to be modeled. It is likely that this variable captures many factors beyond the strictly economic motivations that drive migration to the United States. These additional factors, however, are beyond the scope of this article and are thus not analyzed here.

Figure 1. Economically Active Population with Intention to Migrate (PEAC), 2005Q1-2014Q1

Source: INEGI (2014).

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$$ER(0) = \int_0^n [P_1(t)P_2(t)Y_d(t) - P_3(t)Y_o(t)]e^{-rt}dt - C(0) \tag{1}$$

Where:

ER (0) = net return expected for n periods at the moment of departure "0", $P_1(t)$ = the probability of not being deported, $P_2(t)$ = probability of obtaining a job in the country of destination, $Y_d(t)$ = destination country wage, $Y_o(t)$ = country of origin wage, $P_3(t)$ = probability of obtaining a job in the country of origin, r = discount factor, C(0) = total cost of migrating (including physical and psychological costs due to crime).[3]

With respect to these violence-related costs, it is worth mentioning that they have increased systematically since the last decade, reaching a peak during the administration of Felipe Calderon, as a collateral effect of the official *war against organized crime* (Walser *et al.*, 2011).

It is estimated that between 80 and 95 per cent of illegal immigrants hire the services of human traffickers (*coyotes)* to cross the border. The main risk is being left behind due to fatigue or dehydration, as the crossing routes run through the desert. 30 per cent of the 390 people whose bodies were recovered in 2008 died due to exposure to extreme heat (Walser *et al.*, 2011).

Regarding the kidnapping of illegal migrants, between September 2008 and February 2009 there were a total of 9 758 cases, with the number increasing to 11 333 for the months of April through September 2010. In average, more than 400 people are kidnapped every day. In 2008-2009, 55 per cent of reported kidnappings occurred in the southern regions of Mexico; by 2010 the fraction had risen to 67.4 per cent. Also in the period 2008-2009, of the 2 525 cases of kidnapping in which the exact site of abduction was determined, almost 98 per cent occurred near the train tracks or on trains (Walser *et al.*, 2011). All in all, it is estimated that the intention to cross the border results in more than 22 000 victims each year.

Illegal immigrants are also subject to extortion by federal and local authorities, most often at unlawful immigration checkpoints. Lastly, injury and death due to boarding freight trains that cross the country have also been identified as an important risk.

Additionally, the variable Index of Non-Criminal Deportations (INCD) is a powerful, discouraging factor for migration. This is reflected in the fact

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[3] In recent years, organized crime has become an enormous threat to the safety of migrants as they cross through Mexico. Their passage now carries a risk of kidnapping, theft, extortion, sexual violence and death at the hands of the cartels, traffickers and even corrupt officials of the Mexican government (Walser *et al.*, 2011). All of this has psychological and cultural implications for the drivers of migration, which are ultimately subsumed in the variable PEAC.

that, as mentioned in Massey *et al.* (2009), a large percentage of migrants hire the services of *coyotes*, due to the growing complexity of border crossing.

The costs of the choice whether to migrate or not have thus increased, since now aspiring migrants must estimate whether the cost of paying the *coyote* will be compensated by obtaining a job and remaining in the United States.

Therefore, deportations have become a highly relevant variable, since the estimated cost of the choice whether to migrate or not involves the decision of whether to migrate independently or to hire assistance.

The easier it is to cross the border, the less the demand for the services of *coyotes*. And, when this undertaking becomes more difficult (i.e. when the number of deportations increases), more migrants will demand assistance, increasing its price.

In the end, to a higher difficulty of crossing the border and staying in the United States corresponds a more expensive crossing fee and a higher risk to the physical integrity of the migrant. And, to an easier and safer crossing and permanence, correspond a lower total cost (both economic and personal), which is the reason why an increase in the number of deportations has a direct impact on the cost of migration.

All these variables are considered costs effects, C in equation (1).

The above risk factors are also highly relevant to understanding the drop in the dynamics of migration intentions (PEAC). Migration itself continues to be, of course, a behavior that can open new life opportunities, but the worsening costs and personal risk involved constitute an internal factor that discourages PEAC.

Formerly, the most accepted hypothesis among academics was that the Great Recession (2007-on) was one of the most important causes for the decline in Mexican migratory flow to the U.S. Following this vein, this article also includes relative unemployment (U.S. to mexican unemployment ratio).[4]

However, while the critical drivers of the global recession started in the U.S. housing sector, where most of the mexican migrants found jobs, the drop in the number of migrant workers can be observed in several statistics since 2005. Furthermore, with the U.S. reinforcing immigration policies and shielding the border, and also intensifying efforts to round up undocumented migrants inside the U.S. in work places and public gathering sites,

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[4] We refer to this variable as ur_t in the remainder of the text.

deportations seem to have increased, causing a decline in mexican migratory flow and an increase in voluntary returns.

