DOLLARIZATION AND THE MEXICAN LABOR MARKET

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Abstract

This paper examines how dollarization affects wages and employment in the Mexican labor market, and alters the incentives of Mexican nationals to migrate to the United States. By adopting a fixed rate regime tied directly to the U.S. dollar, Mexican policy-makers are in effect giving up "a degree of freedom" in their toolkit of policy remedies. If there are imperfections in the Mexican economy, such as downward wage rigidity, an adverse economic shock would generate more unemployment in a dollarized economy, further increasing the propensity of Mexican workers to migrate to the United States. The adverse effects of dollarization could be reversed if the adoption of the dollar as a medium of exchange signals a more stable Mexican economy, reduces political inefficiency in the monetary system, and helps to attract more foreign capital. The paper investigates how Mexican emigration to the United States responds to relative changes in economic conditions between the two countries. The evidence indicates that the illegal flow is very sensitive to relative economic conditions, and is more volatile when the Mexican monetary authorities adopt a fixed rate regime. In contrast, the legal immigrant flow is not sensitive to changes in relative economic conditions.

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I. Introduction

The adoption of the U.S. dollar as legal tender in Mexico may have a profound impact on the Mexican labor market, as well as on what is perhaps the most important—and politically sensitive—link between the Mexican and American economies, the large-scale migration of Mexican nationals to the United States. There is some uncertainty about whether dollarization will make the Mexican labor market more sensitive to asymmetric shocks, or help stabilize the Mexican economy. On the one hand, dollarization would reduce the number of policy parameters at the disposal of the Mexican government to tackle the effects of idiosyncratic adverse shocks, and would lead to more volatility in employment and perhaps a larger emigrant flow. On the other hand, dollarization would expose the Mexican economy to a more sophisticated regime of monetary policy, and might help reduce economic volatility.[1] This "dollarization externality" could hasten the process of economic convergence between Mexico and the United States and greatly reduce the incentives of Mexican nationals to emigrate.

This paper presents a theoretical examination of how dollarization affects wages and employment in the Mexican labor market. A simple economic model shows that by adopting a fixed rate regime tied directly to the U.S. dollar, Mexican policy-makers are in effect giving up "a degree of freedom" in their toolkit of policy remedies. If all other prices in the Mexican economy were flexible,

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[1] Studies of the impact of dollarization on other developing economies include Calvo (1997b) and Moreno-Villalaz (1999).

asymmetric adverse shocks in productivity or in foreign investment would have the same impact regardless of whether the Mexican economy was dollarized or not. However, if there were imperfections in the Mexican economy, such as downward wage rigidity, the adverse shocks would lead to more unemployment and increase the propensity of Mexican workers—employed in both the tradable and non-tradable sectors—to migrate to the United States.

The adverse effects of dollarization could be attenuated, and perhaps even reversed, if the adoption of the dollar as a medium of exchange signals a more stable Mexican economy, and helps to attract more foreign capital. In doing so, dollarization would hasten the process of economic convergence between Mexico and the United States, perhaps leading to a large reduction in the number of Mexican emigrants.

To illustrate the potential importance of dollarization on the politically sensitive issue of Mexican emigration to the United States, the paper also presents an empirical study of how both legal and illegal flows of Mexican immigrants respond to relative changes in economic conditions between the two countries.[2] There has been a very rapid rise in the number of Mexicans who migrated to the United States in the past few decades, with Mexican nationals becoming an ever-more important component of the foreign-born population in the United States. During the 1950s, about 30,000 thousand Mexican immigrants entered the United States *legally* during a typical year. By 1996, the United States was admitting 164,000 Mexican nationals legally. The Immigration and Naturalization Service also estimates that another 150,000 Mexicans entered—and stayed in—the United States illegally. If we account for

[2] Studies of the economic performance of Mexican immigrants in the United States include DeFreitas (1991) and Trejo (1997). Borjas, Freeman, and Katz (1997) and Schoeni (1997) analyze the labor market impacts of the large-scale migration of less-skilled workers, particularly Mexican immigrants.

both the legal immigrants and the undocumented workers, the Mexican immigrant flow in the 1990s was 10 times as large as it was in the 1950s. As a result of these trends, Mexican nationals made up only 6.2 percent of the foreign-born population in the United States in 1960, but made up over 27.1 percent of the foreign-born population by 1998.

The evidence reported in this paper indicates that the number of illegal immigrants apprehended in any given year is very sensitive to relative economic conditions. The number of apprehensions rises when the real wage in the U.S. labor market increases or when the real wage in the Mexican labor market falls. Moreover, the elasticity of apprehensions with respect to the Mexican wage is larger when the Mexican monetary authorities adopt a fixed exchange rate regime. Dollarization, therefore, is likely to be associated with much greater volatility in illegal immigration. In contrast, the evidence indicates that the flow of legal immigrants is unresponsive to changes in economic conditions, probably because of the types of immigration policies that regulate legal immigration into the United States.

II. Framework

To illustrate the impact of dollarization on the Mexican labor market—as well as on the incentives of Mexican workers to migrate to the United States—it is convenient to examine a highly stylized theoretical framework.[3] The model sketched in this section builds on related work by Rodrik

[3] Classic studies that investigate how exchange rate regimes affect economic outcomes include Friedman (1957) and Mundell (1961). Although a large literature examines how exchange rate regimes affect macroeconomic outcomes, few of these studies focus on labor market issues; see Sachs (1980) for an exception.

(1999), which analyzes how different exchange rate regimes alter the distribution of wages in the labor market.[4]

Suppose that the utility of the representative consumer/worker in Mexico depends on the consumption of two goods. One of these goods, I, is imported from abroad (and, more specifically, imported from the United States); the other (C_0) is a non-tradable good that is produced and consumed within Mexico. Workers in the Mexican labor market also produce a tradable good, C_1, that is exported to the United States. The utility function of the representative consumer in Mexico is given by:

$$U = \alpha \log I + (1 - \alpha) \log C_0 - v(L_0 + L_1), \tag{1}$$

where L_0 gives the amount of time that the typical Mexican worker devotes to producing the non-tradable good, and L_1 gives the amount of time that the typical Mexican worker devotes to producing the tradable good that is exported to the United States. The utility function in (1) uses the functional form introduced by Hansen (1985) and Rogerson (1988) to study the impact of "indivisible" labor in real business cycle models.[5] It is useful to interpret the quantities L_0 and L_1 as the total number of workers supplied to each of the two employment sectors in the Mexican labor market.

The production function for the tradable good manufactured in Mexico is given by:

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[4] Rodrik (1999) allows the domestic economy to produce two tradable goods and one non-tradable good, but has inelastic labor supply to each sector as well as wage differentials across the sectors. Rodrik uses this framework to examine how the choice of an exchange rate regime alters the distribution of wages in the economy. The assumption of inelastic supply to each sector precludes Rodrik from examining how exchange rate regimes alter the incentives to emigrate the domestic economy. I am grateful to Stephanie Schmitt-Grohé for recasting my original theoretical framework in terms of the indivisible labor model in the real business cycle literature. The framework presented in the paper uses and extends the Schmitt-Grohé reformulation.

[5] Mulligan (1999) discusses the economic implications of the indivisibility assumption.

(2) $$C_1 = \pi_1 L_1^{\beta},$$

where π_1 is a productivity shifter and $\beta < 1$. The production technology used to produce the non-tradable good is simpler. In particular, the marginal product of workers in the non-tradable sector is normalized to equal 1, so that the total amount of the non-tradable good produced is simply L_0 (and $C_0 = L_0$).

