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Downward Wage Rigidities in the Mexican Labor Market: 1996–2011

ABSTRACT In this paper, we provide evidence of the existence and evolution of downward real and nominal wage rigidities in Mexico in the period 1996–2011, which was characterized by a reduction in the level and volatility of inflation. Our results suggest that, throughout the period, a much larger fraction of private sector workers, who stay in the same job from one year to another, are subject to downward real wage rigidities than to nominal ones. Nevertheless, the relative prevalence of nominal rigidities increases slightly as inflation decreases.

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In this paper, we provide evidence of the existence and evolution of downward real and nominal wage rigidities (DRWR and DNWR, respectively) in Mexico in the period 1996–2011. DNWR constrain nominal wage changes to be greater or equal to zero, whereas DRWR constrain nominal wage changes to be greater or equal to a reference point, which could possibly be different from zero. This point is commonly referred to as the focal point for wage negotiations or the wage indexation point. The existence of either type of wage rigidity is typically associated with the labor market institutions in a given country. For instance, legal provisions against reducing nominal wages could result in DNWR. On the other hand, the inclusion of indexation clauses in labor contracts, which explicitly tie wage changes to the inflation rate or any other focal point, would lead to DRWR. Gauging the relative prevalence of the two types of wage rigidity, if they exist, is relevant since rigidities could prevent the adjustment of the labor market to shocks, thus amplifying the effects of such shocks on real output.

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Mexico is an interesting case in which to study downward wage rigidities in the period 1996–2011 for several reasons. First, in this period fiscal and monetary policy were successful in stabilizing the Mexican economy after the 1994 crisis. In particular, the Bank of Mexico, the Mexican central bank, adopted a strategy of rendering monetary policy implementation more transparent, keeping a restrictive bias and responding adequately to inflationary shocks.[1] This strategy allowed the Mexican central bank to gradually move toward an inflation-targeting regime, which was officially adopted in 2001. As a result, annual inflation decreased from 27.7 percent in December of 1996 to 3.98 percent in December of 2003, and it remained at single-digit levels for the rest of the period. Second, the Mexican labor law, which dates from 1970 and remained virtually unchanged until 2012, constrains wage adjustment through several provisions, for instance by penalizing employers for reducing wages. Third, the collective wage bargaining system in Mexico, which is argued to be relatively centralized, together with the importance of the minimum wage as a reference point for wage negotiations, could contribute to the existence of DRWR.[2] In sum, the interaction of all these elements could potentially generate an environment in which DNWR might become more prevalent over time, but DRWR are still pervasive.

Previous studies, which focus mainly on developed countries, use several methods to document the existence and extent of downward wage rigidities: (i) graphical detection of asymmetries and bunching of observations in the histogram of nominal wage changes; (ii) regression-based methods to formally test whether the excess mass at zero or any other point is significant; or (iii) maximum likelihood estimation of a particular type of censored regression model to obtain the parameters of DNWR and DRWR, such as the probability of being in a given wage regime and the focal point of wage negotiations.[3] Despite the variety in the methods used, previous studies share some common features. They use microdata from firms, household surveys, or administrative records, and the key variable of interest is the annual change in log nominal wages. The majority focus on job stayers, that is, workers who stayed in the same job from one year to another, to keep the job characteristics constant.

In this paper, we follow the studies that estimate wage rigidity parameters by maximum likelihood. We use a modified version of the Altonji-Devereux

1. Ramos-Francia and Torres (2005).

2. See O'Connell (1999).

3. Card and Hyslop (1997); Kahn (1997); Castellanos, García-Verdú, and Kaplan (2004); Castellanos (2005); Altonji and Devereux (2000); Bauer and others (2007); Devicienti, Maida, and Sestito (2007); Barwell and Schweitzer (2007); and Messina and Sanz-de-Galdeano (2014).

model, which was extended by Goette, Sunde, and Bauer to estimate the prevalence of both types of wage in the presence of measurement error in wage changes.[4] This model distinguishes between the notional wage change, which is a latent variable capturing the wage change that would be implemented in the absence of any restrictions, and the actual wage change, which might be censored at zero if wages are subject to DNWR or at a non-zero value (that is, the wage indexation point) if wages are subject to DRWR. In the model, the observed wage change might differ from the actual wage change due to measurement error and from the notional wage change due to both measurement error and downward wage rigidities. The model is estimated via maximum likelihood to yield estimates for the wage indexation point, whose value is not imposed a priori, and the fraction of workers belonging to each of three wage regimes: (i) flexible wages, (ii) wages subject to DNWR, and (iii) wages subject DRWR. In addition, the model yields estimates for the fraction of reported wage changes that are subject to measurement error and for the actual incidence of wage rigidities, that is, the probability that the wage change of a worker is constrained given that she belongs to the DNRW or DRWR regime.

We use data from the Mexican Urban Employment Survey (ENEU, 1996–2004) and the Mexican Survey of Occupation and Employment (ENOE, 2005–2011), two household surveys collected by the National Institute of Statistics and Geography (INEGI). For comparability with previous studies, we focus on a subsample of salaried workers in the private sector who stayed in the same job from one year to another, and we use the annual change in the nominal hourly wage as the variable of analysis in our estimation. The panel structure of both surveys allows identifying such "job stayers," though not perfectly. We classify workers as job stayers if they did not change industry and occupation from one year to another, as in previous work by Castellanos.[5]

Our findings suggest that a much larger fraction of workers in our sample are subject to DRWR than to DNWR. This might be due to some institutional features of the Mexican labor market that remained relatively stable between 1996 and 2011. However, we also find that as inflation decreased, the relative prevalence of DNWR increased slightly, as found by similar studies for other countries such as Germany, Italy, and the United Kingdom.[6] Regarding the focal

4. Goette, Sunde, and Bauer (2007b).

5. Castellanos (2005).

6. Bauer and others (2007); Devicienti, Maida, and Sestito (2007); Barwell and Schweitzer (2007).

point for wage negotiations, we find that it decreased with inflation during the period. After 2003, shortly after the Mexican central bank officially adopted inflation targeting, we cannot reject that the focal point was statistically equal to the lagged values of inflation and the change in the minimum wage. However, for the whole period the focal point had a positive and significant correlation with the lagged change in the minimum wage only. Finally, between 2009 and 2011, the focal point was not statistically different from zero, which suggests that DNWR became particularly acute during the latest recession. A caveat to these results is that our methodology has less power to distinguish between DNWR and DRWR when inflation is low, as in the later years of our period of analysis.

Our paper contributes to the literature on wage rigidities by providing evidence for a developing country over a relatively long period, including the most recent years. So far this literature has mainly focused on the United States and Europe, with few exceptions: Messina and Sanz-de-Galdeano provide evidence for Brazil and Uruguay; Castellanos and Castellanos, García-Verdú, and Kaplan study Mexico through 2001.[7] We use the same methodology as Messina and Sanz-de-Galdeano to provide more recent evidence on wage rigidities in Mexico.[8] This is relevant because inflation became lower and relatively more stable in Mexico after 2001. Thus we also add to previous studies for Mexico by jointly estimating the extent of nominal and real wage rigidities, by taking into account the possibility of measurement error in the estimation, and by looking at year-to-year changes in the estimated parameters to explore their relation with the macroeconomic environment.

Background

Labor Market Institutions in Mexico 1996–2011

As mentioned in the introduction, the Mexican labor law (*Ley Federal del Trabajo*, LFT) dates from 1970 and remained virtually unchanged until 2012, throughout the period of our analysis. Several provisions in the LFT explicitly constrain the downward adjusment of wages. For instance, the law entitles workers to terminate the labor relationship, take legal action, and receive compensation if the employer decreases their wage (article 51, part IV). In addition, the law could implicitly prevent wage adjustments for new hires

7. Messina and Sanz-de-Galdeano (2014); Castellanos (2005); Castellanos, García-Verdú, and Kaplan (2004).

8. Messina and Sanz-de-Galdeano (2014).

by stipulating that a given worker cannot be paid less than other workers in the same firm or establishment for the same kind of job, schedule, and efficiency (article 5, part XI; article 86). The law also entitles workers to request modifications of their working conditions when their wages are not "remunerative," by appealing to the Conciliation and Arbitration Board (article 57).

These and other legal provisions could interact with the collective wage bargaining system to prevent downward wage adjustments. The government intervenes in the process through the registration of unions and strikes and, in conflict resolution, through the Conciliation and Arbitration Boards, where substantial negotiation takes place.[9] Fairris presents evidence of a decrease in unionization rates in Mexico from 26 percent in 1984 to 17 percent in 2000, but the process, which is regulated by the LFT, did not change substantially in our period of analysis.[10] In addition, the LFT extends collective agreements to all workers in the signing firm, including those not belonging to the union (article 396). The law also potentially limits the possibility of negotiating wages downward by preventing collective contracts from stipulating worse working conditions, including pay, than those currently in place in the firm or establishment (article 394). Furthermore, the contract remains valid even if the employer parts with the union, or if that union is dissolved (articles 402 and 403). Similar provisions apply to the master contract (*contrato ley*), a collective agreement that a union with at least two-thirds of the workers in a given industry or region negotiates with one or more employers. Such master contracts cover all workers in a given industry or region. The centralization of the process, whose rules barely changed in our period of analysis, and the extension provisions just discussed could contribute to the prevalence of DRWR, even if the actual share of unionized workers fell in Mexico.

The LFT also establishes the minimum wage, defined in pesos per day. In the period of analysis, the value of the minimum wage varied by region and occupation. Minimum wages are set by the National Commission of Minimum Wages (CONASAMI), composed of representatives of workers, employers, and the government. The real value of the minimum wage in Mexico has decreased in recent decades, declining by about 50 percent relative to median earnings between 1989 and 2001.[11] Despite this decline and the relatively small fraction of workers earning exactly one minimum wage, previous studies show evidence of clustering of wage levels at exact multiples of the minimum

9. O'Connell (1999).

10. Fairris (2007) calculates these unionization rates using a sample of formal and informal wage workers from the National Household Income and Expenditure Survey (ENIGH).

11. Bosch and Manacorda (2010).

wage in Mexico using both household surveys and administrative data.[12] Moreover, Fairris, Popli, and Zepeda show that this clustering is observed not only for formal workers but also for informal ones.[13] Thus the existing evidence suggests that the level of the minimum wage had an important role in the wage distribution in Mexico during the period we study. Fairris, Popli, and Zepeda further show that changes in the minimum wage affect overall wage changes, particularly for workers in the mid- to lower tail of the wage distribution.[14] This suggests that both the level and the rate of change of the minimum wage could be an important signal for overall wage setting in the Mexican labor market. Consequently, we would expect our focal point to have a significant correlation with the change in the minimum wage.