Figure 2 depicts unemployment rates in the construction, leisure and hospitality, recreational and agricultural sectors. Also shown are the rates of unemployment in the U.S. between October 2000.1 and 2014.7. A great disparity between unemployment in these economic sectors can be detected, but also that by the end of 2009 unemployment in construction and agriculture doubled.

In the regional perspective, unemployment caused by the Great Recession in the U.S. affected jobs for mexican migrants. The two states with the highest concentration of mexican undocumented workers, California and Illinois, presented higher levels of unemployment than the national average.[5]

The strategy to control migration has shifted from a focus on dissuasion to detentions, trials, deportations and future penalizations to undocumented immigrants residing in the U.S. In the past, a decline in apprehensions used to be an indicator of the efforts to control the border and suggested more lax restrictions at the border. But this is not so according to our analysis. The decline in detentions is due to a weaker migration flow into the U.S.

Between 2002 and 2010, around 1.8 million mexican illegal immigrants were deported, representing between 30 and 40 per cent of the migrant population of some regions (Hagan *et al.*, 2011).

Econometric issues

Methodology

Based on a modified version of equation (1), a VECM(2) was estimated. Three crucial variables constitute the information system:
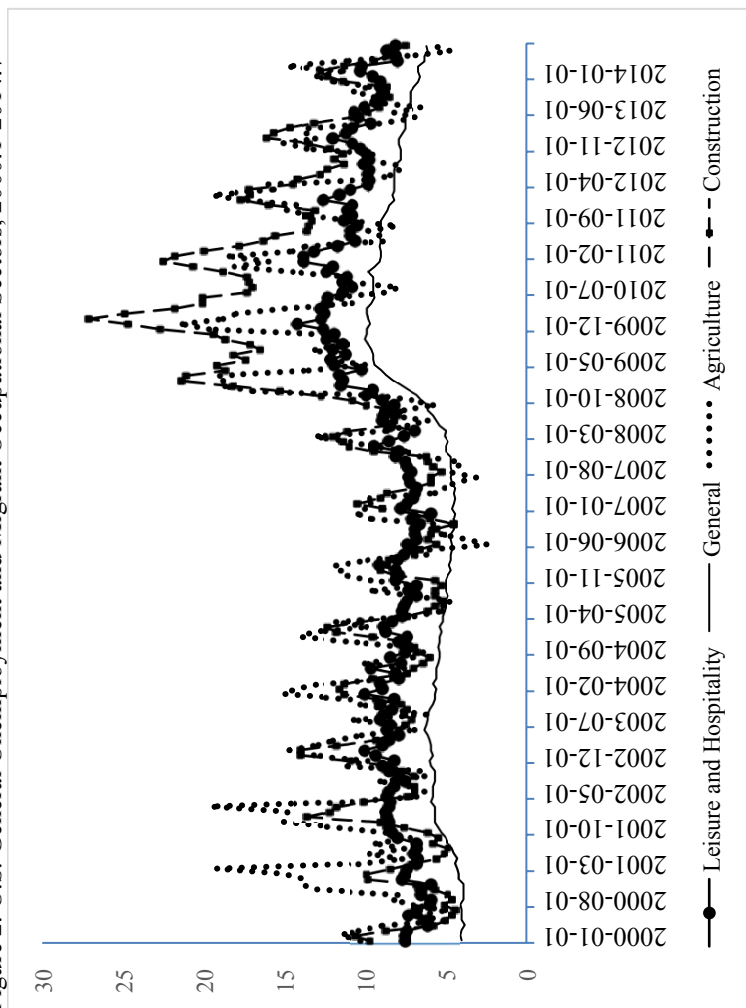y: $\{ur_t, peac_t, incd_t\}$.[6]
Variables are in logarithms, as indicated by the lowercase notation.

Given that all variables are stationary in their first differences (see unit root tests in Table 1A in the appendix), it is appropriate to use the Johansen (1988 and 1992) cointegrating procedure by which long-run relations and the corresponding error correction model can be obtained (Figure 3).