Suppose that labor flows within the Mexican economy equilibrate the wage between the tradable and non-tradable sectors. The single wage in the Mexican economy is then denoted by w.[6] Let the world price of both tradable goods (i.e., the good produced in the United States and consumed in Mexico, as well as the good produced in Mexico and consumed in the United States) be equal to 1, and let e be the exchange rate between the two countries. In particular, e gives the number of Mexican pesos per U.S. dollar. Finally, let p be the price of the non-tradable good in Mexico. The total income of the Mexican economy then equals:

(3) $$Y = eC_1 + pC_0 = e\pi_1 L_1^{\beta} + pL_0.$$

[6] An earlier draft of this paper considered the situation where different types of skills are required to produce each of these two goods, and where it was very costly to retool a particular worker with the skills that would permit this worker to move across sectors. As a result, there was no internal intersectoral mobility of workers within the Mexican labor market. The theoretical analysis led to exactly the same qualitative results as those derived from the current framework.

The representative Mexican household maximizes the utility function in (1) subject to the income constraint given by equation (3). The first-order conditions resulting from this maximization problem are:

(4a) $$\frac{\alpha}{I} = \lambda e,$$

(4b) $$\frac{1-\alpha}{C_0} = \lambda p,$$

(4c) $$v = \lambda w.$$

The simultaneous solution of these equations implies that $\lambda = 1/Y$. We can then write the demand functions and the labor supply function as:

(5) $$C_1 = \frac{\alpha Y}{e},$$

(6) $$C_0 = \frac{(1-\alpha)Y}{p},$$

(7) $$w = vY.$$

Because labor flows equilibrate the wage across sectors, it must be the case that the value of marginal product of labor is equal in the two sectors. This implies:

(8) $$w = p = \beta \pi_1 L_1^{\beta-1}.$$

Suppose there is trade balance between the United States and Mexico. The trade balance equation is then given by:

(9) $$I = C_1.$$

Finally, to close the model we need to define the exchange rate policy adopted by the monetary authorities in Mexico. It is useful to consider initially the case where Mexico adopts a flexible exchange rate. The monetary policy can then be summarized as:[7]

(10) $$\bar{M} = \gamma Y,$$

where $\bar{M}$ gives the fixed money supply and γ is a constant.

Equations (5)–(10) define an equilibrium system with six equations and six unknowns. To illustrate the impact of dollarization on wages and employment in Mexico, it is instructive to first consider the simplest case. In particular, suppose the Mexican authorities adopt a flexible exchange rate—so that equation (10) holds—and that there are no frictions in the Mexican labor market (such as downward wage rigidity). Suppose further that there is a sudden and unexpected real adverse shock on the productivity of Mexican workers employed in the tradable sector, with $\tilde{\pi}_1$ measuring the percentage

[7] Ethier (1995, Chapter 14) presents a clear discussion of the link between exchange rate regimes and monetary policy.

change in the marginal product of workers in that sector ($\tilde{\pi}_1 < 0$).[8] By differentiating the six equations that define the equilibrium, it can be shown that the adverse productivity shock will lead to the following changes in the Mexican economy:

(11) $\tilde{w} - \tilde{e} = \tilde{\pi}_1$,

(12) $\tilde{L}_0 = 0$.

(13) $\tilde{L}_1 = 0$.

The productivity shock in the tradable sector induces a decline in the real wage for all Mexican workers, but does not change total employment in either sector. Because both the wage and the exchange rate are flexible, changes in prices take up the full brunt of the productivity shock. In other words, the monetary authorities simply devalue the *real* wage in the Mexican economy by the full amount of the productivity shock.

It turns out that this simple model—with flexible exchange rates and no market imperfections in the Mexican economy—serves as a good benchmark against which one can assess the impact of alternative exchange rate regimes. Consider, for example, the adoption of a fixed rate regime by the Mexican monetary authorities, of which dollarization is a particular example. Equation (10), which defines Mexican monetary policy in the presence of flexible exchange rates no longer holds, and is instead replaced by $e = \bar{e}$. Because other prices in the economy remain flexible, the real wage will still

[8] Throughout the analysis, the tilda is used to denote a percentage change. Mendoza (1995) presents a more detailed analysis of the link between economic shocks, exchange rates, and macroeconomic outcomes.

adjust fully to the productivity shock, and the wage and employment responses given by equations (11)-(14) completely describe the adjustments that take place in the Mexican labor market. In short, fixed exchanged rate and flexible exchange rate regimes have similar labor market implications as long as other prices in the Mexican economy can adjust fully to the productivity shock.

The fixed and flexible exchange rate regimes will have different labor market effects when there is an imperfection in the Mexican economy that prevents full adjustment of prices. Such an imperfection could arise because of downward wage rigidity. Suppose, in particular, that Mexico dollarizes the economy, so that equation (10) is replaced by $e = \bar{e}$. And suppose further that there is nominal wage rigidity, so that the labor supply function in equation (7) is replaced by $w = \bar{w}$. Differentiation of the equations defining the equilibrium yields:

$$\tilde{w} - \tilde{e} = 0, \tag{14}$$

$$\tilde{L}_0 = \frac{\tilde{\pi}_1}{1-\beta}, \tag{15}$$

$$\tilde{L}_1 = \frac{\tilde{\pi}_1}{1-\beta}. \tag{16}$$

In short, real wages (in terms of the exchange rate) are fixed, but employment is variable when there is an adverse supply shock. Nominal wage rigidity prevents the labor market from adjusting through price changes, and a fixed exchange rate prevents the monetary authorities from responding to the adverse productivity shock through a devaluation of the peso. Therefore, the dollarization of the Mexican economy—combined with nominal wage rigidity—implies that employment fluctuations in the Mexican

economy will be much more volatile. In other words, the economy will adjust to adverse productivity shocks through changes in employment.

Unemployment and Emigration

To link the various exchange rate regimes to the incentives of the Mexican population to emigrate to the United States, one must specify who the emigrants are likely to be. A simple approach would be to define the emigrants as a "residual," the sample of unemployed workers. The application of this definition to the result presented in the previous section would then indicate that emigration is likely to be greater when there is a fixed rate regime—as long as the Mexican economy also has downward wage rigidity.

This conclusion, however, is not very appealing because even though the fixed rate regime leads to more unemployment, it is also the case that the flexible rate regime leads to a lower real wage (i.e., $\tilde{w} - \tilde{e} = \tilde{\pi}_1$). In other words, a downward productivity shock lowers the wage in Mexico relative to that in the United States. Although there is no unemployment under a flexible rate regime, the real wage decline would itself induce some Mexican workers to move to the United States, where they can now get a relatively higher payoff for their labor. A better conceptual approach to the emigration issue, therefore, would allow for an upward-sloping labor supply curve to the Mexican labor market. As real wages go up or down, more or fewer Mexican workers would be willing to remain in the Mexican economy.

The model can generate an upward-sloping labor supply function by specifying a slightly different utility function for the representative consumer. In particular, suppose that *U* can be written as:

(17) $$U = \alpha \log I + (1-\alpha)\log C_0 - v e (L_0 + L_1)^2.$$

The specification of the utility function in equation (17) incorporates two changes over the simpler utility function specified in (1).[9] First, note that the disutility of working is nonlinear in (L_0 + L_1), so that higher wages are required to motivate more Mexican workers to enter the Mexican labor market. Second, Mexican workers get more disutility from work when the exchange rate is very high—that is, when the Mexican peso has little value relative to the American dollar. As we shall see, the inclusion of the exchange rate *e* in equation (17) will generate an upward-sloping labor supply curve in terms of the wage rate in the Mexican labor market *relative* to the wage rate in the U.S. economy (or *w*/*e*).