In sum, wage-setting institutions in Mexico, which remained relatively stable during the period we analyze, could potentially generate DRWR in the Mexican labor market. As a final note, an important labor reform was passed in 2012, after the period covered by our data. Although many of the specific wage-setting provisions discussed in this paper did not change substantially, the reform could increase the flexibility of the Mexican labor market in the period after our analysis.

Macroeconomic Stabilization and Monetary Policy after the 1994 Crisis

In the period covered by our analysis, Mexican fiscal and monetary policies were successful in stabilizing the economy after the 1994 crisis. In particular, the Mexican central bank adopted a strategy of rendering monetary policy implementation more transparent, keeping a tightening bias and responding adequately to inflationary shocks.[15] In the years following the 1994 crisis, the instrument used by the central bank to induce upward pressure on interest rates was an objective for the daily accumulated balances of commercial banks in their current accounts with the institution, called the *corto* in Spanish.[16] The *corto* was gradually substituted by the adoption of a benchmark rate (the

12. Castellanos (2005); Bosch and Manacorda (2010); Fairris, Popli, and Zepeda (2008); Castellanos, García-Verdú, and Kaplan (2004).

13. Fairris, Popli, and Zepeda (2008). In the period we analyze, the minimum wage was still used as a numeraire in the law, and benefits, pensions, and even fines were defined in multiples of the minimum wage. This is no longer the case, however: the law was changed to eliminate the use of the minimum wage as a reference for such calculations in 2016.

14. Fairris, Popli, and Zepeda (2008).

15. Ramos-Francia and Torres (2005).

16. Under this mechanism, the central bank supplied a minimum part of the money demanded at an interest rate above the market rate to banks with overdrafts in their current accounts. See www.banxico.org.mx/acerca-del-banco-de-mexico/historical-outline.html.

overnight interbank funding rate) as the central bank's main monetary policy instrument. This strategy allowed the Mexican central bank to gradually move toward an inflation-targeting regime, which was officially adopted in 2001. In 2002, the Bank of Mexico announced a permanent annual target of 3 percent for inflation, in a range of one percentage point on either side of the target.[17] As a result, annual inflation decreased from 27.7 percent in December of 1996 to 3.98 percent in December of 2003, and it remained at single-digit levels for the rest of the period.

Broadly speaking, wage indexation is thought to be more common in high-inflation contexts, like Mexico in the first years of our period of analysis. This fact, together with the importance of the minimum wage as a reference point for wage levels and wage changes in the Mexican labor market, would suggest a high correlation of the estimated focal point with the change in the minimum wage in those early years. As inflation decreases, the importance of wage indexation could also decrease. In addition, the adoption of inflation targeting could modify the focal point of wage negotiations by providing a new reference, such as expected inflation or the central bank's target. However, as discussed above, during the period of analysis, implicit and explicit indexation to the minimum wage seems to have persisted in Mexico due to lack of major changes in the institutional framework of the labor market. Thus, to provide empirical evidence on this matter, we compare our estimated focal point for wage negotiations with the lagged values of inflation and the change in the minimum wage. These two indicators are the most common focal points considered by similar studies in the literature because they are widely observed by the public, and, as in Mexico, it is common to have either implicit or explicit indexation of wages to them. We also compare our estimated focal point with a measure of inflation expectations, available from a survey of analysts conducted by the Bank of Mexico.

Previous Studies

As mentioned, the majority of existing studies focus on developed countries, and the heterogeneity in their findings is attributed to the differences in the institutional setting in each particular country.

17. According to the historical account on the central bank's website, although the adoption of inflation targeting was officially announced in the 2001 Monetary Program, the Bank of Mexico began setting temporary annual inflation targets in 1996. See www.banxico.org.mx/acerca-del-banco-de-mexico/historical-outline.html.

Previous studies for the United States focus primarily on the existence of nominal wage rigidities using a variety of methods.[18] The first method is the graphical inspection of the histogram of nominal wage changes to detect asymmetries in their distribution. For instance, one would observe a bunching of wage change observations at zero in the presence of DNWR or at a positive value (expected or past inflation) in the presence of DRWR. For the United States, an early study by Card and Hyslop finds a spike at zero in the distribution of nominal wage changes, suggestive of DNWR, which is negatively correlated with inflation.[19] However, other reasons apart from resistance to implementing wage cuts, owing to social conventions or legal restrictions, might explain such bunching, for instance the existence of menu costs.

Kahn uses a regression to test for nominal wage rigidities in the United States and finds that 9.4 percent of wage workers did not receive a wage cut due to DNWR and that the pile-up of wage change observations at zero can be explained by the infrequency of small wage changes.[20] The Kahn test is also used by other studies to measure whether the excess mass at zero or any other point is significant because it allows constructing a counterfactual wage distribution in the absence of DNWR using the observed wage change distribution during periods of high inflation.[21]

Altonji and Devereux find evidence of substantial nominal wage rigidity in the United States: in their data from a private corporation, only 0.5 percent of salaried workers received wage cuts, whereas 11 percent had a wage freeze.[22] The authors also find that those few negative wage changes were mostly associated with changes in job characteristics, such as full-time/part-time status, or a switch in compensation involving incentives.

Studies for European countries look at the relative incidence of both nominal and real wage rigidities, which typically reflect different labor market institutions across countries. Dickens and others examine individual workers' earnings data for sixteen countries.[23] They find a high incidence of wage freezes and a lack of nominal wage cuts, which they take as evidence of DNWR. A second asymmetry they find is a tendency for workers' wage changes to clump in the vicinity of the expected rate of inflation, which suggests the

18. Card and Hyslop (1997); Kahn (1997); Altonji and Devereux (2000); Barattieri, Basu, and Gottschalk (2014).
19. Card and Hyslop (1997).
20. Kahn (1997).
21. Castellanos, García-Verdú, and Kaplan (2004); Castellanos (2005).
22. Altonji and Devereux (2000).
23. Dickens and others (2007).

existence of DRWR. They find substantial variation across European countries in the extent of both types of rigidities, even after controlling for data set characteristics. After examining the relationship between their measures of wage rigidity and some characteristics of labor markets in the countries of their sample, they find that only greater union density appears to have a robust positive relationship with the extent of DRWR.

Other studies apply a common maximum likelihood estimator, the one also used in this paper, to three European countries: Germany, Italy, and the United Kingdom. They find that real rigidities are far more prevalent in these countries than nominal ones, but as inflation has decreased over time, the latter have become relatively more widespread. For instance, Bauer and others report that in Germany, the probability of being subject to DRWR decreased from 62 percent in 1975 to 33 percent in 2000, whereas the one for DNWR increased from 19 to 28 percent between those years.[24] For Italy, Devicienti, Maida, and Sestito report that the probability of being subject to DRWR decreased from 58 percent in 1985–88 to 39 percent in 1997–99, whereas that of DNWR increased from 21 to 26 percent between those two periods.[25]

Several studies provide evidence for developing countries in Latin America.[26] Cobb and Opazo use microdata for the period 2001–2007 and a structural-break approach to assess the degree of DNWR in Chile.[27] The authors find that it takes about nine quarters to adjust nominal wages in Chile and that the percentage of workers experiencing a nominal wage cut in a given firm is negatively related to some firm characteristics, such as firm size. In contrast, Agudelo and Sala use data at the sector level and focus on DRWR in Colombia.[28] They estimate that the fraction of real wage cuts prevented (FWCP), their measure of DRWR, is about 12 percent, which is substantially higher than the 3.7 percent obtained for European countries by other studies.

As discussed above, the previous studies for Chile and Colombia focus either on DNWR or DRWR, but not on both simultaneously. Messina and Sanz-de-Galdeano use employer-employee administrative data and the same econometric model as Bauer and others to examine how both types

24. Bauer and others (2007).

25. Devicienti, Maida, and Sestito (2007).

26. See Cobb and Opazo (2008) for Chile, Agudelo and Sala (2017) for Colombia; Messina and Sanz-de-Galdeano (2014) for Brazil and Uruguay; and Castellanos (2005) and Castellanos, García-Verdú, and Kaplan (2004) for Mexico.

27. Cobb and Opazo (2008).

28. Agudelo and Sala (2017).

of wage rigidities, DNWR and DRWR, change with rapid disinflation in Brazil and Uruguay.[29] They find that in Uruguay, DRWR fall from 75 percent in 1996–99 to 7 percent by the 2000s, and DNWR become more prevalent (from 11 to 66 percent). In Brazil, DRWR are stable (around 43 percent), but the introduction of inflation targeting anchors wage negotiations to expected inflation. To assess both DNWR and DRWR simultaneously, and their relative prevalence over time, we apply the same econometric model used by Messina and Sanz-de-Galdeano to Mexican data.

For Mexico, Castellanos and Castellanos, García-Verdú, and Kaplan use the regression-based method proposed by Kahn to provide evidence of DNWR up to 2001.[30] Castellanos uses data from ENEU, whereas Castellanos, García-Verdú, and Kaplan use individual IMSS administrative records. Both of these studies find evidence of DNWR for a sample of job stayers, especially in large, formal sector firms. Castellanos, García-Verdú, and Kaplan also provide some evidence of indexation to the minimum wage by imposing this focal point in an ordinary least squares (OLS) regression. The main differences between our paper and these two previous studies for Mexico are the use of more recent data and a different empirical model, which allows us to jointly estimate the parameters of both nominal and real wage rigidities, together with the wage indexation point, and to control for measurement error. In addition, we look at year-to-year changes in the estimated parameters to explore their relation with the macroeconomic environment, whereas previous studies for Mexico consider a period of several years as a whole.

Data and Estimation Sample

We use data from two household surveys, which are conducted by the National Institute of Statistics and Geography (INEGI) for the purpose of generating labor market statistics. The first is the Mexican Urban Employment Survey (ENEU), which is a rotating panel of households in a subsample of Mexican cities. The ENEU data are available from 1987 to 2004, but we use only the data for the period 1996–2004 because they are more comparable across years. Nevertheless, the sample of cities changed over this period, as more cities were added every few years. The second data set is the Mexican Survey of Occupation and Employment (ENOE), which is a nationally representative

29. Messina and Sanz-de-Galdeano (2014); Bauer and others (2007).
30. Castellanos (2005); Castellanos, García-Verdú, and Kaplan (2004); Kahn (1997).

household survey, available from 2005 to 2011. The ENOE survey has both urban and rural households, and as such it replaced and expanded the ENEU. It also has a very similar panel structure. In both surveys, each household is followed for a maximum of five quarters. We use both data sets to construct a sample that covers the period 1996–2011. To maximize comparability between the two, we focus on the twenty-seven cities that were included in all the ENEU years and, as described below, we define the variables accordingly.

