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Capital and Labor Mobility and their Impacts on Mexico's Regional Labor Markets

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Abstract: This paper examines Mexico's real wages across its 32 states for the period 1997-2006. Employing dynamic panel data methods, our estimates for the effects of Mexico's "second wave" of market liberalization on real wages provide interesting results. First, we find strong positive effects on real wages from foreign direct investment (FDI) and also positive but smaller effects from migration. Second, slightly larger wage effects are observed from domestic than from foreign migration. Third, alternative partitions indicate that real wages are more sensitive to FDI-related fluctuations across states with relatively lower wages and migration levels. Other robustness exercises are provided.

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1. Introduction

Since the mid-1990s the Mexican labor market has been exposed to significant supply and demand shocks, first with the start of NAFTA in January 1994, and then with the devaluation of the Mexican peso in December of that year. As a result of NAFTA, Mexico's total trade to GDP ratio increased from 34% in 1993 to 64% in 2000. Foreign Direct Investment (FDI) inflows went from 4.3 billion U.S. dollars in 1993 to 10.9 billion U.S. dollars in 1994. Between 1994 and 2006 Mexico received more than 217 billion U.S. dollars in FDI (totaling around 40% of its GDP). In terms of migration, following the depreciation of the Mexican peso, the net outflow of people went from 412,000 in 1993 to 625,000 by the year 2000.[1]

Economic theory suggests that while FDI shocks increase labor demand, international migration would cause a decline in labor supply; both factors leading to higher wages. This paper examines this proposition after a period of significant adjustment by the Mexican economy to several macroeconomic shocks. In a sense, our empirical assessment of fluctuations to labor demand and supply is conducted when the economy is on its path to economic recovery amid liberalization of *both* its financial and trade sectors. Researchers have identified the post-NAFTA years as the "second wave of trade and financial liberalization" in Mexico, following the entry to the GATT in the mid-1980s as the "first wave". Feenstra and Hanson (1997) studied the latter period and showed that rising inequality in Mexico is linked to foreign capital inflows. Examples of the "second wave" are numerous and include, among others, Chiquiar (2008) for changes in individual wage regressions between 1990 and 2000. A few other papers investigate a longer time span that includes both waves, such as Robertson

[1] FDI and trade Figures are taken from the International Monetary Fund database International Financial Statistics, Migration Rates are calculated with data from CONAPO, the Mexican government national council of population.

(2005) for absolute wage convergence from 1982 to 2002 and Mollick (2008), who explores relative wages for two monthly data samples due to data compatibility: 1987-1995 and 1994-2007.

To illustrate the development of real wages in Mexico, we observe in Figure 1 the path of minimum real wages and manufacturing industry real wage indices since 1980. The dissimilar pattern of both real wage measures before and after 1994 is evident. Minimum real wages have declined constantly since 1981 with a short period of stability between 1992 and 1994. Manufacturing real wages seem a lot more consistent with the business cycle; they started to decline in 1982, after a significant depreciation of the Mexican peso, and recover 6 year latter in 1988, reaching a peak in 1994. After the depreciation of the Mexican peso in late-1994, manufacturing wages declined 22.5% in the subsequent two years but started their recovery in 1996 moving up to reach levels similar to those of 1994 by 2003. A third real wage measure presented in Figure 1 (available only since 1997) is the daily average real wage for workers registered in the Mexican social security system.[2] Along with the manufacturing sector, this broader measure of the real wage show a more significant recovery of wages with an annual average growth rate of 2.3% between 1997 and 2006. We argue in this paper that this observed recovery of real wages was related to FDI and migration shocks affecting the Mexican economy since the second part of the 1990s.

Previous studies have shown some evidence regarding the effects of FDI on real manufacturing wages. Brown et al. (2004) and Lipsey (2004) review the empirical literature on the effect of multinational firms on wages and consistently find that foreign-owned firms pay higher wages than local firms. More recently, some studies have challenged this evidence.

[2] This measure corresponds to the average wage received by permanent employees registered at the Mexican Institute of Social Security (IMSS) in urban and rural areas. This measure is the same we employ later at the state level to observe the effect of openness on wages.

Heyman et al. (2007) studying employer-employee data for the Swedish manufacturing sector show that foreign-owned firms pay higher wages than domestic firms but they find no evidence that foreign firms pay higher wages for identical workers. They suggest that higher payments are caused by differences in workers and firms characteristics. They also find that the premium paid by foreign-owned firms is smaller than in previous studies employing more aggregated data. Moreover, in the case of firm takeovers, they find no effect or even negative effects on wages.

The effects of FDI on more aggregate real wages, rather than manufacturing real wages, have been also explored in the literature. A recent example is Ge (2006) who employs a panel of Chinese cities to examine the effect of FDI on urban real wages finding that foreign capital inflows have a significant positive effect on real wages while controlling for other city characteristics. Also, Axarloglou and Pournarakis (2007) examine the effects of FDI on employment and wages in manufacturing employing a sample of U.S. states. They find that foreign capital in manufacturing have a weak effect on employment or wages. The effects of FDI, however, depend on the industry composition of those foreign capital inflows. For specific subgroups of industries the effects of FDI have been beneficial for local labor markets.