The six equations defining the equilibrium in the Mexican economy are now given by:

(18) Demand for tradable good: $$I = \frac{\alpha Y}{e}.$$

(19) Demand for non-tradable good: $$C_0 = \frac{(1-\alpha)Y}{p}.$$

(20) Labor supply: $$w = e\, v\, (L_0 + L_1)\, Y.$$

(21) Marginal productivity condition: $$w = p = \beta \pi_1 L_1^{\beta-1}.$$

(22) Balanced trade equation: $$I = C_1.$$

(23) Flexible exchange rate: $$\bar{M} = \gamma Y.$$

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[9] The utility function in (17) belongs to a class of preferences that is widely used in the real business cycle literature. The functional form satisfies all the conditions specified in King, Plosser, and Rebelo (1988) for preferences to be compatible with balanced growth. The functional form also implies that the Frisch labor supply elasticity is unity, which is more appealing than the infinite Frisch elasticity implied by the indivisible labor assumption used in the previous section.

Consider again an adverse shock on the productivity of workers in the tradable sector, and assume initially that Mexico adopts a flexible exchange rate and that there are no wage rigidities in the Mexican economy. By differentiating equations (18)–(23), it is easy to show that the wage and employment responses in the Mexican economy are given by:

$$\tilde{w} - \tilde{e} = \frac{\tilde{\pi}_1}{2-\beta}, \tag{24}$$

$$\tilde{L}_0 = \frac{\tilde{\pi}_1}{2-\beta}, \tag{25}$$

$$\tilde{L}_1 = \frac{\tilde{\pi}_1}{2-\beta}. \tag{26}$$

Because the labor supply curve is now upward sloping, the adverse productivity shock changes *both* real wages and employment. Figure 1 illustrates what happens in the tradable sector in response to the productivity shock. Initially, the economy is in equilibrium at point A. The productivity shock generates a downward shift in the labor demand curve to D', moving the economy to point B and lowering both real wages and employment. Suppose that the flow of emigrants (E) generated by the adverse productivity shock is given by the pool of newly unemployed workers, so that $E = -(dL_0 + dL_1)$. The number of emigrants from the Mexican economy to the United States is then given by:

$$E_{\text{FLEXIBLE}} = -(L_0 + L_1)\frac{\tilde{\pi}_1}{2-\beta} > 0. \tag{27}$$

Consider now the consequences of an adverse productivity shock when Mexico adopts a fixed rate regime *and* there is wage rigidity in the Mexican economy. It is easy to show that the employment and wage shifts are now given by:

(28) $$\tilde{w} - \tilde{e} = 0,$$

(29) $$\tilde{L}_0 = \frac{\tilde{\pi}_1}{1-\beta},$$

(30) $$\tilde{L}_1 = \frac{\tilde{\pi}_1}{1-\beta}.$$

In terms of Figure 1, the presence of a fixed exchange rate and wage rigidity leaves the real wage at the initial level, so that the economy moves to point C, implying that the employment decline is larger than it would have been had there been no wage rigidities. In particular, the number of emigrants generated by the adverse productivity shock is:

(31) $$E_{\text{FIXED}} = -(L_0 + L_1)\frac{\tilde{\pi}_1}{1-\beta} > 0.$$

The comparison of equations (27) and (31) clearly indicates that unemployment in Mexico—and hence emigration to the United States—will be larger when the Mexican monetary authorities dollarize the economy.

Therefore, the fixed exchange rate increases the number of emigrants because the fixed exchange rate—*along with other market imperfections in the Mexican economy*—prevents the Mexican labor market from optimally adjusting to the adverse productivity shock through price changes. The inefficiencies created by a fixed exchange rate encourage Mexican workers to find economic opportunities in those economic sectors that were unaffected by the productivity shock, such as the U.S. labor market.

Benefits from Dollarization

Despite the unambiguous nature of the results presented in the previous section, it has been argued that dollarization may have beneficial impacts on the Mexican labor market, and may reduce the incentives of Mexican workers to migrate to the United States. This argument typically assumes that the adoption of the dollar as legal tender would impart some benefits on the Mexican economy.

For instance, dollarization might reduce uncertainty about economic trends in the Mexican economy and minimize the influence of political interference, inefficiency, and corruption in the setting of monetary policy. These "externalities" from dollarization could then improve the efficiency of the Mexican economy, increase the amount of foreign capital flowing into the country, and hasten the process of economic convergence between the United States and Mexico.[10] The reduction of the wage gap between the two countries would then help reduce the size of the emigrant flow since income differentials are probably a key determinant of the migration flow between the two countries.

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[10] Bacchetta and van Wincoop (1998) present a theoretical discussion of how exchange rates affect capital flows. Calvo (1999a) argues that the benefits from dollarization should not be assessed by comparing a fully-dollarized economy with a flexible exchange rate regime, but by comparing a fully-dollarized economy with the

Although these externalities are theoretically plausible, there is little empirical evidence that documents the size of the externality, or that even proves their existence in other merging economies. In particular: How does dollarization move an emerging economy to a more efficient allocation of resources? By how much does dollarization increase the amount of foreign investments in countries that adopt this type of fixed rate regime? By how much does dollarization narrow the income gap between the adopting countries and the United States?

It is also important to note that even if the externalities did exist, they may not be sufficiently large to overcome the adverse impacts that a fixed rate regime—in the presence of nominal wage rigidity—would have on employment in the Mexican economy. To illustrate, consider the following extension of the theoretical framework developed above. Suppose the trade balance equation were given by:

$$\pi_1 L_1^{\beta} + K = \frac{\alpha Y}{e}. \tag{32}$$

where K gives the (exogenous) value of the foreign capital infusion into the Mexican economy. As before, the Mexican economy is hit by an adverse productivity shock, with $\tilde{\pi}_1 < 0$. It is easy to show that the number of emigrants generated by this productivity shock in the presence of a flexible rate regime is:

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economic outcomes that result from partial dollarization, where part of the economy, such as the debt, is already dollarized.

$$(33) \qquad E_{\text{FLEXIBLE}} = -L_0\left(\frac{1-2\theta+\delta\theta}{2-\beta-\beta\delta\theta}\right)\tilde{\pi}_1 - L_1\left(\frac{1+\delta\theta}{2-\beta-\beta\delta\theta}\right)\tilde{\pi}_1,$$

where $\theta = K/(\pi_1 L_1^{\beta} + K)$, and $\delta = L_0/(L_0 + L_1)$.

Dollarization shifts the incentives for foreign investors to invest in the Mexican economy. In particular, suppose that if the Mexican monetary authorities dollarize the currency the externality takes the form of an infusion of foreign capital. Let $\tilde{K}$ give the percentage change in foreign investment, with $\hat{K} > 0$. It can be shown that the number of emigrants generated by a productivity shock in the presence of a fixed rate regime and wage rigidity is:

$$(34) \qquad E_{\text{FIXED}} = -L_0\left(\frac{1-\theta}{1-\beta}\tilde{\pi}_1 + \theta\tilde{K}\right) - L_1\frac{\tilde{\pi}_1}{1-\beta}.$$

The comparison of equations (33) and (34) indicates that the difference in the number of Mexican emigrants under the two exchange rate regimes is:

$$(35) \qquad E_{\text{FIXED}} - E_{\text{FLEXIBLE}} = -\left[\frac{L_0(1-\delta\theta)(1-\beta\theta) + L_1(1+\delta\theta)}{(1-\beta)(2-\beta-\beta\delta\theta)}\right]\tilde{\pi}_1 - \theta L_0\tilde{K}.$$

The bracketed term in (35) is positive, so that the adverse productivity shock still generates a "direct" effect that induces more Mexicans to migrate to the United States under a fixed rate regime. This effect,

however, could be reversed the greater the importance of foreign investment to the Mexican economy (i.e., the greater θ) and the greater the dollarization externality (i.e., the greater $\tilde{K}$).

In the end, the question of whether dollarization increases or decreases the incentives of the Mexican population to migrate to the United States is an empirical question. On the one hand, the dollarization externality would tend to reduce the number of emigrants. On the other hand, the fact that the dollarized economy could not adjust fully through price changes would tend to increase the number of emigrants. The net impact of dollarization could then be determined only by collecting evidence on the quantitative value of the externality and comparing this effect to the potentially adverse employment impact of fixed rate regimes.