For the whole period, we focus on a subsample of salaried workers age eighteen to sixty-five who work full time (that is, report at least thirty work hours per week) in the private sector. Thus, we drop self-employed, unpaid, commission, and piece-rate workers. We do not include workers in government and other public institutions because wage-setting practices in the public sector might be different from those in private firms. In addition, because the literature focuses on private sector workers, we will be able to compare our results with previous studies. Also for comparability, we further restrict our sample to job stayers, that is, those workers who remained in the same job between their first and fifth interview. The ENEU survey does not allow us to clearly identify whether a worker stayed in exactly the same job during a year. The ENOE does, but the information is available only in selected quarters of the period of interest.[31] So, for the whole sample, we classify workers as job stayers if they had the same four-digit occupation and four-digit industry in their first and fifth interviews, as in previous work by Castellanos.[32] Using the additional information in the ENOE for the quarters in which it is available, we are able to verify that about 80 percent of the workers in our sample are correctly classified as job stayers. After applying these restrictions and dropping out observations with missing values in the variables we use in the analysis, we are left with 50,446 individual observations for the ENEU 1996–2004 and 14,623 for the ENOE 2005–2011.

Our dependent variable of interest is the change in the log nominal wage per hour between the first and fifth interview, that is, between a given quarter and the same quarter in the following year. Both surveys have information on nominal monthly earnings, the hours usually worked by each individual per

31. Starting in 2009, an extended questionnaire is given to respondents only during the first quarter of each year. This questionnaire includes questions about the year in which the respondent first started working for her current employer and whether she has remained with that same employer ever since, with no interruptions. This information could be combined with the occupation variable to have a more accurate classification of job stayers. Before 2009, the extended questionnaire was applied in all quarters of 2005 and in the second quarter of 2007 and 2008.

32. Castellanos (2005).

week, and the hours worked in the week previous to the survey. This information can be provided by the workers themselves or by another respondent in the household. Insofar as this feature could affect measurement error, we include a dummy variable for whether the workers themselves answered the survey, as explained below. We construct the hourly wage as monthly earnings divided by usual weekly hours of work multiplied by 4.3, for our main results. However, using the hours worked during the previous week does not change our results significantly. Finally, we estimate the model described in the next section using the sampling weights of the survey.

Econometric Model

We use a censored regression model with measurement error that Altonji and Devereux use to analyze DNWR in the United States.[33] This model was extended by Goette, Sunde, and Bauer to include also DRWR.[34] In this section we outline the basic features of the model, following closely the exposition in Goette, Sunde, and Bauer and Messina and Sanz-de-Galdeano.[35]

The model has a latent variable: the *notional* wage change for worker i at time t, which is the nominal wage change that would be implemented in the absence of any wage rigidities and measurement error. This notional wage change is not always observed, but can be described by the following equation:

$$\Delta w_{it}^{n} = \mathbf{X}_{it-1}\alpha + \epsilon_{it}, \tag{1}$$

where Δw_{it}^{n} is the notional wage change between $t - 1$ and t for individual i, $\mathbf{X}_{it-1}$ are worker and job characteristics at $t - 1$, and $\epsilon_{it} \sim N(0, \sigma_{w}^{2})$ is an error term. For estimation, worker characteristics include age (and its square), years of schooling (and its square), and a dummy variable for female workers. Job characteristics include a dummy variable for formal workers, equal to one if the job is covered by social security benefits (IMSS), a dummy variable

33. Altonji and Devereux (2000).

34. Goette, Sunde, and Bauer (2007b).

35. Goette, Sunde, and Bauer (2007a); Messina and Sanz-de-Galdeano (2014). For additional technical details, see the technical appendix to Goette, Sunde, and Bauer (2007a), available online at www.iza.org/files/EJ-WageRigidityFeature-TechApp.zip. Messina and Sanz-de-Galdeano (2014) also provide a detailed technical note as part of the online appendix of their article.

equal to one if the worker has a written job contract, and dummy variables for industry, firm size, and occupation. Descriptive statistics for these control variables are presented in tables A1 and A2 in the appendix. To control for any other factors affecting all observations in a given year, we also include year dummy variables.

The *actual* wage change for worker i at time t is Δw_{it}, which can be classified into one of the following three wage regimes: a regime with downward nominal rigidities (N), one with real wage rigidities (R), and one with flexible wages (F). As shown below, the actual wage change, Δw_{it}, will be zero if the observation belongs to the nominal regime and the notional wage change is less than zero. So, if the nominal wage change that would be implemented in the absence of DNWR is a decrease, then the worker would actually receive a wage freeze. Conversely, if the observation belongs to the real regime and the notional wage change is less than r_{it}, the actual wage change received by the worker will be equal to r_{it}. The variable r_{it} is the focal point of wage negotiations or wage indexation point, which constrains from below the wage change observations that are subject to DRWR. Depending on the labor market institutions in a given country, the focal point could be equal to actual or expected inflation or to the change in a reference wage, such as the minimum wage. The actual wage change will be equal to the notional one in any other case, for example, if the observation belongs to the flexible regime. In addition, a given observation can belong to the nominal or real regime without being necessarily constrained if the notional wage change is strictly greater than zero or r_{it}.

$$\Delta w_{it} = \begin{cases} 0 & \text{if } \Delta w_{it}^{n} \leq 0 \wedge i \in N, \\ r_{it} & \text{if } \Delta w_{it}^{n} \leq r_{it} \wedge i \in R, \\ \Delta w_{i}^{n} & \text{otherwise.} \end{cases} \tag{2}$$

An advantage of this model is that the focal point of wage negotiations (r_{it}) is not imposed but estimated jointly within the model with the following equation:

$$r_{it} = \mathbf{Z}_{it}\gamma + v_{it}, v_{it} \sim N\left(0, \sigma_{r}^{2}\right). \tag{3}$$

Thus, in principle, the focal point of wage negotiations can be a function of worker and job characteristics. In this paper, we include only year dummy

variables in $\mathbf{Z}_{it}$ to be able to estimate an average focal point that varies over time.[36]

Each worker i has an index p^j_i that affects the probability of being in regime $j(j = N, R, F)$, but, as mentioned, she can only be in one regime at time t. For instance, $P(N) = Prob(p^N_i > p^R_i$ and $p^N_i > p^F_i)$. The index p^j_i may also be a function of the worker's characteristics, but we include only year dummy variables in our main results.

Let Δw^o_{it} be the *observed* wage change. To account for measurement error, in the model the equation for the observed wage is as follows:

$$\Delta w^o_{it} = \Delta w_{it} + \tilde{u}_{it}, \text{ where } \tilde{u}_i = \begin{cases} u_i & \text{w/ probability } p^m_i, \\ 0 & \text{w/ probability } \left(1 - p^m_i\right), \end{cases} \tag{4}$$

$$\text{and } u_i \sim N\left(0, \sigma^2_m\right).$$

Thus, Δw^o_{it} potentially differs from Δw^n_i as a result of wage rigidities and measurement error.[37] The measurement error is specified as above to allow some wage changes to be accurately measured.

To summarize, the table below shows all the possible cases that apply to a given wage change observation, according to the empirical model. Observation can belong to any of the three regimes already defined above. If the observation is in either the nominal or real regime, it can be either constrained or unconstrained within that regime. Finally, each observation can be measured with or without error.

	Wage regime				
		Real		*Nominal*	
	Flexible	C	U	C	U
Without error	F0	RC0	RU0	NC0	NU0
With error	F1	RC1	RU1	NC1	NU1

36. Accounting only for time variation in this variable is standard in similar studies. For instance, Messina and Sanz-de-Galdeano (2014) perform a separate estimation for each year in their data, leaving the focal point as a constant. Devicienti, Maida, and Sestito (2007) estimate the model by grouping their data in three-year periods and including only year dummies in the focal point for each of them.

37. In the original model by Goette, Sunde, and Bauer (2007a), the measurement error affects wage levels in each period. We introduce this slight modification, a measurement error in the observed wage change, to simplify the model.

Each cell in the table contributes with a term in the likelihood function. For instance, the part of the likelihood that corresponds to an observation that is in the nominal regime, constrained and measured without error (NC0), is $L_{NC0} = P(N)P(\Delta w_{it}^{n} \leq 0|N)(1 - p_i^m)$. This term is a joint probability, expressed as the product of the marginal probability of being in the nominal regime, the conditional probability of the notional wage change being negative given that the observation belongs to the nominal regime, and the probability of no measurement error in the observed wage change.[38]

The likelihood function for observation *i*, in abbreviated form, can be expressed as follows:

$$
\begin{aligned}
(5) \qquad L_i = {} & I\left(\Delta w_i^o > 0\right)\left(L_{FP0} + L_{NU0}\right) + I\left(\Delta w_i^o = 0\right)L_{NC0} \\
& + I\left(\Delta w_i^o < 0\right)L_{FN0} + I\left(\Delta w_i^o \neq 0\right) \\
& \left(L_{RU0} + L_{RC0} + L_{FP1} + L_{NU1} + L_{NC1} + L_{FN1} + L_{RU1} + L_{RC1}\right),
\end{aligned}
$$

where $I(.)$ is an indicator function and the terms corresponding to the flexible regime have a *P* or *N*, depending on whether the notional wage change is positive or negative. For instance, L_{FP0} refers to the term corresponding to the case of belonging to the flexible regime, having a positive notional wage change, and having an observed wage change measured without error.

If the observed wage change is greater than zero, then the likelihood function for observation *i* will not have the terms corresponding to the L_{NC0} and L_{FN0}. In the first case, this is because if a wage change observation is in the nominal regime, constrained, and measured without error, it has to be zero, not positive. The second case is straightforward because it is the probability that the wage change observation is negative, in the flexible regime, and measured without error. The other terms remain because if the observed wage change is positive, then it could belong to the real regime (and be in any of the particular cases of this regime); to the flexible regime and be positive (with and without measurement error); to the flexible regime and be negative, but measured with error; to the nominal regime and be unconstrained

38. This expression relies on the assumption that the error terms of the index variables and the notional wage change are independent. This is a strong assumption, but it is standard in this framework. For a more thorough explanation of this and other details of the model, please refer to the technical note by Goette, Sunde, and Bauer (2007a).

(L_{NU0}, L_{NU1}); or to the nominal regime, be constrained, and be positive, instead of equal to zero, merely because of measurement error (L_{NC1}).

If the observed wage change observation is equal to zero, the only term remaining in the likelihood function is L_{NC0}, because that case can only arise if the observation is in the nominal regime, constrained, and measured without error. Finally, if the observed wage change is negative, the cases FP0, NU0, and NC0 are ruled out, and the rest remain. In particular, according to the expression for L_i above, a negative wage change observation could still belong to the real regime. This is because the focal point is assumed to be different from zero, but it is not constrained to be strictly positive in the estimation.