This paper also pays attention to labor supply shifts through state-to-state migration or through international migration. We use a new dataset at the state level made publicly available by CONAPO, the Mexican government national council of population. This dataset provide us with net outflows or inflows of people from or into each of the 32 Mexican states, as well as with domestic and foreign migration rates (outflows minus inflows over total population).[3] In a

[3] Our approach uses these migration measures as regressors in the wage equation at the state level in order to gauge labor supply shifts. Dahl (2002) develops a model of mobility and earnings where workers choose in which of the 50 U.S. states to live and work. His empirical work uses 1990 U.S. Census Data and confirms the role of comparative advantage in mobility decisions. The relative state-to-state migration flows of college versus high

paper close in nature to ours, Robertson (2005) analyzes the effects FDI (proxied by maquiladora establishments), trade and migration (proxied by border enforcement) on labor market integration using data for 6 urban areas in Mexico and the United States. He finds that trade and FDI have positively contributed the integration of the labor market between the two countries but the increase in border enforcement, a proxy for migration, has negatively affected wages in Mexico. A number of other studies have explored the effects of migration on real wages in Mexico. For instance, Hanson (2004) uses census data for 1990 and 2000 to examine the effects of trade and investment on Mexico's wages structure following NAFTA. He finds that wage differences in Mexico have increased due to the dissimilar access to trade, foreign investment and opportunities for migration to the United States. Employing also census data, Aydemir and Borjas (2007) observe that Mexico emigration rates are relatively higher for workers in the middle of the skill distribution, making the relative wage of workers in that section of the distribution also higher. This has, however, reduced the relative wage of the workers at the bottom of the distribution. They suggest that, "*despite the large scale migration of low skill workers from Mexico to the U.S., the wage of the low-skill workers in Mexico may have fallen"* (p. 666).

Despite the large amount of literature that assesses the effects of greater openness on Mexico's labor market, little is yet known about the impact of FDI and migration at the subnational (state) level. It is well known that inequality across Mexico's regions is significant; see, for instance, Sanchez-Reaza and Rodríguez-Pose (2002) and Chiquiar (2005). It is expected that shocks to labor demand and labor supply would affect real wages differently

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school educated individuals respond strongly to differences in the return to education and amenities across states. Dahl (2002)'s approach is beyond the scope of this paper.

across regions.[4] Moreover, FDI inflows might put in place additional dynamics by increasing the rate of domestic emigration to those states that attract more capital flows, thus requiring additional labor force.[5] Because of these complex dynamics, additional research is required in order to evaluate whether Mexico's second liberalization wave has had a positive or negative impact on subnational living standards.

This study examines the effect of market liberalization on Mexico's real wages markets across its 32 subnational entities for the period 1997-2006. We pay particular attention to the effect of FDI and migration shocks on real wages. Employing static and dynamic panel data methods, our estimates provide some interesting results. First, we find strong and positive effects on real wages from foreign investment and international migration but larger effects from domestic migration than from foreign. This is interesting as much attention has been given to the effect of Mexico's international migration on real wages but little to the flows of domestic migration across states, especially of unskilled labor moving from the south to the north. Overall, the result on FDI versus migration effects is suggestive of stronger labor demand shifts than labor supply, which is in line with strong complementarities between capital and labor in production. Second, alternative partitions indicate that real wages are more sensitive to FDI-related fluctuations across states with relatively lower wages and migration levels. These robustness exercises are discussed in detail below.

The rest of this paper proceeds as follows. Section 2 describes the dataset, presents some descriptive statistics and political maps which describe the geographical patterns of real wages, FDI and migration. Section 3 contains the theoretical foundations underlying our

[4] In a multi-country study Paus and Robinson (1997) find no evidence that greater economic openness is associated to higher or lower wage growth.

[5] Aroca and Malloney (2006) suggest that this might go the other way around and that foreign investment and trade rather reduce the incentives to migrate.

empirical model. Section 4 examines the determinants of real wages across Mexican subnational states. Finally, section 5 provides some concluding remarks.

2. Data

Data was compiled from different government agencies. Wages were taken from Mexico's ministry of employment (1997-2006 daily average state wages data are available from Secretaria del Trabajo y Prevision Social). These data correspond to average daily wages reported by the employers to the Mexican Institute of Social Security (Instituto Mexicano del Seguro Social) regarding permanent employees registered in rural and urban areas. Foreign Direct Investment (FDI) data were obtained from the Ministry of Economy (Dirección Nacional de Inversión Extranjera, Secretaría de Economía). International migration rates, domestic migration rates and state population figures were gathered from the National Population Council (CONAPO, Consejo Nacional de Población).[6] GDP per capita, our proxy for labor productivity, was constructed based on national accounts statistics provided by INEGI (Instituto Nacional de Estadística Geografía e Informática) and population figures were obtained from CONAPO. Ideally, the period covered by this analysis would include some of the pre-NAFTA years. Nonetheless, the availability of state wages statistics restricts our analysis to the period 1997-2006.