III. Exchange Rate Regimes and Emigration from Mexico

The theoretical framework suggests that the number of Mexican emigrants depends not only on differences in economic conditions between the United States and Mexico, but also on the exchange rate regime adopted by the Mexican monetary authorities. The empirical analysis presented in this section investigates if the flow of both legal and illegal immigrants from Mexico responds to economic factors, and if this response depends on the exchange rate regime adopted by the Mexican monetary authorities. It is useful to first examine the determinants of illegal immigration to the United States because this flow is likely to respond swiftly to changing economic conditions in the two countries.

The latest wave of illegal immigration from Mexico began in the late 1960s, after the discontinuation of the bracero program. This program was launched in 1942, when the U.S. and Mexican governments agreed to allow the temporary migration of agricultural workers due to a labor

shortage caused by World War II. The program continued in various guises until 1964, when it was unilaterally ended by the United States. The main reason given for the discontinuation at the time was the undocumented presumption that the bracero program depressed the wages of native-born American workers in the agricultural industry.

The number of illegal aliens apprehended by the Border Patrol began to increase soon after the bracero program ended. In 1964, fewer than 42,000 Mexican illegal aliens were apprehended; by 1974, nearly 710,000 Mexican illegal aliens were apprehended. The number of apprehensions peaked in 1986 when 1.7 million Mexican illegal aliens were apprehended. In 1986, Congress enacted the Immigration Reform and Control Act (IRCA), hoping to stop the flow of illegal aliens by providing amnesty to a large number of illegal aliens already residing in the United States, and by setting up a system of employer sanctions designed to penalize employers who knowingly hire illegal aliens. Nearly 2.7 million illegal aliens were granted amnesty (of whom about 2 million were Mexicans). The employer sanctions, however, did not achieve their objective. After a temporary dip, the number of annual apprehensions of Mexican illegal aliens rose steadily in the early 1990s. By the mid-1990s, over 1 million Mexican illegal aliens were being apprehended annually.

Figure 2 shows the trend in the number of monthly apprehensions made by the Border Patrol on "linewatch" duty. The data on linewatch apprehensions are useful because the illegal aliens are apprehended while they are attempting to enter the United States illegally.[11] As a result, the trend in linewatch apprehensions is likely to be most correlated with changing economic conditions. Although the

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[11] The Border Patrol also captures many persons in locations away from the border. However, we do not have any information on when the illegal aliens captured in "non-linewatch" duty entered the United States. As a result, the data on non-linewatch apprehensions need not reflect the economic conditions facing the two countries at the time of the arrest.

data on linewatch apprehensions refers to all apprehensions made by the Border Patrol, it turns out that 99.2 percent of linewatch apprehensions in the 1977-96 period occurred at the U.S.-Mexico border. The figure illustrates the highly seasonal nature of apprehensions. Linewatch apprehensions tend to peak in the spring (at the height of the growing season), and typically reach their annual lows in December.

It is worth noting that studies of the determinants of the size of the illegal immigration flow typically focus on the trends in the apprehension data summarized in Figure 2 because we do not know how many illegal aliens actually enter the United States at any point in time. The use of the data on apprehensions is problematic because 1 million annual apprehensions may imply that 1 million different persons were caught trying to enter the United States illegally, or that 100,000 persons were each caught ten times during the entry attempt. In other words, the number of apprehensions depends on the probability that someone attempting to enter the country illegally is caught by the Border Patrol, and there are no reliable estimates of the apprehension probability or of how this probability has changed over time.

Despite this measurement problem, it is not difficult to isolate the impact of economic variables on the size of the illegal alien flow (as opposed to the number of apprehensions). We can write the number of illegal aliens who are apprehended at time t as:

$$\log A_t = \log p_t + \log I_t , \tag{36}$$

where A_t gives the number of apprehensions; p_t gives the probability of apprehension; and I_t gives the number of persons who attempt to enter the United States illegally. To isolate the impact of economic

factors on I_t (the relevant measure of illegal immigration), it is crucial to control for differences in the probability of apprehension over time.

The empirical analysis estimates the following reduced-form regression model using a measure of Border Enforcement activities to adjust for secular variations in the probability of apprehension:

$$\begin{aligned}\log A_t = {} & \delta_1 \log A_{t-1} + \delta_2 \log A_{t-2} + \alpha_0 \log H_t + \alpha_1 \log H_t + \phi_0 \log w_t^M + \phi_1 \log w_{t-1}^M \\ & + \beta_0 \log(e_t w_t^{US}) + \beta_1 \log(e_{t-1} w_{t-1}^{US}) + \text{other variables},\end{aligned} \tag{37}$$

where A_t gives the number of baseline apprehensions made by the Border Patrol in month t; H_t gives the number of person-hours spent by the Border Patrol policing the U.S. border; w_t^M is the real wage in the manufacturing sector of the Mexican economy (available since 1968), deflated by the Mexican consumer price index; e_t is the exchange rate (defined as the number of pesos per dollar); w_t^{US} is the real wage in the manufacturing sector of the U.S. economy, deflated by the U.S. consumer price index. Note that both of the wage variables in the regression are in units of Mexican pesos and that the regression allows for lagged effects in the key variables.[12] The "other variables" in the regression include a vector of fixed effects indicating the month of the year (to control for seasonality effects in apprehensions), and a time trend (set to unity for January 1968).[13] The regression is estimated using data for the period January 1968 through December 1996.

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[12] The data on apprehensions, border enforcement, real wages in the Mexican manufacturing sector, and the exchange rate are drawn from Hanson and Spilimbergo (1999). The U.S. data on wages in the manufacturing sector and the consumer price index are available in the website of the Bureau of Labor Statistics.

[13] The regressions also include dummy variables indicating if the data is for the post-1977 period or for the post-1990 period, as well as interactions between these dummy variables and the time trend. These variables control

Figures 3, 4, and 5 illustrate the trends in the real wage data for Mexico and the U.S., respectively, as well as in the exchange rate. It is evident that the Mexican real wage has experienced several periods of substantial decline, typically associated with a major devaluation of the currency, as in 1982-83 and in 1994-95. The U.S. real wage fell slightly in the 1980s, but the drop was slight compared to the decline observed in the Mexican economy. Finally, the trends in the exchange rate illustrate the impact of the severe devaluation of the Mexican peso in the past two decades.

The first two columns of Table 1 report the estimates of the key parameters of the regression model. The first column simplifies the specification of equation (37) by omitting the lagged variables from the regression, while the second column reports the estimates of the full specification. It is evident that both specifications generate similar qualitative results. In particular, the number of Mexican illegal aliens apprehended by the U.S. Border Patrol is quite sensitive to enforcement expenditures, as well as to changes in economic conditions in Mexico and the United States.

The lagged specification implies that the long-run elasticity of apprehensions with respect to enforcement is .216, so that doubling the number of person-hours spent by the Border Patrol policing the border increases the number of apprehensions by about 20 percent.[14] The long-run elasticity of apprehensions with respect to the Mexican real wage is -.65, suggesting that a substantial reduction in the Mexican real wage will lead to a large increase in the number of apprehensions. Finally, the regression reveals that the long-run elasticity of apprehensions with respect to the U.S. real wage is .61.

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for administrative changes in the way that the Immigration and Naturalization Service measures apprehensions (see Gordon and Hanson, 1999). In addition, the regression includes dummy variables indicating if the data is for the post-1986 period (to control for the impact of IRCA on illegal immigration), and if the data is for the post-1994 period (to control for both the impact of the enactment of Proposition 187 and for a policy change, discussed below, that regulates how illegal immigrants can adjust their status to become legal residents of the United States), as well as for interactions between these dummy variables and the time trend.

It seems, therefore, that the number of illegal aliens apprehended depends on economic conditions in both Mexico and the United States.