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[5] King *et al.* (2012) argue that deportations in the United States tend to rise when unemployment rates increase.
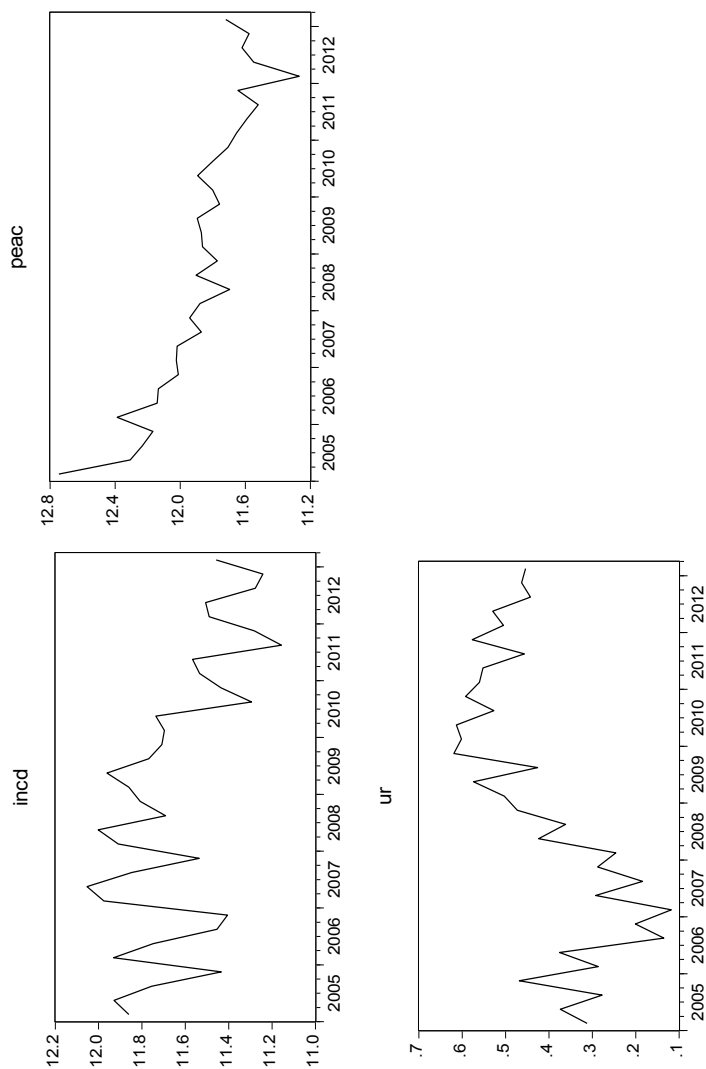[6] Mexico's economically active population with intention to migrate (PEAC); deportations of non-criminal immigrants (INCD); the relative unemployment rate of US to Mexico (uss/u) is *ur*.

Figure 2. U.S. General Unemployment and Migrant Occupational Sectors, 2000:1-2014:7

Source: US Bureau of Labor Statistics (2014).

Figure 3. Historical variables (logs)

Source: the data was taken from the National Occupational and Employment Survey (ENOE) and from the National Institute of Statistics and Geography (INEGI), and refers to Mexico's economically active population with intention to migrate (PEAC). Mexico's unemployment rate (u) was taken from the same source; deportations of non-criminal immigrants (INCD) was taken from the Enforcement Integrated Database of the U.S. Department of Homeland Security (2011); and the US unemployment rate (uss) is from the U. S. Bureau of Labor Statistics (2014). The relative unemployment rate of US to Mexico (uss/u) is ur. There is no previous data and thus the period is considered as long term.

The *let the data freely speak approach* (Hoover *et al.*, 2008), by which non-*a priori* restrictions are imposed was followed. A crucial point is determining how many cointegrating relations exist, as well as the structure of the error correction mechanism. Therefore, a careful marginalization process (Hendry, 1997) was carried out, based on the theoretical issues contained in equation (1).

It is convenient to point out that the economic theory usually refers only to long-run equilibrium relationships, leaving the dynamic adjustments to mathematics and to the data structure. According to the modern time-series approach, it is necessary to deal not only with the long run parameters but also with the short run disequilibrium by letting the data freely speak. This is a specific feature of the VECM methodology because it allows the data to indicate the adjustment properties and, therefore, the statistical relation of the series in the short and long run (Hoover *et al.*, 2008; Juselius, 2006; Lütkepohl and Krätzig, 2004).

The necessary condition for these models to be solved is that at least one cointegrating vector (r = 1) exists, from which it shall be concluded that the range of the system is $\beta' = r \times k$ and that $Y_t \beta' Y_{t-1}$ is a vector of $r \times 1$ lagged disequilibrium terms (Patterson, 2000: 634), where *k* refers to the number of variables of the information system (y).