Table 1 shows some descriptive statistics for our data set. Average wages are measured in daily real pesos in 1993 prices. The highest average real wage is observed in the capital of Mexico, Distrito Federal (id #9), at $54 pesos, followed by the northeast state of Nuevo Léon

[6] For the construction of international and domestic migration flows and rates CONAPO employs census data from Censos Generales de Población y Vivienda available every 10 years (year ending in 0) and surveys made in between each census from Conteo de Población y Vivienda (years ending in 5). Projections for the years in between are calculated by CONAPO. Full details can be found in http://www.conapo.gob.mx/00cifras/00indicadores/documentacion_tecnica.pdf

(id # 19) at $42.9 pesos. Average output per capita is also the largest in these two states, which is expected given that wages should be related to the productivity of labor. The lowest average real wages is observed in Durango, only $26 pesos, followed by Zacatecas and Chiapas, with only $26.4 and $27, respectively. The lowest output per capita is observed in the southern states of Oaxaca, Chiapas and Guerrero. In our sample, the relation between real wages and output per capita is positive and strong with a correlation coefficient of 0.77. A clear pattern of real wages and their geographical location can be observed in Figure 2. The political map in Figure 2 clearly shows how states with higher than average real wages are concentrated along the border with the United States and at the center of Mexico. Sonora, the only northern border state that does not observe a higher than average real wage, is only $2.5 pesos below the national average. Meanwhile, Campeche is the only southern state with higher than average real wages and this is due to the presence of the state company PEMEX. The company concentrates a significant part of its extraction of oil and gas from the Gulf of Mexico in this state.

For the period observed FDI represents on average around 1.6% of GDP across all 32 states. The largest receptor of FDI is the capital of Mexico, Distrito Federal, 8.7%, followed by the northern border states of Nuevo Leon and Baja California, 5.1% of their respective GDP each. The states with the lowest FDI reception are the southern states of Chiapas and Oaxaca, followed by center state of Hidalgo (less than 0.5% of their respective GDP in all three cases). Figure 3 shows the geographical location of states above and below the average annual FDI to GDP ratio. The concentration of the highest receivers of FDI along the northern border and the center of Mexico is evident in this diagram.

Finally, with respect to migration, in the last two columns of Table 1 we observe the average rates of international and domestic migration (outflows of people minus inflows over

total population). On international migration, only three states in the country experienced a net inflow of people: Quintana Roo (0.79%), Baja California (0.30%), and the capital of Mexico, Distrito Federal (0.05%). These states typically receive a considerable amount of foreign immigrants due to tourism and business activities. Among the states that expel more migrants abroad are Michoacán (1.66%), Zacatecas (1.51%) and Nayarit (1.35%). The geographical pattern of international migration is shown in Figure 4. States with more than average net migration rates extend all along Mexico from Chihuahua in the northern border to Oaxaca. The correlation between real wages and international migration is negative (correlation coefficient of -0.45), which is more in line with the idea that those states with higher net migration also observe the lowest real wages. This negative correlation coefficient goes against the theoretical hypothesis that higher migration leads to a reduction of the labor supply and thus to higher real wages.

The sample correlation between real wages and domestic migration is also negative, but with a much smaller value by a correlation coefficient of -0.08. We observe 10 states that are net exporters of labor to other states of Mexico and 22 that are net importers of domestic labor. Among the main exporters are the nation capital (Mexico, D.F.), Guerrero and Tabasco and among the main importers are Quintana Roo, Baja California Sur and Baja California. The relation between domestic and foreign migration is positive (correlation coefficient of 0.45) but far from perfect.[7] Indeed, shocks to labor supply and demand might play a very important role across the states of Mexico, contributing to move wages away from its normal level, as given by the marginal product of labor. Consequently, considering the effect of not just foreign but also domestic migration could be useful to control for the effects of demand and supply shocks across states over time.

[7] Geographically speaking, domestic and international migration patterns are also very different.

3. The Model

Our model departs from a very simple setup. Labor demand follows Barrel and Pain (1997, 1999).[8] We assume that production in subnational entity *i* at time *t* is given by a constant returns to scale Cobb-Douglas production function which depends on capital (*K*), labor (*L*), and a productivity factor (*A*):

$$Y_{it} = A_{it} K_{it}^{\gamma_{it}} L_{it}^{\sigma_{it}} \quad (1)$$

where capital and labor elasticities, γ_{it} and σ_{it}, are entity and time varying.

Obtaining the marginal productivity of labor $\left(\frac{\partial Y_{it}}{\partial L_{it}}\right)$ and equalizing it to the real wage $\frac{W_{it}}{P_t} \equiv w_{it}$, we obtain the labor demand:

$$w_{it} = \sigma_{it} A_{it} K_{it}^{\gamma_{it}} L_{it}^{\sigma_{it}-1} \quad (2)$$

Labor supply is a positive function of real wage and a negative function of net migration (*M*):

$$L_{it} = S(w_{it}, M_{it}); S_w > 0, S_M < 0 \quad (3)$$

Foreign direct investment, denoted as *I* henceforth, enters in our model affecting positively the stock of capital:

[8] A similar derivation of the impact of an exogenous source such as FDI (which should affect the absorption of technology) on labor demand can be found in Driffield et al. (2005). More recently, Mollick and Cabral (2009) have employed this set up to observe the effects of productivity on labor demand of Mexican manufacturing.

$$K_{it} = K(I_{it}) \Rightarrow K_{it} = kI_{it}; k > 0 \tag{4}$$

Substituting equation (4) into (2) yields:

$$w_{it} = \sigma_{it} A_{it} (kI_{it})^{\gamma_{it}} L_{it}^{\sigma_{it}-1} \tag{5}$$

Rewriting (5) we express labor demand as:

$$L_{it} = \left[w_{it} (\sigma_{it} A_{it} (kI_{it})^{\gamma_{it}})^{-1} \right]^{1/(\sigma_{it}-1)} \tag{6}$$

Labor market equilibrium is reached when labor supply equals labor demand, from (3) and (6) we have:

$$S(w_{it}, M_{it}) = \left[w_{it} (\sigma_{it} A_{it} (kI_{it})^{\gamma_{it}})^{-1} \right]^{1/(\sigma_{it}-1)} \tag{7}$$

Labor market equilibrium (7) determines the equilibrium real wage w_{it}.