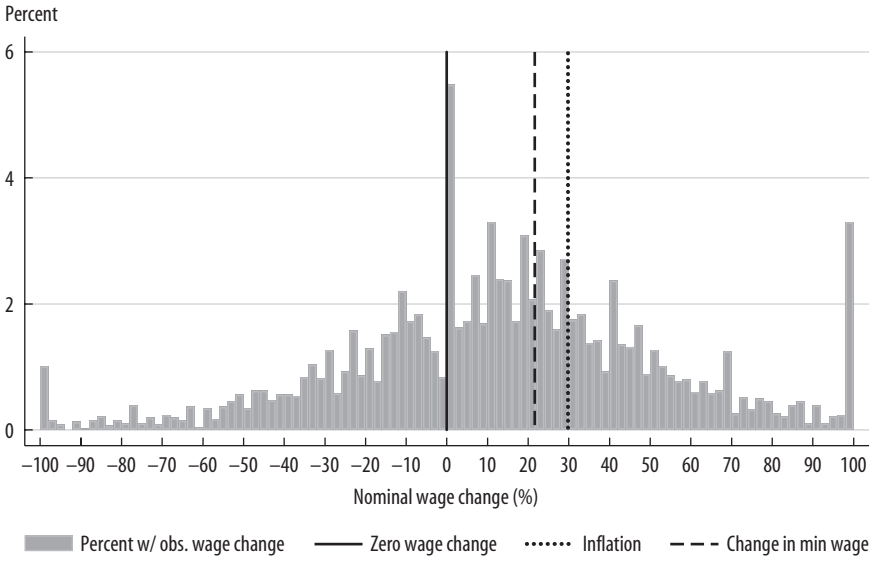
In summary, in the model described in this section, the actual wage change might differ from the notional wage change owing to the presence of wage rigidities, and the observed wage change might differ from the actual wage change owing to measurement error. As explained by Goette, Sunde, and Bauer and Messina and Sanz-de-Galdeano, the identification of the parameters for both wage rigidities and measurement error relies on the detection of asymmetries in the observed distribution of wage changes, conditional on individual characteristics, and the distributional assumptions of the model.[39] Given that the assumed distribution for the measurement error in wage changes is continuous, it is less likely that a spike or bunching of observations at a certain point of the observed wage change distribution is merely due to the presence of an error but rather would be more indicative of wage rigidities. Nevertheless, excess mass around those points, relative to other parts of the distribution, could indicate the presence of measurement error. Thus the model uses the points at which wage change observations bunch, the relative size of the spike, and the excess mass in the vicinity of that point to identify the parameters of the model.

Descriptive Evidence

Figures 1 and 2 show histograms of annual nominal wage changes for our sample of salaried job stayers in the private sector in two different years. Figure 1 shows the distribution of wage changes for 1996, a high-inflation year. The vertical lines show the different cutoffs used in the literature to show

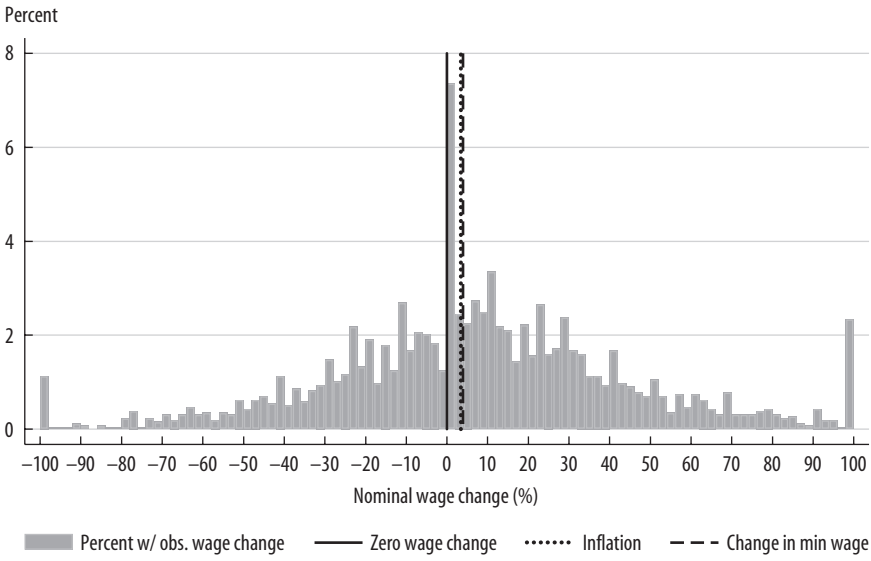
39. Goette, Sunde, and Bauer (2007a); Messina and Sanz-de-Galdeano (2014).

F I G U R E 1 . Histogram of Observed Nominal Wage Changes in a High-Inflation Year: 1996[a]



a. Annual percentage change in nominal wage per hour for a sample of full-time wage workers in the private sector who did not change their industry or occupation between their first and fifth interview, from ENEU.

F I G U R E 2 . Histogram of Observed Nominal Wage Changes in a Low-Inflation Year: 2006[a]



a. Annual percentage change in nominal wage per hour for a sample of full-time wage workers in the private sector who did not change their industry or occupation between their first and fifth interview, from ENOE.

the presence of DNWR and DRWR graphically. The first line corresponds to zero, and the distribution shows a spike at this value, which is visual evidence suggesting the presence of DNWR. About 5 percent of workers in our sample experienced a wage freeze in 1996. In addition, the bar just below zero is far smaller than the one just above, which reinforces the idea that some negative wage changes might have instead been converted to wage freezes. Overall, more mass is observed to the right of zero than to the left. The other two vertical lines correspond to the annual inflation rate (27.7 percent) and the change in the minimum wage in that year (24.2 percent).[40] At those positive values, it is possible to observe some bunching of observations, suggestive of DRWR, but not as salient as the bunching at zero. The spikes at –100 and 100 are merely due to the fact that all wage changes that are either below –100 or above 100 are grouped together in those values. These extreme wage changes are most probably due to measurement error.

Figure 2 shows the histogram of wage changes for 2006, a low-inflation year. The spike at zero is still observed, and it is higher than the one in figure 1. About 7.5 percent of workers received a wage freeze in 2006, slightly more than in 1996. Once again, the bar just below zero is much lower than the one just above it, suggesting the presence of DNWR. The vertical lines corresponding to annual inflation in December 2006 (4.05 percent) and the change in the minimum wage (4.0 percent) overlap each other in this year and are fairly close to zero, a result of the much lower levels of inflation observed in 2006 compared to 1996. Just by visual inspection of figure 2, it is not easy to distinguish between the spike at zero and that, if there is one, at the inflation rate. As shown in our results, the model will also have difficulty distinguishing between the two in periods of low inflation.[41]

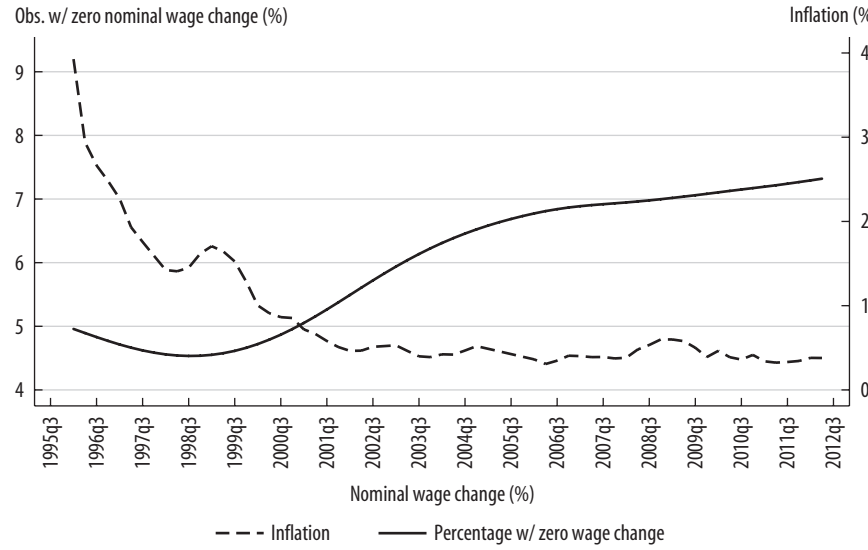
Figure 3 shows the evolution in the percentage of workers in our sample who receive a wage freeze during the period 1996–2006.[42] The share is just below 5 percent in 1995, when the annual inflation rate in December of that

40. In most years, the minimum wage is revised only once per year. In 1995 and 1996, the minimum wage was increased a few times each year, so we calculate the change in the average value of the minimum wage between those years.

41. Put differently, the model requires a very large number of observations to be able to distinguish between DNWR and DRWR at low levels of inflation, as mentioned in Goette, Sunde, and Bauer (2007b).

42. To see the trend in the proportion of wage freezes more clearly, we apply a Hodrick-Prescott filter to this series.

FIGURE 3. Proportion of Workers with Zero Nominal Wage Changes over Time[a]



a. A zero nominal wage change is defined as a change between plus or minus 1 percent in the nominal wage of a worker. The sample is composed of full-time wage workers in the private sector who did not change their industry or occupation between their first and fifth interview, from ENEU (1995–2004) and ENOE (2005–11). Inflation is measured as the annual percentage change in the national consumer price index.

year was 51.97 percent. Inflation starts to decrease in 1996 owing to the stabilization policies implemented by the Mexican government and central bank after the 1994 peso crisis. The proportion of wage freezes remains low and stable until 1999. After that, as inflation continues to decrease to single-digit levels, the proportion of wage freezes starts to increase steadily, reaching about 6.5 percent in 2004. This suggests that, as inflation decreased in Mexico, DNWR gained prevalence. In fact, after 2004, the share of wage freezes continues to increase but at a much lower rate, which also coincides with a stabilization of inflation at low levels. After 2009, the slope of the curve rises again, suggesting the strengthening of DNWR during the latest recession, in which inflation increased, but not as substantially as in the Mexican crises of the 1980s and 1990s.

In summary, figures 1, 2, and 3 suggest the presence of both DNWR and DRWR in the Mexican labor market. These figures also suggest that DNWR gained prevalence as inflation decreased to single-digit levels in Mexico.

TABLE 1. Annual Proportional Changes in Wages and Work Hours for Estimation Sample[a]

	ENEU 1996–2004		*ENOE 2006–11*	
Variable	*Mean*	*Std. dev.*	*Mean*	*Std. dev.*
Annual change in nominal hourly wage (usual work hours)	0.14	0.45	0.04	0.42
Annual change in nominal hourly wage (hours worked last week)	0.15	0.46	0.04	0.44
Annual change in monthly nominal earnings	0.13	0.42	0.04	0.39
Annual change in usual work hours	–0.02	0.21	0.00	0.18
Annual change in hours worked last week	–0.03	0.24	0.00	0.23
No. observations	50,466		14,623	

a. In both periods, the sample consists of wage workers in the private sector who work full time (thirty hours or more per week) and who did not change their industry or occupation between their first and fifth survey interview (one year) in 1996–2011. Only the twenty-seven cities that were surveyed consistently throughout the period are included.