Johansen's (1988) general unrestricted VECM in reduced form can be expressed as:

$$\Delta Y_t = \Gamma \Delta Y_{t-1} + \alpha\beta' Y_{t-1} + B*D + \zeta_t \tag{2}$$

Where D accounts for the exogenous or dummy variables.

Results and discussion

According to the trace statistic and the maximum eigenvalue tests,[7] only one cointegrating vector was found, and therefore an unrestricted VECM(2) for 2007Q3-2012Q3 with intercept was specified, obtaining the following outcome:

$$(3) \quad peac_t = 40.86 - 2.63*incd_t - 1.04*ur_t + e_t$$
$$t \quad (5.56) \quad (-6.22) \quad (-2.00)$$

Urzua = 9.86(0.99); LM(6) = 0.81(0.52); White(n.c.) = 105.72(0.38). Two impulse dummies[8] were included to capture outliers.

The estimated VECM features the following error correction vector α (transposed):

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[7] MacKinnon-Haugh-Michelis (1999). See Table 2A in the appendix.
[8] D1: 2007.3 = 1, 2008.2 = -1, 2009.1 = 1, 2011.4 = 1, 2012.2 = 3; D2: 2008.1 = -1, 2009.3 = 1.

	d(peac)	d(ur)
α	-0.124	- 0.106
t	(-1.879)	(-4.18)

In addition to passing all the tests for correct specification and stability,[9] the VECM displays highly relevant results in terms of our goals.

Since the parameters express constant elasticities, it is possible to make straightforward comparisons among them. The variable that most affects (expulsion factor) the intention to cross the border (peac) is non-criminal deportations, with a high elasticity (2.63), while relative unemployment (ur) is elastic (1.04). Moreover, since $α_{21}$ is statistically significant and negative, we reject the hypothesis that *ur* is weakly exogenous to *peac*; therefore ur must be modeled itself, following Johansen (1992).[10] The latter empirical finding suggests that U.S. and mexican labor markets exhibit a high degree of integration, and that migration works as a communication channel.

The model yields a close approximation to the data generating process, since the historical simulation (calculated with the Broyden algorithm) replicates the data fairly well, as can be seen in Figure 4.

Conclusion and final comments

Since 2005, a sharp contraction in mexican undocumented migratory flow to the United States has been observed, despite some crucial factors: i) Mexico's slowdown in economic growth (since 1982); ii) high unemployment rates: iii) skyrocketing informal economy[11] and iv) lower salaries compared to those of the U.S. It was thus the objective of this article to find the main determinants for this seemingly paradoxical behavior. Todaro's canonical migration model was the analytical base that led to a cointegrating analysis, which confirms and gauges the effect of the individual variables.
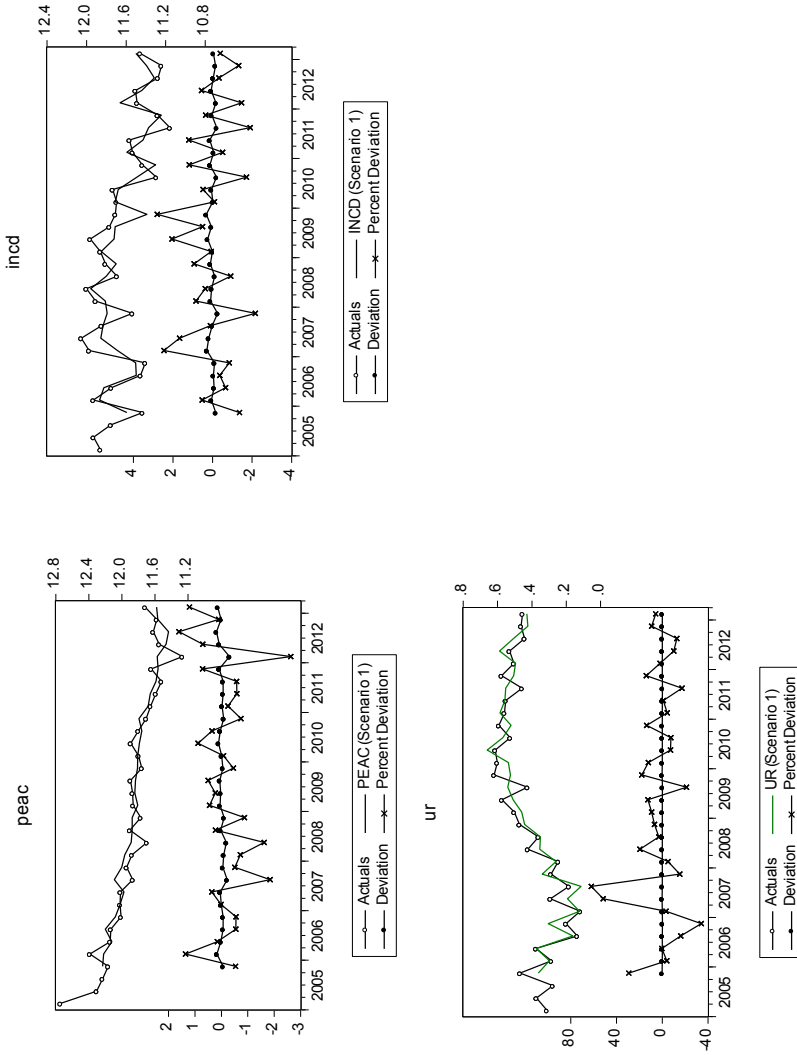
The empirical results confirm the validity of migration economics, given that the deterioration in domestic economic conditions increases unemployment and consequently creates the intention to migrate. At the same time, the United States' anti-immigration actions and rising unemployment, as well as the difficulties to cross the border have reduced the intentions to do so.