Total differentiation of expression (7) yields:

$$dw_{it} = \frac{\left(\frac{\gamma_{it} w_{it}}{I_{it}} \right) dI_{it} + (\sigma_{it} - 1) \left[\sigma_{it} \frac{Y_{it}}{L_{it}} \frac{L_{it}}{L_{it}^{\sigma_{it}}} S_M \right] dM_{it}}{1 - (\sigma_{it} - 1)(\sigma_{it} A_{it} (kI_{it})^{\gamma_{it}} S_w)} \tag{8}$$

The expression (8) shows that equilibrium real wage is a function of FDI (*I*), migration (*M*), and output percapita (*Y/L*).

An econometric specification corresponding to (8) is:

$$\omega_{it} = \beta_o + \beta_{1i} + \beta_2 y_{it} + \beta_3 fdi_{it} + \beta_4 im_{it} + \varepsilon_{it} \tag{9}$$

where: ω_{it} is the log of the real wage, y_{it} is the log of the labor output per capita, β_o is a constant, β_{i1} is a estate specific effect, international migration (*im*) and the ratio of FDI to GDP (*fdi*) in each state, and ε_{it} is the stochastic random component. We expect output per capita (y_{it})

to control for productivity differences across states under the idea that the more productive states are also those that receive higher real wages. In addition, equation (2) suggests that wages are paid according to their contribution to marginal product. Since marginal product is not available at the state level, average product of labor may serve as a proxy for the fundamental determinant of wages[9].

Equation (8) also allows us to assess the impact of exogenous changes in FDI and migration on real wage.

The impact of FDI on real wages is:

$$\frac{dw_{it}}{dI_{it}} = \frac{\left(\frac{\gamma_{it} w_{it}}{I_{it}}\right)}{1-(\sigma_{it}-1)(\sigma_{it} A_{it} (kI_{it})^{\gamma_{it}} S_w)} > 0 \qquad (10)$$

Note that $(\sigma_{it} - 1) < 0$, and the denominator is positive, as a consequence the impact of FDI on real wages is positive.

The impact of migration on real wage is:

$$\frac{dw_{it}}{dM_{it}} = \frac{(\sigma_{it}-1)\left[\sigma_{it} \frac{Y_{it}}{L_{it}} \frac{L_{it}}{L_{it}^{\sigma_{it}}} S_M\right]}{1-(\sigma_{it}-1)(\sigma_{it} A_{it} (kI_{it})^{\gamma_{it}} S_w)} > 0 \qquad (11)$$

Note that $S_M < 0$, and the numerator is positive, therefore the impact of net migration on real wage is positive.

From the comparative statics in equations (10) and (11), we expect coefficients β_3 and β_4 in (9) to be positive.

[9] Output per capita also controls for the effect of the economic crisis of 1995 and the influence of the recovery on wages: "the business cycle effect".

An alternative and more general specification of our model, when an open economy is taken into account, is stated when we control not just for international migration, but also for domestic migration, the real exchange rate and lagged real wages:

$$\omega_{it} = \beta_o + \beta_1 w_{it-1} + \beta_2 y_{it} + \beta_3 fdi_{it} + \beta_4 im_{it} + \beta_5 dm_{it} + \beta_5 rer_{it} + \varepsilon_{it} \quad (12)$$

The model in equation (10) takes into account the effects of real wages persistence or stickiness, through the β_1-coefficient. We would expect that for the period observed the declining rate of inflation in Mexico would also lead to wage stickiness and little flexibility of the labor market. We expect the effects of domestic and international migration on real wages to be positive as before; that is, a contraction in domestic labor supply would also imply an increase in domestic real wages. A real exchange rate depreciation would make the state economies more competitive if they are heavily engaged in trade activities. However, the pass-through effect into prices will negatively affect the value of the real wage since the price level would go up, pushing down real wages.

A serious problem arises when one wishes to estimate the model in (10) using OLS since the right hand side contains a lag of the dependent variable which is correlated with the error term even if we assume that the residuals are not autocorrelated. Arellano and Bond (1991) developed a Generalized Method of the Moments (GMM) estimator that solves this problem. Their method takes first differences of (10), removing the industry effects (β_{1i}), and produces an equation that is estimable using instrumental variables. Endogenous explanatory variables are instrumented with suitable lags of their own. Blundell and Bond (1998) proposed a model in which lagged differences are employed in addition to the lags of the endogenous

variables, producing more robust estimations in comparison with the Arellano and Bond (1991) method which becomes weak as the autoregressive processes becomes persistent.