The theoretical analysis presented earlier suggests that the response of illegal immigration to changes in economic conditions (such as a change in the Mexican wage attributable to an adverse productivity shock) will differ depending on whether the Mexican authorities adopt a fixed or flexible exchange rate regime. The Mexican monetary authorities changed the exchange rate regime several times between January 1968 and December 1996.[15] Prior to February 1982, Mexico had a pegged exchange rate. In practice, however, the exchange rate did not change much during this period—so that, in effect, Mexico had a fixed exchange rate until early 1982. The exchange rate was then allowed to float freely between February 1982 and August 1982, at which time Mexico adopted an exchange rate regime of "predetermined depreciation." The monetary authorities, however, set a relatively high depreciation rate, so that the exchange rate was allowed to effectively float from February 1982 until February 1988. In March 1988, the predetermined depreciation rate was set to zero for one year—essentially re-imposing a fixed rate regime, and this depreciation rate was kept low until December 1994. The exchange rate was then allowed to float beginning in January 1995. These changes in exchange rate regimes are evident in Figure 5, which shows the secular trend in the Mexican exchange rate (in terms of the U.S. dollar) over the 1968-1996 period.

I estimated the regression model in equation (37) separately in each of two periods: the months during which Mexico adopted a flexible exchange rate, and the months during which Mexico adopted a

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[14] The standard errors of the long-run elasticities are calculated using the delta method.

fixed exchange rate.[16] The remaining columns of Table 1 report these regressions. It is evident that the exchange rate regime has a significant impact on the estimated elasticity of apprehensions with respect to the Mexican wage. The long-run elasticity was –.55 during the years in which Mexico adopted a flexible exchange rate. In contrast, the elasticity was twice as high, or –1.11, during the years in which Mexico adopted a fixed exchange rate. A 20 percent drop in real wages, therefore, generates a 10 percent increase in apprehensions when Mexico adopts a fixed rate, and a 20 percent increase when Mexico adopts a flexible rate. It should be noted, however, that the difference between the two elasticities is not statistically significant at conventional levels (although the difference is significant in the simpler regression specification that omits the lags).[17]

The theoretical analysis presented earlier indicated that Mexican unemployment—and hence emigration to the United States—would be much more sensitive to productivity shocks if Mexico adopted a fixed rate regime than if Mexico adopted a flexible rate regime (as long as there were also nominal wage rigidities in the Mexican economy). The data suggest that a decline in the Mexican real wage leads to a larger emigrant flow if the Mexican monetary authorities adopt a fixed rate regime.[18]

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[15] The International Monetary Fund (various issues) documents the timing of changes in exchange rate regimes. Del Negro and Obiols-Homs (1999) present a very useful history of the changes in Mexican monetary policy and exchange rate regimes during the period under analysis.

[16] In particular, I classify the data so that Mexico had an effective floating rate between February 1982 and February 1988, and after January 1995. Mexico is assumed to have adopted a fixed rate in all other months.

[17] The regressions also indicate that the elasticity of apprehensions with respect to the U.S. wage is much more positive during the years in which Mexico adopted a fixed exchange rate.

[18] It is important to stress that the empirical evidence does not provide a direct test of the theory. In the presence of a fixed rate regime and nominal wage rigidity, the theory implies that an adverse productivity shock to the Mexican economy leads to more emigration *because* real wages are constant. The regression estimated in this section, however, measures the correlation between illegal immigration to the United States and changes in the Mexican real wage. My interpretation of the empirical evidence implicitly assumes that (unobserved) productivity shocks are correlated with movements in the real wage. This interpretation may be valid if there are imperfections in

Both the theory and the evidence, therefore, seem to suggest that dollarization will make illegal immigration to the United States much more volatile (in the sense that illegal immigration will be more responsive to specific changes in the economic opportunities offered by the Mexican labor market)

Determinants of Legal Immigration

Many Mexicans also migrate legally to the United States. Immigration policy in the United States, however, introduces a number of important rigidities into the system, making it unlikely that the flow of legal immigration from Mexico can be as responsive to changing economic conditions as the flow of illegal immigration.

Prior to 1965, U.S. immigration policy was guided by the national-origins quota system. Under this system, visas allocated to persons who originated in the Eastern Hemisphere were awarded mainly on the basis of national origin (with two countries, Germany and the United Kingdom, receiving about 60 percent of the available slots). In contrast, persons originating in the Western Hemisphere were exempt from the quotas and faced no numerical restrictions on the number of visas, presumably because of the close economic and political ties between the United States and its geographic neighbors. Visas for Western Hemisphere applicants were awarded on a first-come, first-served basis as long as the persons satisfied a long list of health, moral, and political requirements.

The 1965 Amendments to the Immigration and Nationality Act (and subsequent minor legislation) repealed the national origins quota system, set a world-wide numerical limit (507,000 visas in 1996), and enshrined a new objective for awarding entry visas among the many applicants: the

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the Mexican economy, besides perfectly rigid nominal wages, that prevent wages from fully adjusting to the productivity shock. The incomplete wage adjustments would force the Mexican labor market to adjust partly along

reunification of families. The United States sets aside the bulk of the visas (62 percent in 1996) to certain persons who have relatives already residing in the country, including the adult children and siblings of U.S. citizens, as well as the spouses and minor children of permanent resident aliens. "Immediate" relatives of U.S. citizens—such as spouses, parents, and minor children—are exempt from the numerical limits, and are entitled to immediate entry. In the mid-1990s, 32 percent of the immigrants entered with an "immediate relative" visa, and over 70 percent entered through one of the family reunification provisions of the law.[19]

The family reunification provisions at the heart of U.S. immigration policy likely create a "multiplier effect" where the presence of a certain number of immigrants from a particular country in the United States virtually ensures that more immigrants will originate from that country in the future, as the current immigrants sponsor the entry of additional relatives. Consider, for instance, the long-run impacts of admitting a married couple into the United States. After five years (the time required for naturalization), both of these immigrants can sponsor the entry of their siblings. Once the siblings arrive in the United States, they can then sponsor the entry of their spouses, who can in time sponsor the entry of their siblings, and so on. Because there are numerical restrictions on the number of visas allocated to particular types of family preferences in any given year, the multiplier effect generates long queues that determine when the sponsored relatives can actually enter the United States. In September 1999, for example, the State Department was processing applications for the entry of unmarried (adult) sons and

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the employment margin, affecting the emigration decisions of individual workers.

[19] U.S. Immigration and Naturalization Service (1997), p. 34. The period refers to 1994-96, so that the statistics are unaffected by the large number of illegal aliens who received amnesty and were awarded permanent residence in the early 1990s.

daughters of U.S. citizens that were filed in October 1993, as well as applications for the entry of the siblings of U.S. citizens that were filed in August 1988.

These long queues suggest that the legal immigration flow is likely to be quite insensitive to transitory changes in economic conditions in either country. After these longs waits, the legal immigrant will choose to move to the United States when he or she reaches the head of the queue regardless of the year-to-year blips in relative real wages. Over the long haul, of course, the legal immigrant flow should be more responsive to permanent trends in economic variables, such as a narrowing of the wage gap between Mexico and the United States. But the long-run elasticity of legal immigration with respect to relative wages may be relatively small simply because family reunification plays such a central role in U.S. immigration policy.

I use the Immigrants Admitted to the United States surveys, a set of micro data files constructed by the Immigration and Naturalization Service (INS), to analyze the link between exchange rate regimes and legal immigration. These data files contain a record for each person admitted legally to the United States between 1972 and 1996.