[9] The VECM exhibited 1 cointegrating relation and therefore 2 common trends; max eigenvalue = 0.98.
[10] But to do it is out of the scope of this article.
[11] According to INEGI (2014), the informal economy accounts for 60 per cent of total employment and 25 per cent of GDP.

Figure 4. Historical simulation (Broyden's method) of the information system (logs)

Source: own calculations. See definition in the Appendix.

On the other hand, the rise in non-criminal deportations also reduces intentions to migrate. Both the works of Massey (2007) and Cornelius and Lewis (2007) mention rising monetary costs, risks and dangers, and the deaths of migrants that trek through isolated areas as factors that have also reduced attempts to cross into the United States. Now —and as an additional factor— we have rampant, international organized crime in Mexico that dramatically affects the undocumented migrant workers and should be considered a crucial and new psychological dissuasion factor.

APPENDIX

Table 1A. Unit Root Tests

		peac	D(peac)	incd	D(incd)	ur	D(ur)
PP	Trend and intercept	-7.13	-13.52	-2.47*	-6.22	-2.96*	-11.57
	Intercept	-5.26	-11.09	-2.48*	-6.49	-2.26*	-11.90
	No trend or intercept	2.94*	-11.09	0.40*	-6.83	0.23*	-11.85
KPSS	Trend and intercept	0.19*	0.16*	0.12	0.50*	0.10	0.17*
	Intercept	0.69*	0.43	0.21	0.50*	0.48*	0.18

Ho: * variables have unit root (95 per cent). PP.

Table 2A. Cointegration test Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical value	Prob.**
None *	0.802448	41.93020	29.79707	0.0013
At most 1	0.217627	7.873386	15.49471	0.4790

 Trace test indicates 1 cointegrating eqn(s) at the 0.05 level.
* denotes rejection of the hypothesis at the 0.05 level.
**MacKinnon-Haug-Michelis (1999) p-values.

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical value	Prob.**
None *	0.802448	34.05681	21.13162	0.0005
At most 1	0.217627	5.153898	14.26460	0.7223

 Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level.
* denotes rejection of the hypothesis at the 0.05 level.
**MacKinnon-Haug-Michelis (1999) p-values.

Broyden's method

Broyden's method is a modification of Newton's method (often referred to as a quasi-Newton or secant method) where an approximation to the Jacobian is used when linearizing the model rather than the true Jacobian which is used in Newton's method. This approximation is updated at each iteration by comparing the equation residuals obtained at the new trial values of the endogenous variables with the equation residuals predicted by the linear model based on the current Jacobian approximation. Because each iteration in Broyden's method is based on less information than in Newton's method, Broyden's method typically requires more iterations to converge to a solution. Since each iteration will generally be cheaper to calculate, however, the total time required for solving a model by Broyden's method will often be less than that required to solve the model by Newton's method (Eviews, 2013: 671).

URZUA TEST

The ALM's tests for multivariate normality of the residuals can be defined as (Urzua, 1997: 26):

$$ALMR_p = \sum_{i=1}^{p} \frac{V_{iii}^2}{Var\{\sqrt{b_1}\}} + \sum_{i=1}^{p} \frac{(W_{iii} - E\{b_2\})^2}{Var\{\sqrt{b_2}\}} \sim^A \chi_{2p}^2$$

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