GMM estimations are said to be consistent if there is no second order autocorrelation in the residuals and the instruments employed are valid. The most common test employed to verify the validity of instruments in this GMM setup is the Sargan (1958) test of over-identifying restrictions. We employ the system GMM model proposed by Blundell and Bond (1998) to estimate equation (10), as well as equation (9) and a more restricted version of the model that only takes into account labor demand:

$$\omega_{it} = \beta_o + \beta_{1i} + \beta_2 y_{it} + \varepsilon_{it} \quad (13),$$

For comparison purposes we start by estimating equations (13), (9) and (12) using static panel data methods.

4. Empirical Results

4.1 Static Specification

Table 2 presents the estimations of equations (13), (9) and (12) employing static panel data methods. Columns (a) to (c) present the estimates of the model without fixed effects and columns (d) to (f) present estimations that include fixed effects. All estimates in Table 2 report in parenthesis standard errors which are robust to autocorrelation and heteroskedasticity. For the estimates without fixed effects from columns (a) to (c), output per worker, FDI, domestic migration and the real exchange rate seem to be significant and present the expected signs. Only international migration presents a non significant and unexpected sign.

The inclusion of the not-reported but significant state specific fixed effects coefficients eliminates the significant effects on real wages of our market liberalization shock variables in

the β_3 to β_5 coefficients: FDI, and international as well as domestic migration. Only output per capita, our proxy for productivity, and the real exchange rate, present the expected sign. The coefficient for output per capita is larger than unity in this case, suggesting that a 1% increase in output per capita has a more than proportional effect on real wages. It is possible, however, that the relationship between real wages and the regressors in (5) is not precisely captured because dynamic adjustment is not present.

4.2 Dynamic Estimates

While we are able to deal with autocorrelation and heteroskedasticity problems in our estimates of Table 2, one of the problems we cannot deal with while employing static panel data methods is that of misspecification. Due to its construction, system GMM estimates are robust to unobserved heterogeneity and endogeneity problems. The method employed differentiates first the estimated equation removing state specific effects. Thereafter, lagged differences and lagged levels are employed as instruments for the level equations.

Columns (a) to (c) in Table 3 present the results of the dynamic estimations of equations (13), (9) and (12). Heteroskedasticity robust standard errors are reported in parenthesis. Before discussing the results in detail, it is important to check the appropriate specification of the model. Our system GMM estimators are consistent only if the moment conditions employed are valid. Under the Sargan test of overidentifying restrictions for the two-step estimations, our estimates do not reject the null that the instruments employed are valid under any of the columns in Table 3. In addition, moment conditions are valid only if there is no second order serial correlation in the residuals. While rejecting the null of no first order autocorrelation does not entail that the model is misspecified, rejecting the null of no

second order autocorrelation (and thus of further orders) would imply that the moment conditions are not valid.

All our estimates in Table 3 present significant coefficients and the expected signs. We reject the null of no second order autocorrelation for the bivariate model and the model augmented for the influence of FDI and international migration in columns (a) and (b), respectively. Columns (c) and (d), however, observe no problems of second order autocorrelation and we take a closer look at these results. For the model in column (c) first, the output per capita presents a coefficient of 0.106 suggesting that a 1% increase in productivity results in nearly a 0.11% increase in real wages. The FDI to GDP ratio is positive and significant, implying that a 1% increase in the share of FDI relative to GDP results in a positive 0.25% in real wages. This effect might be the result of both a larger demand for labor and the better paid jobs created by foreign-owned firms. International and domestic migration rates pose significant and positive effects on real wages, with coefficients of 0.040 and 0.051, respectively. This finding suggests that real wages are slightly more sensitive to domestic migration than foreign migration. Finally, as in the static model, the real exchange rate has negative and significant effects on real wages. We simply argue here that the real exchange rate pass-through to inflation results in lower real wages.

Since according to the descriptive statistics observed in Table 2 states in the northern border present on average higher wages, FDI flows, lower international migration outflows and higher domestic migration inflows, we exclude in Table 3 column (d) the states of Baja California Norte, Sonora, Chihuahua, Coahuila, Nuevo León and Tamaulipas from the sample. The results in this column are consistent with those in (c) but the effect of FDI becomes stronger. The Sargan test and the Arellano-Bond tests also suggest that the indentified restrictions are valid. Output per capita and FDI to GDP ratio coefficients are slightly larger in

column (d). This might reflect the fact that the lower GDP per capita and the more FDI deprived states have the real wages more sensitive to capital inflows and productivity gains. Similarly, international and domestic migration coefficients are slightly smaller and, for the case of international migration, less significant than for the full sample in column (c). This might also suggest that the positive effect of migration on real wages is less important for those states that experience relatively more labor outflows.

4.3 Robustness checks

In addition to taking Mexico's northern border states out of the sample as done in column (d) of Table 3, we check in Table 4 the robustness of our results partitioning the sample above and below the mean of real wages, international and domestic migration and FDI to GDP ratio. We are particularly interested in observing the effects on real wages of FDI demand-related shocks and (international and domestic) migration supply shocks (i.e. coefficients β_3 to β_5). Notice that, for all the estimates in Table 4, whenever significant, our shock coefficients present the positive expected effect on real wages. The Sargan test and the second order autocorrelation tests suggest that the moment conditions employed in each specification are valid.

Under the columns of real wages, we observe how states with below average real wages are significantly more sensitive to FDI inflows, international and domestic migration than states with real wages above the mean. Jointly, these results might suggest that states with relatively low wages are more sensitive to both supply and demand shocks to the labor market.