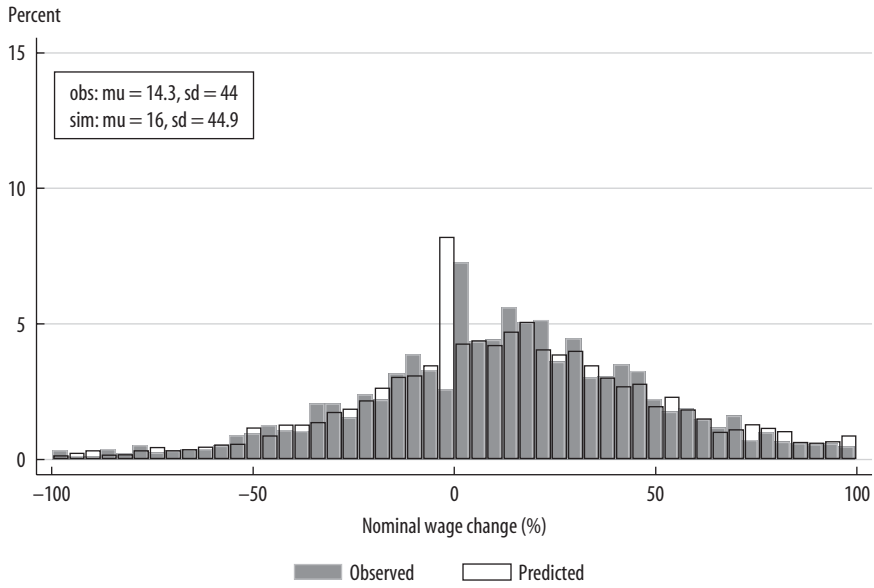
To continue describing our data before turning to our main estimation results, table 1 shows the average annual changes in the nominal hourly wage, the nominal monthly earnings, the hours usually worked per week, and the hours worked the week previous to the survey. The annual change in the nominal hourly wage—measured as monthly earnings divided by either the usual or previous week work hours—averaged 14–15 percent in 1996–2004 and 4 percent in 2006–11. The difference between those two averages is probably due to the decrease in inflation over the whole period. Table 1 also shows that most of the mean change in the nominal hourly wage is due to the mean annual change in monthly earnings and not to those in hours of work, which have a mean annual change close to zero, particularly in the ENOE period.

Estimation Results

Figures 4 and 5 show the histograms of the wage changes predicted by the model compared to those actually observed to get a sense of the fit. Figure 4 shows that in a high-inflation year (1996), the model performs reasonably well and it is able to match closely the mean and the standard deviation of observed wage changes. Figure 5 shows that in a low-inflation year (2006), the model also performs very well, which is reassuring.[43]

43. The standard way to gauge model performance is to compare the observed and simulated histograms and the means and standard deviations of both. See Messina and Sanz-de-Galdeano (2014).

FIGURE 4. Model Performance: Histogram of Nominal Wage Changes in a High-Inflation Year, 1996[a]

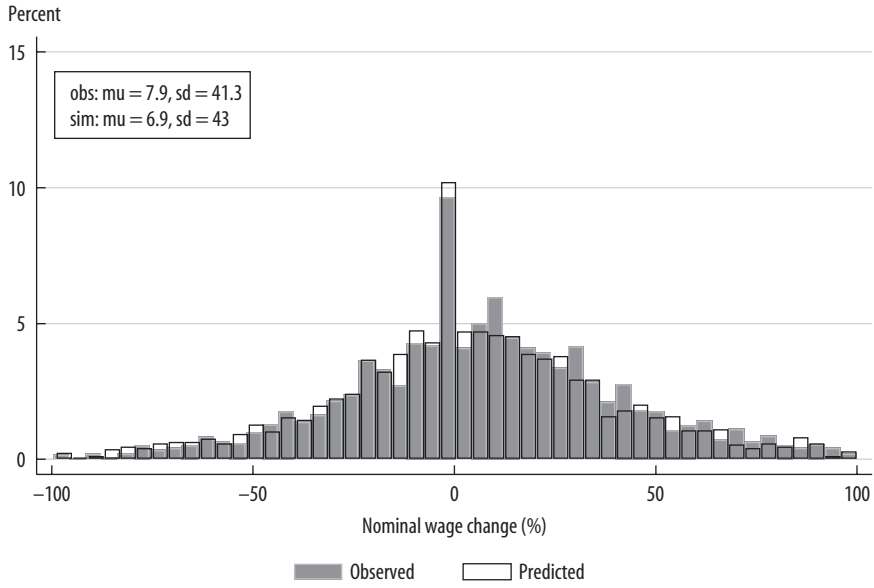


a. The observed histogram is constructed as in figure 1, using ENEU data. The predicted histogram comes from the estimation of the model.

Table 2 shows the estimated coefficients of the notional wage equation for the whole sample of job stayers in 1996–2011. Age has a negative effect on the notional wage change and its squared term is positive, but both age coefficients are statistically insignificant. Education and its squared term are both positive, but also not significant at any conventional levels. Being female has a negative effect on the notional wage, significant at 10 percent only, suggesting that the annual wage change in the absence of rigidities might be lower for women compared to men. Having a job covered by IMSS and having a written contract also have a negative effect on the dependent variable, but only the former is significant at 10 percent.

The estimate for the dummy variable indicating that the worker herself answered the survey has a negative and significant effect on the probability that her wage change is measured with error, as would be expected. This dummy has a positive effect on the variance of the measurement error, but the estimate is not statistically significant.

FIGURE 5. Model Performance: Histogram of Nominal Wage Changes in a Low-Inflation Year, 2006[a]



a. The observed histogram is constructed as in figure 2, using ENOE data. The predicted histogram comes from the estimation of the model.

Using these estimates, we obtain the parameters of DNWR and DRWR shown in table 3. We report all parameters year by year to see their evolution over time. Columns 1 to 3 show the probabilities of being in each of the wage regimes. Column 1 shows that between 8 and 17 percent of salaried job stayers in the private sector are subject to DNWR, whereas between 83 and 91 percent of them are subject to DRWR. Thus, real rigidites are relatively more prevalent during the whole period than nominal ones in Mexico, as has been found for the United Kingdom, Italy, and Brazil using the same empirical methodology.[44] However, our estimated probability of being in the real regime is higher than the corresponding estimate for those same countries. For the United Kingdom, the probability of being in the real regime is about 41 percent; for Italy, it ranges from 58 percent in 1985–88 to 39 percent in

44. Barwell and Schweitzer (2007); Devicienti, Maida, and Sestito (2007); Messina and Sanz-de-Galdeano (2014).

TABLE 2. Estimates of the Model, 1996–2011[a]

Explanatory variable	*Coefficient*
A. Notional wage equation	
Age	–0.0206
	(0.0160)
Age squared	0.000338
	(0.0003)
Education (years)	0.0138
	(0.0280)
Education squared	0.0016
	(0.0013)
Female	–0.1290*
	(0.0670)
Formal job	–0.1980*
	(0.1150)
Contract	–0.0895
	(0.1200)
Industry dummy variables	Yes
Firm size dummy variables	Yes
Occupation dummy variables	Yes
Year dummy variables	Yes
B. Other estimated equations	
P(DNWR): year dummy variables included	Yes
P(DRWR): year dummy variables included	Yes
Focal point: year dummy variables included	Yes
Variance of wages: year dummy variables included	Yes
Variance of focal point: year dummy variables included	Yes
C. Probability of wage measured with error	
Worker answered survey	–0.1200**
	(0.0600)
Year dummy variables	No
D. Variance of measurement error	
Worker answered survey	0.0118
	(0.0150)
Year dummy variables	No
No. observations	66,080

* Statistically significant at the 10 percent level.

** Statistically significant at the 5 percent level.

a. Estimation uses sampling weights. The estimation sample consists of wage workers in the private sector who work full time (thirty hours or more per week) and who did not change their industry or occupation between their first and fifth survey interview (one year) in 1996–2011. Only the twenty-seven cities that were surveyed consistently throughout the period are included. Female is a dummy variable equal to one if the worker is female and zero otherwise. Formal is a dummy variable equal to one if the job is covered by IMSS and zero otherwise. Contract is a dummy variable equal to one if the worker has a written contract and zero otherwise. Robust standard errors are in parentheses.

TABLE 3. Parameter Estimates for Downward Nominal and Real Wage Rigidities, 1996–2011[a]

Year	Prob(N) (1)	Prob(R) (2)	Prob(F) (3)	Focal point of wage negotiations (4)	Prob(N&C) (5)	Prob(R&C) (6)	Prob(C|N) (7)	Prob(C|R) (8)
1996	0.11	0.88	0.01	0.12	0.09	0.78	0.86	0.88
1997	0.09	0.90	0.01	0.19	0.08	0.80	0.84	0.88
1998	0.11	0.88	0.01	0.15	0.09	0.76	0.83	0.87
1999	0.12	0.87	0.01	0.18	0.11	0.82	0.92	0.94
2000	0.11	0.88	0.01	0.14	0.09	0.76	0.84	0.86
2001	0.08	0.91	0.01	0.16	0.08	0.84	0.91	0.93
2002	0.13	0.86	0.01	0.11	0.12	0.81	0.93	0.94
2003	0.12	0.88	0.00	0.03	0.10	0.78	0.89	0.89
2004	0.17	0.83	0.01	0.02	0.14	0.72	0.87	0.87
2006	0.13	0.86	0.00	0.04	0.12	0.80	0.92	0.92
2007	0.13	0.86	0.01	0.05	0.13	0.83	0.96	0.96
2008	0.14	0.85	0.01	0.04	0.13	0.78	0.92	0.92
2009	0.11	0.89	0.01	0.03	0.11	0.86	0.97	0.97
2010	0.15	0.85	0.01	0.01	0.13	0.76	0.90	0.90
2011	0.13	0.87	0.00	0.02	0.12	0.83	0.96	0.96

a. Estimation uses sampling weights. The estimation sample consists of wage workers in the private sector who work full time (thirty hours or more per week) and who did not change their industry or occupation between their first and fifth survey interview (one year) in 1996–2011. Only the twenty-seven cities that were surveyed consistently throughout the period are included. Columns 1 to 3 report the probability of being in the nominal, real, and flexible wage regimes for a given worker, respectively. Column 4 reports the estimated wage indexation point. Columns 5 and 6 report the joint probability of being constrained and in the nominal or real regime, respectively. Columns 7 and 8 report the probability of a wage change being constrained given that the worker belongs to the nominal or real wage regimes, respectively. According to the estimates of the model (not shown), 57 percent of wage changes are measured with error. No estimates are obtained for the year 2005 because a worker cannot be followed between 2004 and 2005 owing to the switch from the ENEU survey to the ENOE survey.