There are two types of legal Mexican immigrants in these data.[20] Some of the immigrants admitted in any given year are "new arrivals," namely Mexicans who have migrated to the United States legally at that particular time. The INS reports the month and year of admission for these new immigrants. Other immigrants in the files, however, are Mexicans who have "adjusted status". An immigrant who adjusted status in March 1982, for example, might have entered the United States in

[20] A large number of the Mexican legal immigrants admitted in the 1990s were illegal aliens who had received amnesty through the 1986 Immigration Reform and Control Act. The INS data files do not contain any information on these immigrants.

September 1975 using a foreign student visa. This immigrant might have married a U.S. citizen in the intervening years. He or she then applied to the INS to adjust status (i.e., to receive a permanent resident visa or "green card") and the INS granted this adjustment in March 1982. The INS does not report the year and month of admission for these types of immigrants.[21] Instead, the date reported in the INS data files gives the month and year in which the immigrant adjusted status.

To provide a closer link between changing economic conditions and the flow of legal immigrants from Mexico to the United States, I restrict the analysis to immigrants who are "new arrivals." I then used the INS data files to construct a monthly time series of newly arrived Mexican immigrants in the United States for the January 1972-September 1996 period. Figure 6 shows the trend in the flow of newly arrived Mexican immigrants during this period, and contrasts this trend with the baseline apprehensions data used earlier. It is evident that there is little connection between the two data series. The apprehensions data reveal a steady increase in illegal immigration over the period (although some of the rise may be accounted for by more intensive border enforcement), while the size of the legal immigrant flow is relatively steady over much of the period. In fact, the correlation between the two series is -.073.[22] It seems, therefore, that the determinants of the flow of new Mexican immigrants are quite different than the determinants of illegal Mexican immigration.

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[21] Actually, the INS data files have a field that is supposed to report the year (though not month) of entry for the immigrants who adjusted their status. This field, however, is typically blank for the Mexicans who adjusted status.

[22] The partial correlation, after adjusting for month of entry, is -.137. The partial correlation, after adjusting for month of entry and enforcement hours, is -.052.

I estimated the regression model in equation (37) using the number of legal immigrants as the dependent variable.[23] Not surprisingly, the evidence reported in Table 2 suggests that there is little link between the flow of legal immigrants and the Mexican wage rate, and that there is an *inverse* correlation between legal Mexican immigration and the U.S. wage (so that fewer Mexican immigrants come to the United States legally when the U.S. wage is high). The weak (and erratic) evidence reported in Table 2 indicates that the timing of legal immigration to the United States is determined less by the economic conditions at the time of the actual migration, and more by the rigidities generated by an immigration policy that unilaterally decides who gets to enter the United States and when.

IV. Summary

This paper investigates how the dollarization of the Mexican economy will affect economic conditions in the Mexican labor market, and particularly how dollarization will alter the incentives of Mexican workers to migrate to the United States. In the past two decades, the Mexican economy has reacted quite strongly to major devaluations of its currency. During the currency crisis of 1994-95, for example, the unemployment rate in large urban areas of Mexico more than doubled in less than a year.

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[23] The regressions also include dummy variables indicating if the data is for the post-1989 period or for the post-1994 period, as well as interactions between these dummy variables and the time trend. The 1989 dummy variable controls for an administrative change in the way that the data categorizes immigrants into new arrivals and adjustments. The 1994 dummy variable controls for a significant change in the policy that regulates adjustment of status (known as the 245I program). This policy change particularly affected the counts of Mexican immigrants. Beginning in September 1994, immigrants who had entered the United States illegally could adjust their status without having to leave the United States. This administrative change created huge backlogs for the INS and dramatically changed how Mexican immigrants were categorized into "new arrivals" or "adjustments." For instance, 88 percent of the Mexican immigrants in the INS data in 1992 and 1993 were classified as new arrivals. This fraction dropped to 40 percent in 1995 and 1996. The change in policy—and the implication that many of the Mexican immigrants who were classified as new immigrants before 1994 should probably have been classified as adjustments—suggests that the regression results for legal immigration reported in Table 2 must be interpreted with some caution.

A simple economic model of dollarization suggests that by choosing a fixed rate regime tied directly to the U.S. dollar, Mexican policy-makers are in effect giving up a degree of freedom in their toolkit of policy remedies. If all other prices in the Mexican economy were flexible, adverse shocks in productivity or in foreign investment would have the same impact regardless of whether the Mexican economy was dollarized or not. If there are imperfections in the Mexican economy, however, the adverse shocks would likely result in more unemployment, lower real wages for Mexican workers, and a greater propensity for the typical Mexican worker to migrate to the United States.

It is also possible, however, that dollarization generates a number of beneficial externalities, such as providing a signal to foreign investors that the Mexican economy may become more stable. In doing so, dollarization might help attract more foreign capital, help stabilize the Mexican economy, and hasten the process of economic convergence between Mexico and the United States. This economic convergence would then reduce the number of Mexican emigrants. There is, however, little empirical evidence to suggest that these externalities are important by-products of dollarization.

The paper also examined the extent to which the migration flow from Mexico to the United States—both of illegal and legal immigrants—responds to differences in economic conditions between the two countries. It turns out that the illegal immigrant flow is quite responsive to economic variables, and that it is much more volatile during those periods when the Mexican monetary authorities adopted a fixed rate regime. In contrast, the legal immigrant flow is not sensitive to economic conditions.

The differential response of legal and illegal immigration to economic conditions has important implications for the impact of dollarization on migration from Mexico to the United States. Suppose that adopting a fixed rate regime does not lead to a very rapid convergence in real incomes between the two countries (so that dollarization externalities are small). Dollarization will then lead to a great deal more

volatility in the flow of illegal immigrants—an outcome that is likely to be politically sensitive in both countries—and may barely affect the number of persons who migrate legally to the United States.

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Figure 1. Impact of an Adverse Productivity Shock on the Tradable Sector