For the partition according to income per capita, the β_3-coefficients is higher and statistically significant only for states with income per capita above average. The effect of FDI

on wages is larger at higher levels of economic development. The effect of domestic migration on wages is larger for states with higher levels of economic development. One possibility is that people in higher income states are more skilled and thus have their wages moving more when they move after searching for better returns. This would be consistent with the results for the 50 Spanish provinces by Mauro and Spilimbergo (1999), who find that highly skilled workers migrate promptly after a decline in regional labor demand, while low-skilled workers drop out of the labor force or remain unemployed for long periods of time.

Below the international migration columns we also split the sample in those states with migration rates above (high migration) and below the average (low migration). Comparing the two subsamples we observe that wages in states with relatively low international migration (below average) are significantly more responsive to FDI-related demand shocks and domestic migration supply shocks. The first result might well indicate that FDI flows favor those states in which labor is more stable by creating better paid jobs. The second result simply suggests that low domestic migration has a higher impact on real wages across those states with lower international migration.

We partition the sample in a similar way for states with domestic migration above and below the national average. As in the case of international migration, we observe a higher responsiveness of real wages to FDI demand-related shocks across states with relatively low domestic migration but we observe no statistical significant different in the response of wages to international migration shocks.

Finally, the partition of the sample between high receivers of FDI (above the mean) and low receivers (below the mean) suggest that the response of real wages to domestic and international migration is significant and differ for the two subsamples but the difference is not

substantial. We observe only a slightly higher response of real wages to foreign and domestic migration supply shocks across states with higher than average reception of FDI flows.

5. Conclusions

Comparing wages of workers between 1990 and 2000, Chiquiar (2008) shows that regions more exposed to globalization exhibited an increase in overall wage levels relative to other regions in the country. This paper examines aggregate wages in Mexico for the period from 1997 to 2006, which is after the transition period following the floating of the peso to the U.S. dollar in December of 1994. At the same time, several forces contributed to making Mexico more open to foreign capital in order to complement trade-related activities spurred by the NAFTA agreement. It is also well-known that international migration (legal and illegal) to the U.S. has intensified over the period, likely to be a response to better returns to labor and working conditions relative to the cost of moving.

The view in this paper is therefore that the equilibrium wage rate (determined in theory by the marginal product of labor) is simultaneously affected by labor demand and labor supply forces, captured by FDI inflows and migration, respectively. We investigate the role of FDI inflows into Mexico as capturing forces in the capital market as well as migration movements within Mexico and between Mexico and the U.S. to gauge the labor market dynamics. In contrast to Robertson (2005), who used border enforcement hours by U.S. border patrol when measuring (illegal) international migration, we use recently available data from Mexico's CONAPO that provides a new perspective on this issue. Our findings indicate very strong and positive effects on real wages from foreign investment and smaller effects from migration (with slightly larger effects from domestic than from foreign migration). Alternative partitions of our sample shed additional light on these central results but the conclusion for this panel

study of 32 Mexican states is that factors from labor demand are likely the ones driving wages in Mexico. The direct policy implication of this study is that real wages will increase in Mexico with legislation that allows capital inflows to come more freely into the country.

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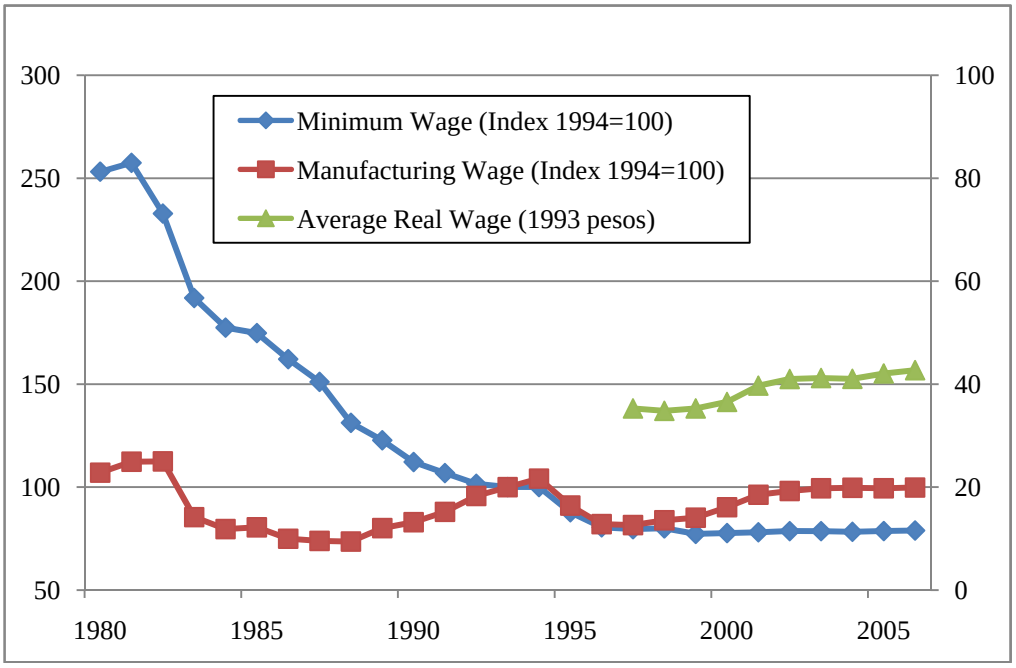
Figure 1. Real Wage and Minimum Wage Behavior



Source: Elaborated with data from Banco de Mexico.