1997–99; for Brazil, it ranges between 27 and 66 percent in 1995–2002. Our estimated P(R) is also higher than the maximum of 72 percent obtained for Germany in 1978, but comparable to the maximum of 88 percent obtained for Uruguay in 1997–98.[45]

According to our results, the probability of being in the nominal regime increases slightly over time, consistent with the descriptive evidence in figures 1 to 3 and the decrease in inflation during the period. This pattern is also similar to what has been found for the United Kingdom, Italy, Germany, Brazil, and Uruguay, as inflation decreased in those countries.[46] The estimated probability for being in the nominal regime at the end our period of analysis is comparable to the 14 percent estimated for the United Kingdom and the

45. Bauer and others (2007); Messina and Sanz-de-Galdeano (2014).

46. Barwell and Schweitzer (2007); Devicienti, Maida, and Sestito (2007); Bauer and others (2007); Messina and Sanz-de-Galdeano (2014).

19 percent estimated for Germany in 1975, back when real rigidities were relatively more prevalent there.[47] However, it is lower than the estimates for P(*N*) in other countries for years with relatively low inflation. For instance, the estimate for Germany is 38 percent in 2000; for Italy, 26 percent in 1995–99; and for Uruguay, 75 percent in 2003–04.[48]

In summary, some of the overall patterns we find for the regime probabilities are consistent with previous results for other countries. Specifically, we find that real rigidities are more prevalent than nominal rigidities in Mexico and that the latter tend to become more relevant as inflation decreases. However, the magnitudes of our estimates tend to be different. Our estimated probability for being in the real regime is on the higher side of the corresponding estimates for other countries, whereas the opposite holds for our estimated probability of being in the nominal regime. Some of these differences might be explained by the type of data we use. Most of the comparable studies we cite above use administrative data, whereas we use survey data. In addition, the Mexican institutional and macroeconomic context might be different from that in other countries. For instance, in Italy inflation was 6.5 percent in 1986, a high-inflation year, whereas in Mexico it was 27.7 percent in 1996.[49] In the discussion section, we expand the comparison of our results with those obtained by Messina and Sanz-de-Galdeano for Brazil and Uruguay, because those two countries are similar to Mexico and yet some differences remain.[50]

In table 3 our estimated probability of being in the nominal regime is also larger than the spike at zero shown in figures 1 and 2. This is because the model accounts for measurement error that might make nominal wages appear more flexible, by misclassifying small changes around zero as actual changes instead of freezes. Column 3 shows that the probability of being in the flexible regime is very small, oscillating between 0 and 1 percent during the period.

Column 4 shows the estimated focal point for wage negotiations, which decreases from two-digit levels (11–19 percent) in 1996–2002 to 1–3 percent in 2009–11. This decline is probably explained by the decrease in inflation during this period. Later, we show how the focal point relates to past inflation

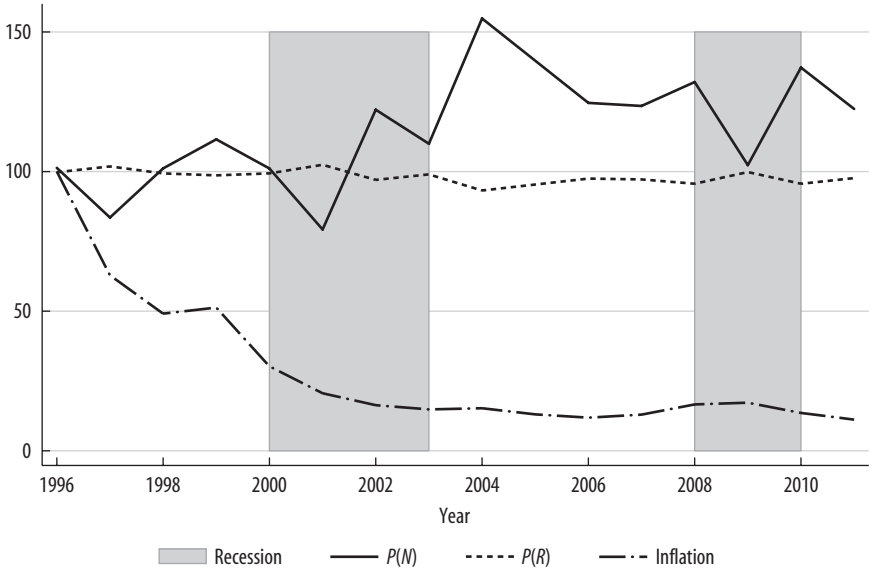
47. Barwell and Schweitzer (2007); Bauer and others (2007).

48. Bauer and others (2007); Devicienti, Maida, and Sestito (2007); Messina and Sanz-de-Galdeano (2014).

49. See Devicienti, Maida, and Sestito (2007) on Italy.

50. See Messina and Sanz-de-Galdeano (2014) on Brazil and Uruguay.

FIGURE 6. Regime Probabilities and Inflation[a]



a. Estimation uses sampling weights. $P(N)$ and $P(R)$ are the estimates for the probabilities of being in the nominal and real regime, respectively. Inflation is measured as the annual percentage change in the national consumer price index. Recession years are those in which any quarter is part of a two-consecutive-quarters decline in real Mexican GDP. All variables are normalized to equal 100 in 1996.

and the lagged change in the minimum wage, two common measures of wage indexation in the literature. In addition, we compare the evolution of the focal point with a measure of expected inflation obtained from a survey of analysts conducted by the Bank of Mexico.

Recall that a given observation can be in the nominal or real regime without necessarily being constrained. Columns 5 and 6 show the joint probabilities of being in the nominal and real regime, respectively, and being constrained, and columns 7 and 8 show the conditional probabilities of being constrained given that the observation belongs to a given wage regime. Overall, columns 5 to 8 show that most of the observations in a given regime are constrained in any given year. Finally, according to the estimates of the model (not shown), about 57 percent of wage changes are measured with error in all years.

To see more clearly how these parameters have evolved over time and their potential correlation with the inflation rate, in figure 6 we report the probabilities of being in the nominal and real regimes (columns 1 and 2 in table 3)

together with the annual inflation rate. All variables are normalized to 100 in 1996. The shaded areas are recession periods, which we identify using the simple rule of two consecutive quarters of decline in real Mexican gross domestic product (GDP). Although we identify these recession periods using quarterly data, we have yearly estimates, so in the figures we shade the whole year if any quarter belongs to a recession.[51] Figure 6 shows that the probability of being in the real regime decreases slightly after 2001. Conversely, also starting in 2001, as inflation continues falling, the probability of being in the nominal regime increases sharply until 2004, decreases a little between 2004 and 2009, and then jumps after the 2009 recession. In summary, figure 6 shows that, as found by some previous studies, as inflation decreases, DRWR also decrease and DNWR increase, and the latter become more acute during recessions in which inflation is also low. However, in terms of proportions, DRWR are still the most prevalent for the workers in our sample (see table 3).

Figures 7 and 8 show the probabilities of being in the nominal and real regimes, together with the joint probability of being in that regime and being constrained. As seen before in table 3, most of the observations in each of these regimes are constrained. However, for the nominal regime, the probability of being constrained increases during recessions, as seen in the narrowing of the vertical distance between $P(N)$ and $P(N\&C)$ in the shaded areas of figure 7. The distance between those two probabilities for the nominal regime closes the most in the years 2001–02 and 2008–10, which implies that a greater proportion of nominal wage changes in that regime were actually constrained to be nonnegative in those recessive periods. The distance between the corresponding probabilities for the real regime in figure 8 seems to narrow around the same periods as in figure 7, but it closes the most during the 2009 recession.

Figure 9 shows the evolution of the estimated focal point for wage negotiations over the period. We plot the point estimate in each year, together with its 95 percent confidence interval. The figure also plots the lagged values of the annual inflation rate and the change in the minimum wage.[52] As inflation decreases, the focal point decreases from 1999 to 2004, slowly at

51. We use seasonally adjusted quarterly Mexican GDP in 2008 prices to calculate the quarter-to-quarter variation and identify these recession periods. The original series is available at www.inegi.org.mx/sistemas/bie.

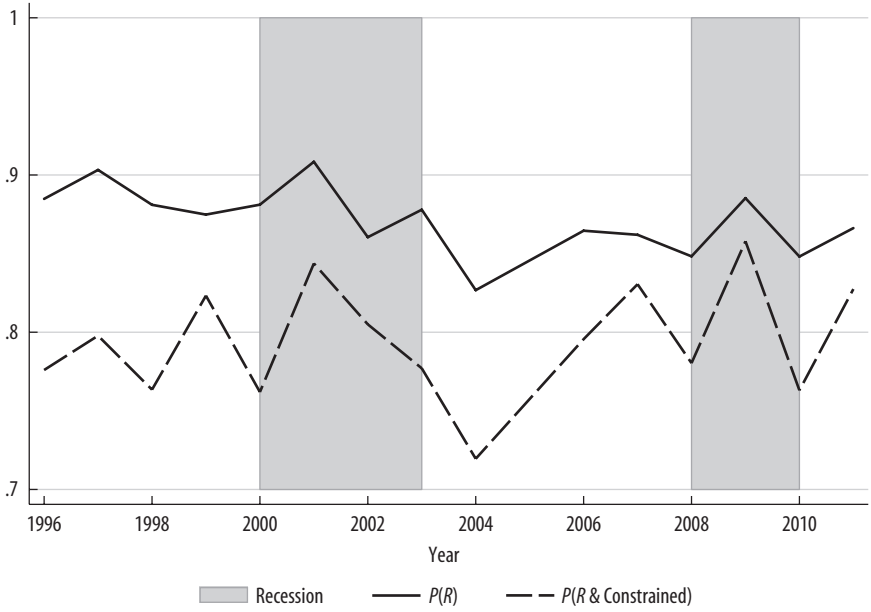
52. Figure A1 in the appendix presents a similar graph, but using the current values of the inflation measures and the change in the minimum wage.

FIGURE 7. Nominal Regime Probabilities[a]

a. Estimation uses sampling weights. *P*(*N*) and *P*(*N* & Constrained) are the estimates for the probability of being in the nominal regime and for the joint probability of being in that regime and constrained. Recession years are those in which any quarter is part of a two-consecutive-quarters decline in real Mexican GDP.

first and then more consistently after 2001, but it stays above lagged inflation and the minimum wage change between 1999 and 2002. Starting in 2003, shortly after the Mexican central bank officially adopted inflation targeting, the confidence interval of the focal point includes the lagged values of those two variables until 2011. After 2008, the point estimate of the focal point of wage negotiations is below lagged inflation and the minimum wage change. In addition, this point estimate is close to zero in 2010 (see table 3), and its confidence interval actually includes zero between 2009 and 2011. Consequently, we cannot reject the hypothesis that during the Great Recession the focal point was equal to a zero wage change. This fact reinforces the idea that DNWR became particularly acute during the latest recession in Mexico, because although the probability of being in the real regime remained relatively high in 2009–10, wages in that regime were indexed to a focal point not statistically different from zero.