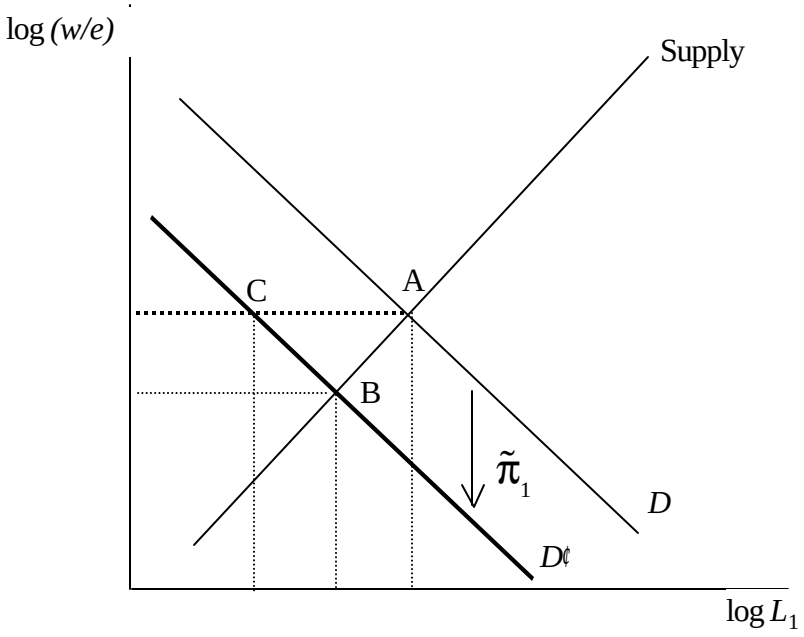
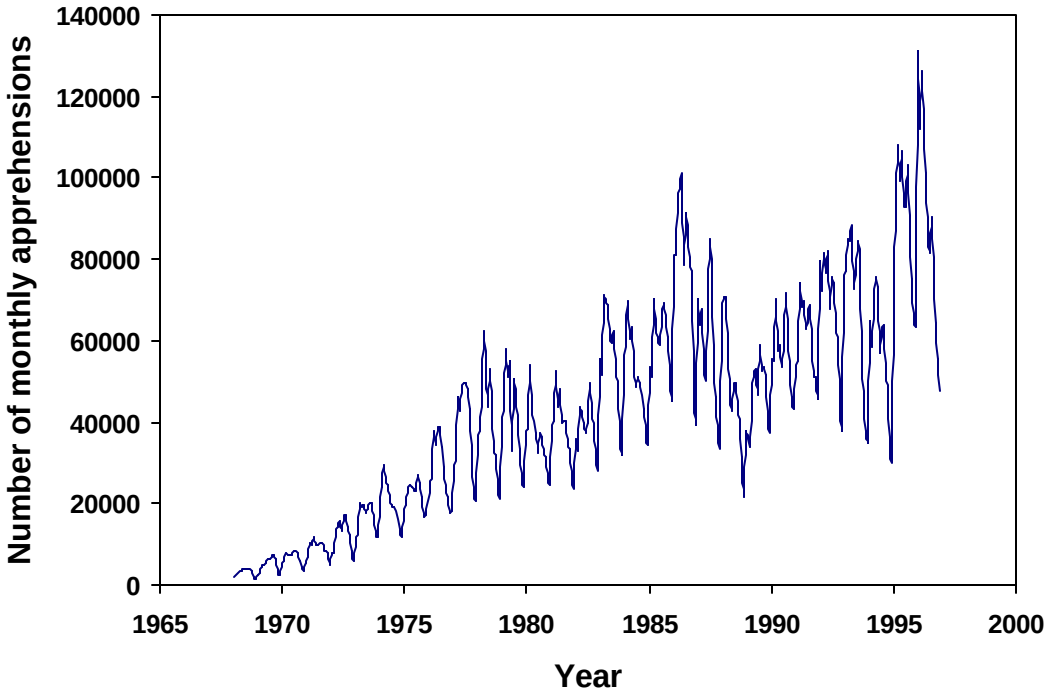
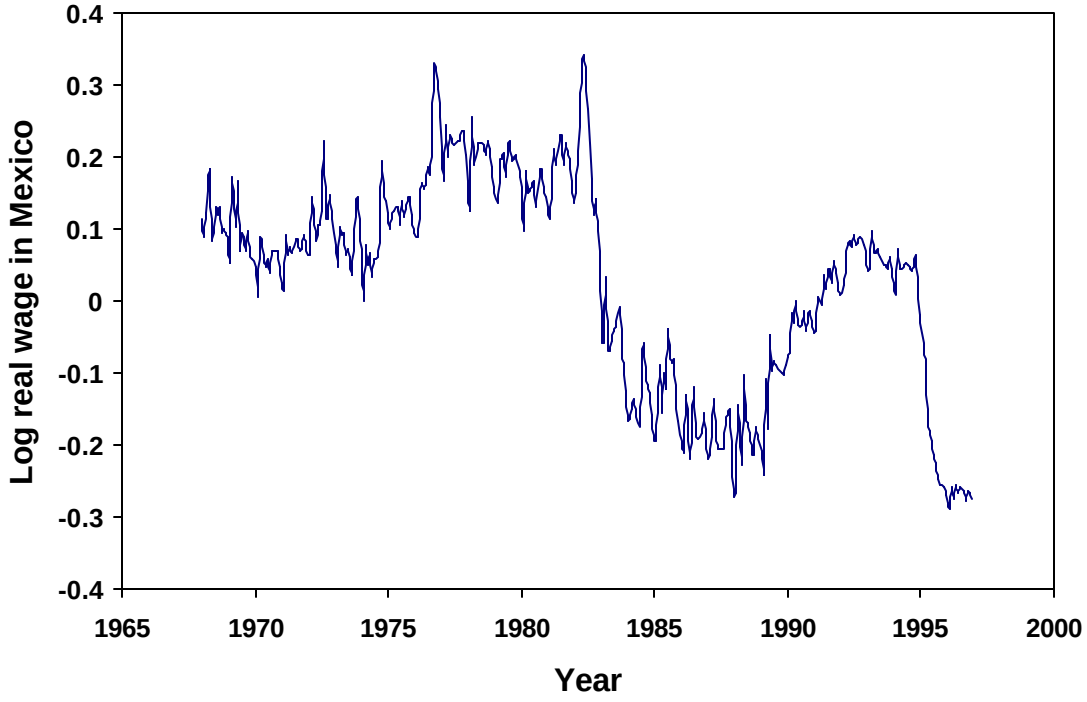


Figure 2. Number of Baseline Apprehensions, 1968-96
(monthly data)



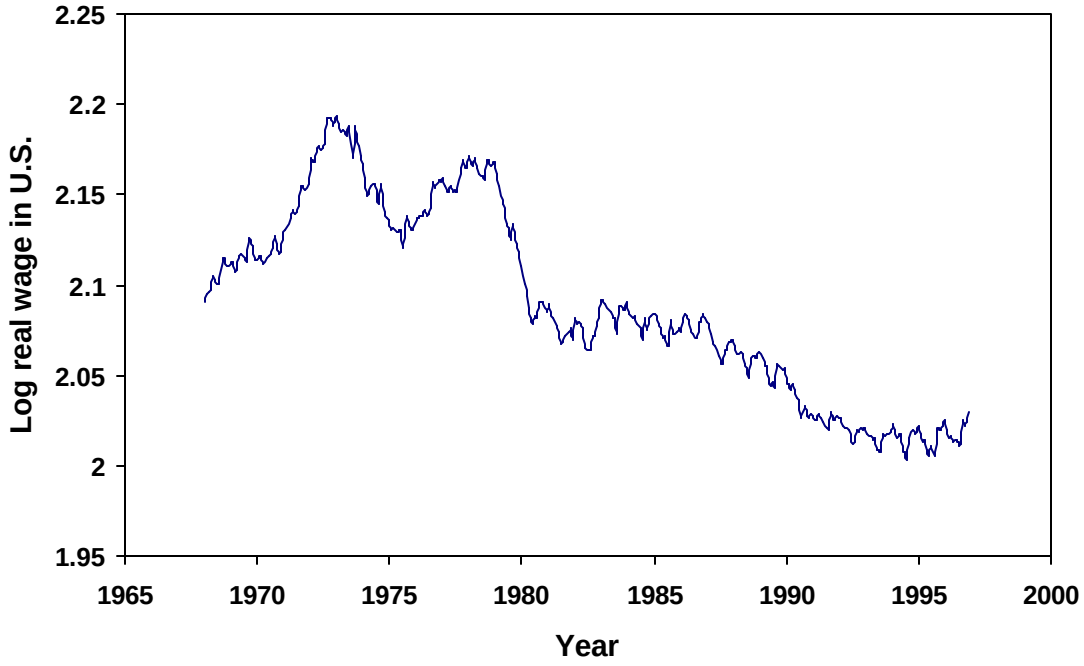
Source: Hanson and Spilimbergo (1999).