Figure 2. Geographic Location of Real Wages across Mexican states

Note: Elaborated with data from the Ministry of Economy taken from National Security System (IMSS)

Figure 3. Geographic Location of FDI across Mexican states

Note: Elaborated with data from the Ministry of Economy, FDI National Commission (CNIE)

Figure 4. International Migration Outflows Geographical Location across Mexican states

Note: Elaborated with data from the National Population Council, Ministry of Employment (CONAPO)

Figure 5. Domestic Migration Outflows Geographical Location across Mexican states

Table 1: Descriptive Statistics

id	state	Real Wage	Output per capita	FDI to GDP ratio	International Migration Rate	Domestic Migration Rate
		w	y	fdi	im	dm
1	Aguascalientes	33.6	17,918	1.2	0.44	-0.49
2	Baja California	39.0	19,208	5.1	-0.30	-1.11
3	Baja California Sur	37.0	18,397	4.3	0.33	-1.57
4	Campeche	39.7	23,185	0.2	0.39	-0.22
5	Chiapas	27.0	6,323	0.0	0.22	0.35
6	Chihuahua	34.9	20,910	3.5	0.68	-0.22
7	Coahuila	34.8	20,726	1.0	0.39	-0.02
8	Colima	32.6	15,123	0.3	0.54	-0.55
9	Distrito Federal	54.0	36,455	8.7	-0.05	0.93
10	Durango	26.0	12,912	0.9	0.96	0.18
11	Guanajuato	30.5	11,313	0.6	1.17	-0.05
12	Guerrero	30.8	7,720	0.2	1.20	0.41
13	Hidalgo	31.6	8,965	0.1	1.05	-0.27
14	Jalisco	35.7	14,487	1.6	0.60	-0.02
15	México	40.8	11,752	1.8	0.30	-0.31
16	Michoacán	31.9	8,615	0.2	1.66	0.08
17	Morelos	37.1	13,335	1.2	0.84	-0.39
18	Nayarit	27.6	8,801	1.6	1.35	-0.26
19	Nuevo León	42.9	26,083	5.1	0.30	-0.28
20	Oaxaca	29.4	6,213	0.0	1.12	0.23
21	Puebla	35.7	10,004	2.3	0.45	-0.01
22	Querétaro	42.1	17,277	1.4	0.30	-0.67
23	Quintana Roo	31.8	21,801	1.3	-0.79	-1.78
24	San Luis Potosí	33.1	11,085	1.0	0.90	0.06
25	Sinaloa	28.2	11,829	0.3	0.93	0.32
26	Sonora	31.4	17,952	1.5	0.53	-0.10
27	Tabasco	31.4	8,910	0.7	0.42	0.39
28	Tamaulipas	36.1	15,892	2.2	0.58	-0.49
29	Tlaxcala	32.2	7,935	0.8	0.33	-0.27
30	Veracruz	32.5	8,753	0.2	0.58	0.37
31	Yucatán	27.6	11,655	0.5	0.01	-0.07
32	Zacatecas	26.4	8,690	0.2	1.51	0.11
	Average	33.9	14,382.0	1.6	0.59	-0.18
	Correlation (W/P, X)	-	0.77	0.8	-0.45	-0.08

Note: Migration rates are calculated as the difference between outflows and inflows of people over total population. Correlations are calculated between real wages averages and its cross sectional average determinants.

Table 2. Mexico Real wage determinants in the post NAFTA era: Static Model

$$\omega_{it} = \beta_0 + \beta_{1i} + \beta_2\, y_{it} + \beta_3\, fdi_{it} + \beta_4\, im_{it} + \beta_5\, dm_{it} + \beta_6\, rer_t + \varepsilon_{it}$$

Coefficients	(a)	(b)	(c)	(d)	(e)	(f)
β_0	0.889***	1.597***	1.925***	-8.542***	-8.539***	-6.997***
	(0.231)	(0.263)	(0.278)	(0.517)	(0.522)	(0.587)
β_2	0.276***	0.199***	0.205***	1.231***	1.231***	1.096***
	(0.025)	(0.028)	(0.027)	(0.053)	(0.053)	(0.058)
β_3		2.313***	2.148***		0.136	0.041
		(0.453)	(0.436)		(0.248)	(0.249)
β_4		-0.013	-0.026		-0.022	-0.001
		(0.022)	(0.021)		(0.025)	(0.038)
β_5			0.033**			0.038
			(0.016)			(0.051)
β_6			-0.005***			-0.003***
			(0.001)			(0.000)
R^2	0.423	0.472	0.527	0.423	0.425	0.441

Note: Logarithms are taken on real wages and output per capita. The Table reports Newey-West standard errors robust to heteroskedasticity and autocorrelation. The symbols *, **, and *** refer to levels of significance of 10%, 5%, and 1%, respectively.