FIGURE 8. Real Regime Probabilities[a]

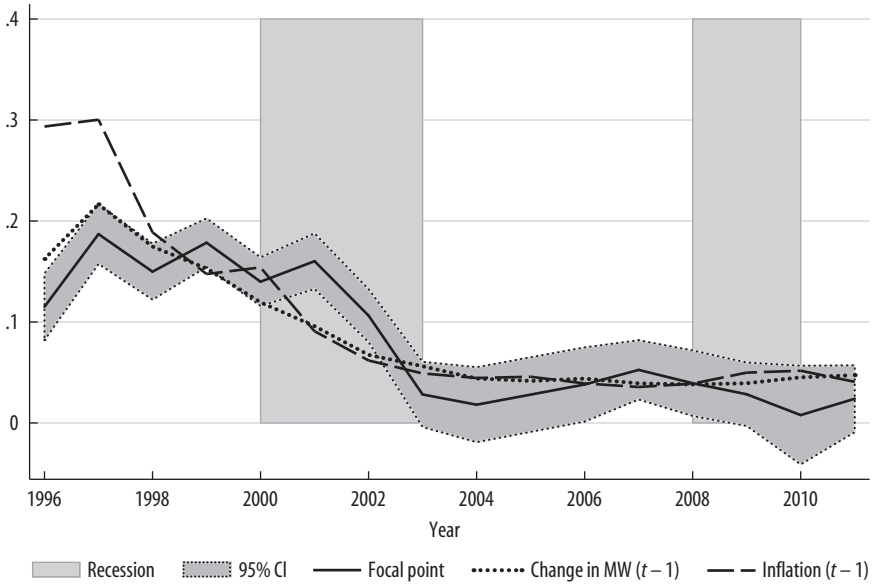


a. Estimation uses sampling weights. *P*(*R*) and *P*(*R* & Constrained) are the estimates for the probability of being in the real regime and for the joint probability of being in that regime and constrained. Recession years are those in which any quarter is part of a two-consecutive-quarters decline in real Mexican GDP.

Figure 10 again plots the focal point and its confidence interval, this time with the permanent annual inflation target of 3 percent announced by the Mexican central bank in 2002 and inflation expectations for the next twelve months (available starting in 2000) from a survey of private sector economists, conducted by the Bank of Mexico.[53] The figure shows that inflation expectations were below the wage indexation point between 2000 and 2003, but within the confidence interval of the latter after 2003. It also shows that this confidence interval includes the central bank's inflation target after 2003.

53. This survey is conducted monthly by the Mexican central bank on a sample of about thirty economic analysts and consulting groups of the private sector in Mexico and abroad. The respondents are asked about their expectations for inflation, interest rates, GDP growth, and exchange rates, among other variables. See "Encuesta sobre las Expectativas de los Especialistas en Economía del Sector Privado" at www.banxico.org.mx.

FIGURE 9. Focal Point, Lagged Inflation, and Lagged Change in the Minimum Wage[a]



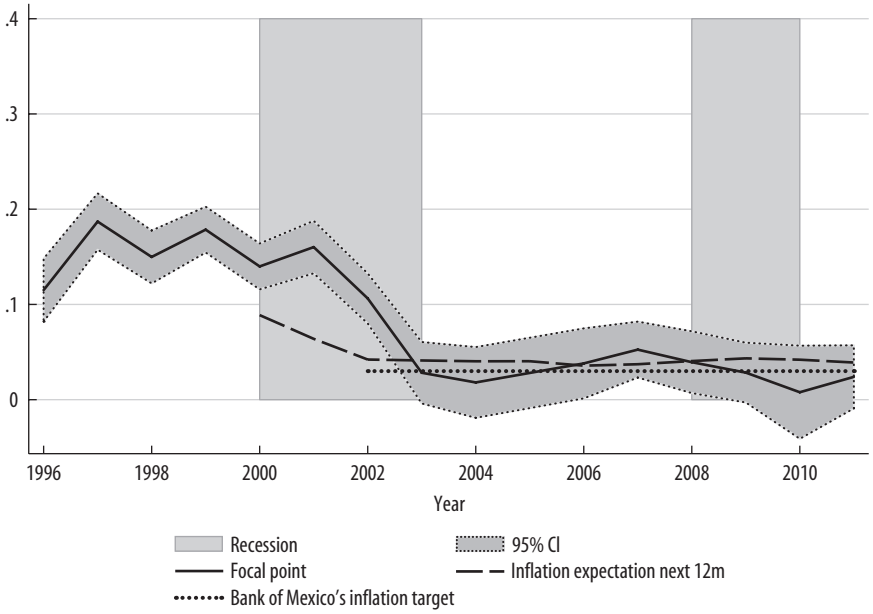
a. The focal point of wage negotiations is estimated by the model, using sampling weights. Inflation is measured as the annual change in the national consumer price index. The annual change in the minimum wage (MW) is from CONASAMI. Lagged values ($t - 1$) are those for the previous year. Recession years are those in which any quarter is part of a two-consecutive-quarters decline in real Mexican GDP. All variables are expressed as proportions.

Thus we cannot reject the hypothesis that the focal point for wage negotiations was equal to inflation expectations and the Bank of Mexico's inflation target for the period 2003–11. This evidence could be partly related to the strengthening of the credibility of the Mexican central bank throughout the stabilization process and after the adoption of inflation targeting.

To analyze which variables have the strongest correlation with our estimated focal point, we ran first-difference OLS regressions.[54] Given that we have few observations (thirteen years), these results must be interpreted merely as suggestive correlations. In addition, we explore only the correlations with the actual inflation rate and the change in the minimum wage,

54. We tested whether the dependent and the independent variables and their first differences were stationary using Dickey-Fuller tests. The original variables are not stationary but their first differences are.

FIGURE 10. Focal Point, Inflation Target, and Inflation Expectations[a]



a. The focal point of wage negotiations is estimated by the model, using sampling weights. The Bank of Mexico's inflation target is 3 percent since 2002. Inflation expectations are taken from a survey of private sector economic analysts conducted by the Bank of Mexico since 2000. All variables are expressed as proportions. Recession years are those in which any quarter is part of a two-consecutive-quarters decline in real Mexican GDP.

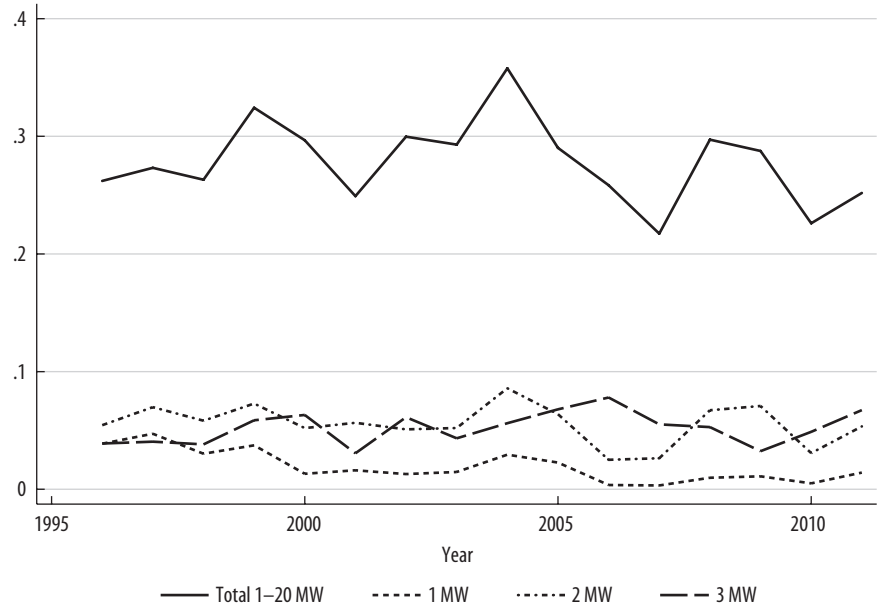
because we have information on inflation expectations only starting in 2000, which would result in even fewer observations. Table 4 shows the results of adding these variables, one at a time. Across columns, the focal point has a positive and statistically significant correlation with the lagged change in the minimum wage, whereas the correlation with the inflation rate is not significant at conventional levels. The contemporaneous change in the minimum wage seems to have a negative and significant correlation with the focal point in the last two columns, but this is only observed there and not in other columns. In contrast, the positive correlation of its lagged value just discussed is consistent in all the corresponding specifications. This suggests that although the behavior of general inflation and the change in the minimum wage are similar, especially in recent years—and both are within the confidence interval of the estimated focal point in figure 9—the minimum wage is a relatively more important reference point for wage changes.

TABLE 4. First-Difference Regressions of the Estimated Focal Point on Inflation and the Change in the Minimum Wage[a]

Explanatory variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
Change in the minimum wage (t)	–1.086				–0.915			–1.011**	–1.504**
	(0.663)				(0.630)			(0.395)	(0.533)
Inflation (t)		–0.389			–0.105		–0.395		0.421
		(0.377)			(0.453)		(0.379)		(0.251)
Change in the minimum wage (t – 1)			1.012***			1.390***		0.981***	1.341***
			(0.246)			(0.205)		(0.188)	(0.231)
Inflation (t – 1)				0.133		–0.434	0.150		–0.179
				(0.241)		(0.247)	(0.266)		(0.173)
Constant	–0.023*	–0.016	0.001	–0.006	–0.023*	–0.005	–0.013	–0.013	–0.012
	(0.011)	(0.012)	(0.009)	(0.013)	(0.012)	(0.008)	(0.012)	(0.009)	(0.010)
Summary statistic									
No. observations	13	13	13	13	13	13	13	13	13
R^2	0.175	0.117	0.383	0.014	0.179	0.479	0.135	0.534	0.603
Adjusted R^2	0.0997	0.0370	0.3260	–0.0755	0.0148	0.3750	–0.0378	0.4400	0.4050
F statistic	2.687	1.063	16.920	0.305	1.770	24.510	0.549	27.800	35.990

* Statistically significant at the 10 percent level.
** Statistically significant at the 5 percent level.
*** Statistically significant at the 1 percent level.
a. Robust standard errors are in parentheses.

FIGURE 11. Fraction of Job Stayers Who Earn Exact Multiples of the Minimum Wage[a]



a. The sample is composed of full-time wage workers in the private sector who did not change their industry or occupation between their first and fifth interview, from ENEU (1995–2004) and ENOE (2005–11). Workers are considered to earn an exact multiple of the minimum wage (MW) if their monthly earnings are within a 5 percent window of n*MW with $n = 1, 2, \ldots, 20$.