Figure 3. Trends in Mexican Real Wage, 1968-96
(monthly data)



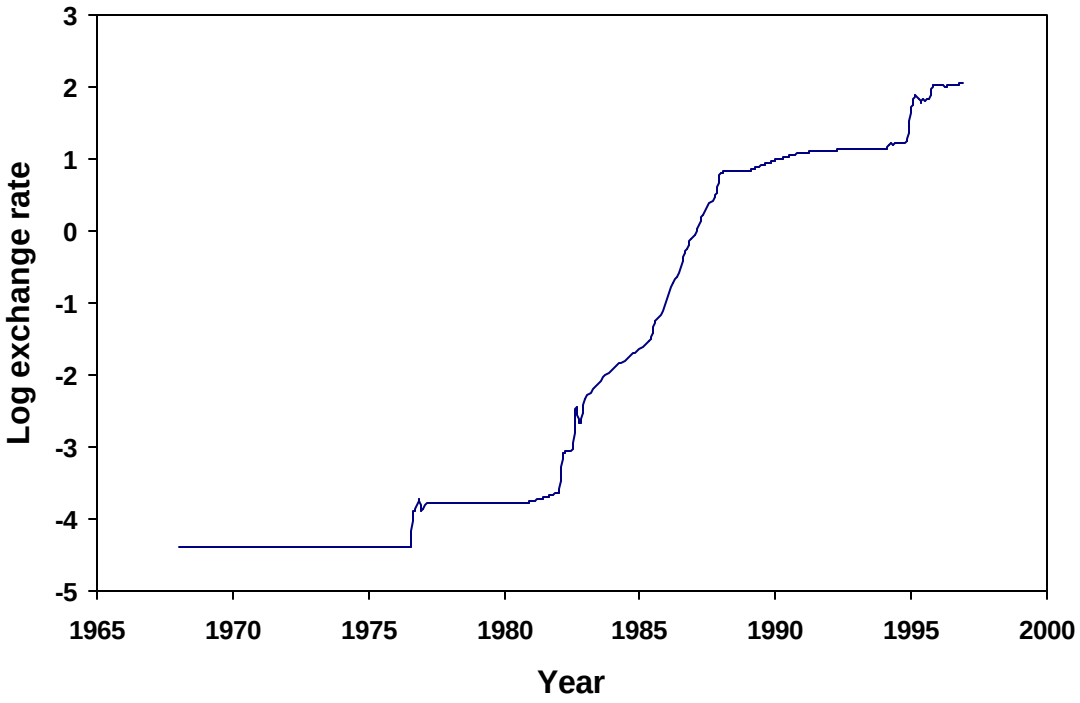
Source: Hanson and Spilimbergo (1999).

Figure 4. Trends in U.S. Real Wage, 1968-96
(monthly data)



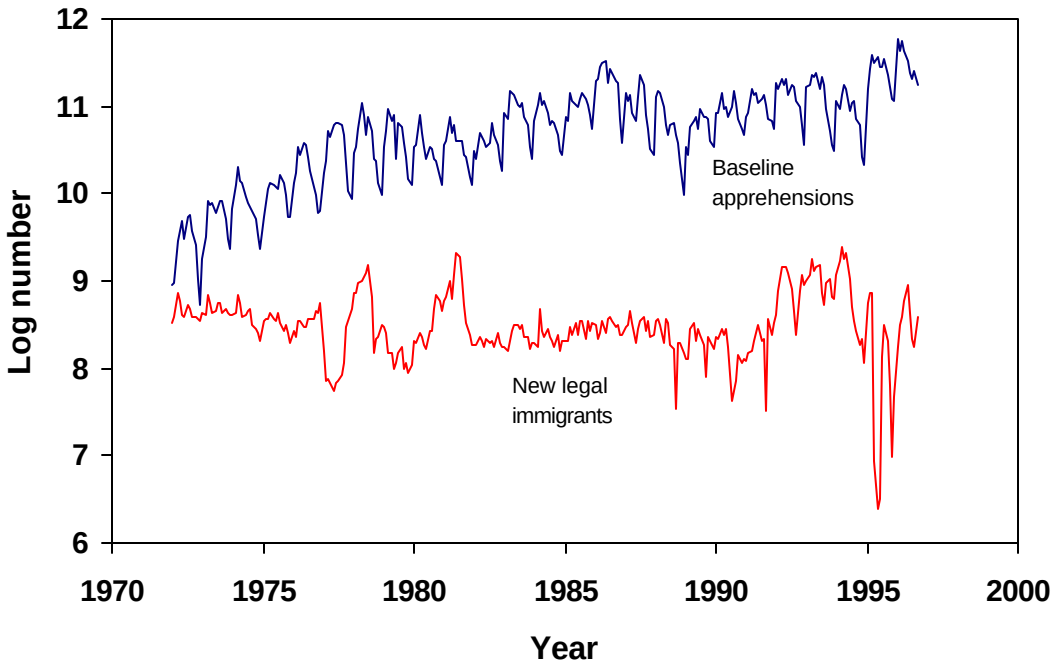
Source: U.S. Bureau of Labor Statistics website.

Figure 5. Mexican Exchange Rate, 1968-96
(new pesos per dollar)



Source: Hanson and Spilimbergo (1999).

Figure 6. Trends in Illegal and Legal Immigration, 1972-96
(monthly data)



Source: Hanson and Spilimbergo (1999) and Immigration and Naturalization Service, Immigrants Admitted to the United States data files.

Table 1. Determinants of Apprehensions of Mexican Illegal Immigrants

	All years		Flexible rate regime		Fixed rate regime	
Log apprehensions (*t*-1)	---	.787	---	.641	---	.714
		(.054)		(.116)		(.063)
Log apprehensions (*t*-2)	---	-.120	---	-.309	---	-.068
		(.052)		(.100)		(.060)
Log enforcement hours (*t*)	.475	.454	1.051	.750	.331	.407
	(.084)	(.084)	(.222)	(.254)	(.108)	(.091)
Log enforcement hours (*t*-1)	---	-.335	---	.069	---	-.381
		(.086)		(.269)		(.093)
Log real wage in Mexico (*t*)	-1.337	-.830	-.850	-.514	-2.034	-.988
	(.138)	(.188)	(.144)	(.288)	(.277)	(.250)
Log real wage in Mexico (*t*-1)	---	.540	---	.002	---	.539
		(.188)		(.294)		(.257)
Log real wage in U.S. (*t*)	.386	.156	.267	.104	.524	-.219
	(.064)	(.112)	(.136)	(.162)	(.140)	(.189)
Log real wage in U.S. (*t*-1)	---	.036	---	-.008	---	.551
		(.117)		(.140)		(.194)
Long-run elasticities:						
Enforcement hours	---	.216	---	.630	---	-.140
		(.190)		(.487)		(.187)
Mexican wage	---	-.645	---	-.554	---	-1.108
		(.313)		(.423)		(.412)
U.S. wage	---	.610	---	-.297	---	.723
		(.248)		(.333)		(.376)
R-squared	.978	.989	.936	.958	.978	.991
Sample size	348		97		251	

Notes: Standard errors are reported in parentheses.

Table 2. Determinants of the Number of Mexican Legal Immigrants

	All years		Flexible rate regime		Fixed rate regime	
Log legal immigrants (*t*-1)	---	.952	---	.878	---	.810
		(.059)		(.099)		(.075)
Log legal immigrants (*t*-2)	---	-.274	---	-.547	---	-.035
		(.059)		(.100)		(.074)
Log enforcement hours (*t*)	-.113	-.062	-.417	-.226	-.614	-.056
	(.212)	(.301)	(.694)	(.718)	(.248)	(.289)
Log enforcement hours (*t*-1)	---	.105	---	-.224	---	-.038
		(.302)		(.778)		(.290)
Log real wage in Mexico (*t*)	-.142	.602	.646	.300	.563	.690
	(.252)	(.441)	(.498)	(.883)	(.371)	(.474)
Log real wage in Mexico (*t*-1)	---	-.762	---	.080	---	-.635
		(.432)		(.876)		(.476)
Log real wage in U.S. (*t*)	-.365	.269	.288	.854	-.504	.015
	(.148)	(.248)	(.478)	(.519)	(.171)	(.342)
Log real wage in U.S. (*t*-1)	---	-.427	---	-.634	---	-.162
		(.254)		(.405)		(.344)
Long-run elasticities:						
Enforcement hours	---	.130	---	-.225	---	-.312
		(.578)		(1.034)		(.575)
Mexican wage	---	-.497	---	2.086	---	.077
		(.836)		(1.893)		(.921)
U.S. wage	---	-.491	---	-.100	---	-.624
		(.513)		(.937)		(.781)
R-squared	.257	.698	.305	.678	.444	.795
Sample size	297		94		203	

Notes: Standard errors are reported in parentheses.