Table 3. Mexico Real wage determinants in the post NAFTA era: Dynamic Model

$$\omega_{it} = \beta_0 + \beta_1 w_{it-1} + \beta_2 y_{it} + \beta_3 fdi_{it} + \beta_4 im_{it} + \beta_5 dm_{it} + \beta_6 rer_t + \varepsilon_{it}$$

Coefficient	(a)	(b)	(c)	(d)
β_1	0.897***	0.899***	0.868***	0.878***
	(0.021)	(0.021)	(0.019)	(0.022)
β_2	0.120***	0.144***	0.106***	0.112***
	(0.030)	(0.029)	(0.023)	(0.029)
β_3		0.470***	0.251***	0.340***
		(0.117)	(0.076)	(0.100)
β_4		0.058***	0.040**	0.039*
		(0.018)	(0.017)	(0.021)
β_5			0.051***	0.045***
			(0.014)	(0.013)
β_6			-0.003***	-0.003***
			(0.000)	(0.000)
β_0	-0.755***	-1.028***	-0.327	-0.417*
	(0.232)	(0.248)	(0.200)	(0.229)
Sargan	31.971	31.923	31.56	25.439
	(0.276)	(0.278)	(0.293)	(0.604)
AB(1)	-1.996	-2.751	-4.76	-4.034
	(0.046)	(0.006)	(0.000)	(0.000)
AB(2)	-3.064	-2.774	0.30	-0.637
	(0.002)	(0.006)	(0.763)	(0.524)
N	288	288	288	234

Notes: Logarithms are taken on real wages and output per capita. The Table reports first-step System GMM robust estimators as proposed by Blundell and Bond (1998). The Sargan test reports that under the null the overidentified restrictions are valid. AB (1) and AB (2) correspond to the Arellano-Bond test for serial correlation, under the null of no autocorrelation. Robust standard errors are reported in parenthesis. The symbols *, **, and *** refer to levels of significance of 10%, 5%, and 1%, respectively.

Table 4. Partitions of the Sample Above and Below the Mean

$$\omega_{it} = \beta_0 + \beta_1 w_{it-1} + \beta_2 y_{it} + \beta_3 fdi_{it} + \beta_4 im_{it} + \beta_5 dm_{it} + \beta_6 rer_t + \varepsilon_{it}$$

Coeff.	Real Wage		Income Per Capita		International Migration		Domestic Migration		FDI to GDP ratio	
	Above	Below	Above	Below	Above	Below	Above	Below	Above	Below
β_0	0.173	-0.270	-0.890**	-0.586**	-0.139	-0.271	-0.011	0.198	-0.623**	-0.202
	(0.317)	(0.250)	(0.398)	(0.238)	(0.177)	(0.368)	(0.225)	(0.159)	(0.309)	(0.168)
β_1	0.800***	0.924***	0.779***	0.890***	0.921***	0.819***	0.909***	0.845***	0.819***	0.895***
	(0.018)	(0.028)	(0.041)	(0.031)	(0.032)	(0.026)	(0.026)	(0.031)	(0.048)	(0.020)
β_2	0.082***	0.080**	0.197***	0.130***	0.063***	0.120***	0.056*	0.063***	0.157***	0.083***
	(0.029)	(0.034)	(0.049)	(0.036)	(0.022)	(0.039)	(0.029)	(0.014)	(0.038)	(0.021)
β_3	0.169**	0.583**	0.225**	-0.138	-0.041	0.264***	0.209	0.227**	0.214***	0.185
	(0.070)	(0.251)	(0.112)	(0.210)	(0.282)	(0.058)	(0.132)	(0.109)	(0.066)	(0.286)
β_4	0.007	0.036**	0.025	0.011	0.061*	0.011	0.034	0.007	0.039*	0.035**
	(0.019)	(0.016)	(0.022)	(0.025)	(0.033)	(0.019)	(0.022)	(0.009)	(0.023)	(0.018)
β_5	0.035	0.042***	0.059***	-0.013	0.021	0.055***	-0.007	0.021*	0.057***	0.045***
	(0.023)	(0.016)	(0.014)	(0.032)	(0.033)	(0.017)	(0.036)	(0.012)	(0.017)	(0.015)
β_6	-0.003***	-0.003***	-0.003***	-0.003***	-0.003***	-0.003***	-0.003***	-0.003***	-0.003***	-0.003***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Sargan	12.781	18.135	13.763	17.571	12.335	18.749	16.851	14.506	9.561	21.821
	(0.998)	(0.923)	(0.989)	(0.936)	(0.995)	(0.906)	(0.952)	(0.984)	(0.999)	(0.790)
AB(1)	-3.25	-3.424	-3.4339	-3.6352	-3.2164	-3.5246	-3.5304	-3.3318	-2.9737	-3.74327
	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)
AB(2)	0.77908	-1.142	2.18	-0.8786	0.10988	0.39719	-0.60434	0.41898	1.838	-0.7806
	(0.436)	(0.253)	(0.029)	(0.380)	(0.913)	(0.691)	(0.546)	(0.675)	(0.066)	(0.435)

Notes: Logarithms are taken on real wages and output per capita. The Table reports first-step System GMM robust estimators as proposed by Blundell and Bond (1998). The Sargan test reports that under the null the overidentified restrictions are valid. AB (1) and AB (2) correspond to the Arellano-Bond test for serial correlation, under the null of no autocorrelation. Robust standard errors are reported in parenthesis. The symbols *, **, and *** refer to levels of significance of 10%, 5%, and 1%, respectively.