As discussed in the background section, previous studies show evidence of clustering of wage levels at exact multiples of the minimum wage in Mexico using both household surveys and administrative data.[55] Moreover, Fairris, Popli, and Zepeda show that this clustering is observed both for formal and informal workers.[56] In addition, Fairris, Popli, and Zepeda provide evidence suggesting that changes in the minimum wage affect overall wage changes, particularly for workers in the mid- to lower tail of the wage distribution.[57] In sum, the high correlation of our estimated focal point with the change in the minimum wage is consistent with previous studies.

To provide additional context for this finding, figure 11 shows the proportion of workers in our estimation sample who earn exact multiples of the

55. Castellanos (2005); Bosch and Manacorda (2010); Fairris, Popli, and Zepeda (2008); Castellanos, García-Verdú, and Kaplan (2004).

56. Fairris, Popli, and Zepeda (2008).

57. Fairris, Popli, and Zepeda (2008).

minimum wage per year. For this figure, we compare the monthly nominal earnings of workers with the monthly minimum wage (thirty times the daily minimum wage) that corresponds to their geographic area and their quarter. We consider multiples from one to twenty, and, insofar as earnings are potentially reported with error or with some rounding, we consider a 5 percent window around the reference values. Thus a worker is considered to earn an exact multiple of the minimum wage (MW) if her monthly earnings are within a 5 percent window of n * MW for $n = 1, 2, \ldots, 20$.

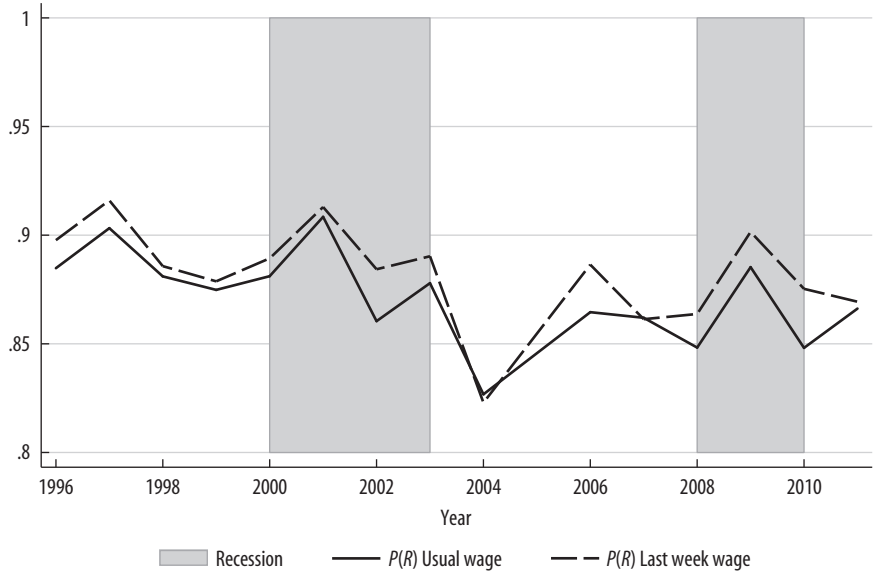
Figure 11 shows that between 22 and 36 percent of job stayers in our sample earn an exact multiple of the minimum wage in the period of analysis. The average for the whole period is 27 percent. We interpret this as supportive evidence for the relatively high fraction of workers subject to DRWR that we find because changes in the minimum wage would probably be fully and almost automatically reflected in the earnings of these workers. Note that for workers whose salary level is not an exact multiple of the minimum wage, the change in the minimum wage could still be used as a signal of what a reasonable or fair wage adjustment should be.[58] Figure 11 also shows that some fluctuations are observed from year to year in the proportion of workers earning exact multiples of the minimum wage, but not a decreasing trend, which would be consistent with the persistence of DRWR we find. Figure 11 also plots the proportion of workers earning exactly one, two, and three minimum wages. The fraction earning exactly one minimum wage seems to decrease during the period to almost zero in the later years. In contrast, the fractions earning exactly two and three minimum wages fluctuate roughly between 2.5 and 9.0 percent during the period of analysis (both are, on average, about 5 percent), but they do not seem to decrease over time. For reference, on average about 59 percent of workers in our sample earn three minimum wages or less per month. Thus, figure 11 suggests that for the majority of workers in our sample, the minimum wage indeed could be an important focal point.

Robustness Checks

We conduct several estimations to check the robustness of our main results. First, we use the hourly wage calculated using the reported hours worked by the individual in the week previous to the survey, instead of the usual hours

58. Fairris, Popli, and Zepeda (2008).

FIGURE 12. Robustness of *P*(*R*) to Different Wage Measures[a]



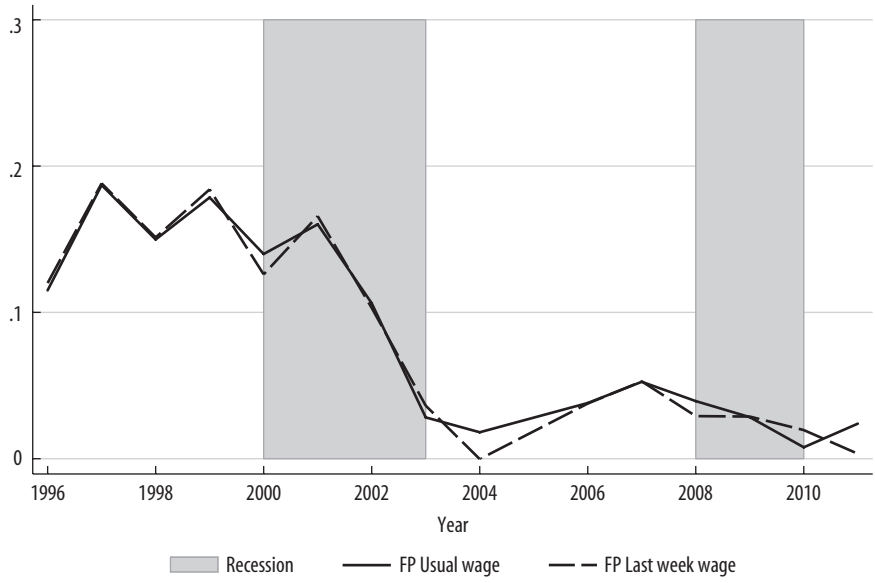
a. The main results for *P*(*R*), obtained using usual hours of work to calculate wage and using sampling weights, are compared to those obtained using hours worked during the week before the survey and sampling weights. Recession years are those in which any quarter is part of a two-consecutive-quarters decline in real Mexican GDP.

worked per week as in our main results.[59] Figure 12 shows the probability of being in the real regime for these two hourly wage measures. The probability of being in the real regime follows a very similar time behavior for both measures. Some differences can be observed, but they are relatively small. For instance, using the last week's wage yields a slightly higher proportion of workers in the real regime compared to our main results, but the average difference is about 0.011 for the whole period. The estimated probabilities of the other regimes—nominal and flexible—are also comparable for these two wage variables, so they are omitted for brevity. Figure 13 shows that the corresponding estimates of the focal point obtained for these two wage measures are also similar.

As explained before, in our main estimation we do not impose a specific value for the focal point a priori, but estimate it jointly with the regime

59. As mentioned, both the ENEU and ENOE surveys include two questions: one about the hours worked by the individual in the week previous to the survey interview and another about the hours that the individual usually works per week, which is the one used for our main results.

FIGURE 13. Robustness of Focal Point to Different Wage Measures[a]

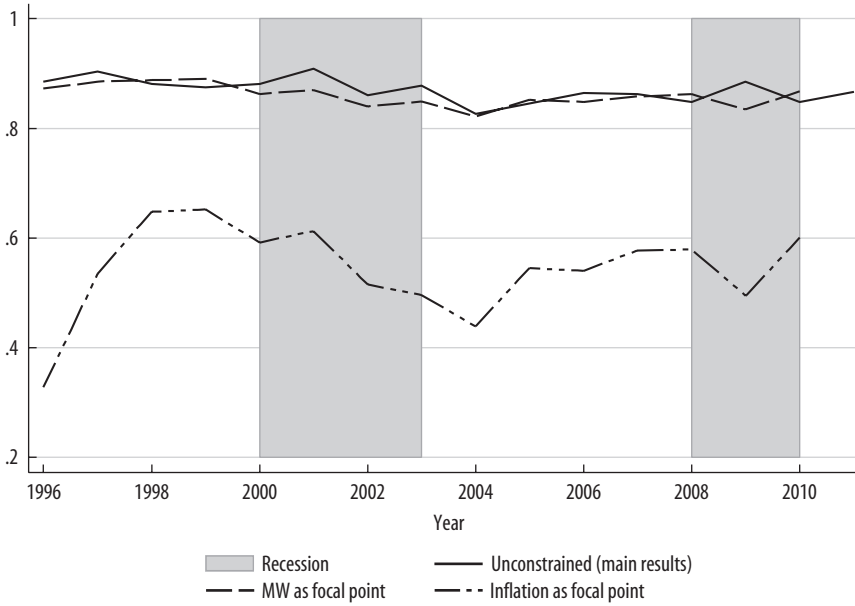


a. The main results for the focal point of wage negotiations, obtained using usual hours of work to calculate wage and sampling weights, are compared to those obtained using hours worked during the week previous to the survey and sampling weights. Recession years are those in which any quarter is part of a two-consecutive-quarters decline in real Mexican GDP.

probabilities. As an additional check, we reestimate the model imposing either the lagged change in the minimum wage or the lagged inflation rate as focal points and obtain the regime probabilities. Figure 14 shows our main results for the probability of being in the real regime in comparison to these estimations. Because in these alternative checks the focal point is imposed, the resulting estimate for $P(R)$ is the proportion of wage changes that are subject to that particular indexation point. As shown in figure 14, the probability of being in the real regime when the focal point is the change in the minimum wage is almost identical to that of our main results. This is not surprising given the high correlation between this variable and our main estimate for the focal point shown in table 4. In contrast, the proportion of wage changes subject to the inflation rate is lower for most years. This confirms the relative importance of the change in the minimum wage as a reference point for wage changes.

Finally, we also reestimated the model (i) using monthly earnings rather than the hourly wage, (ii) using the entire sample of cities available in each

FIGURE 14. Probability of Being in the Real Regime the Focal Point Is Imposed[a]



a. The main results for $P(R)$, obtained when the focal point of wage negotiation is unconstrained, are compared to those obtained when the lagged values of the following variables are imposed as focal points: (i) inflation; (ii) the change in the minimum wage. Recession years are those in which any quarter is part of a two-consecutive-quarters decline in real Mexican GDP.

year (rather than only those that consistently enter the whole period), and (iii) introducing city-level fixed effects in the estimation. These additional checks, not shown but available on request, yield similar results. Using monthly earnings yields a lower probability of being in the real regime, and a larger one for the nominal regime. However, the focal point obtained from (i) is less comparable to the variables that are thought to have influence in wage negotiations, such as inflation measures, inflation expectations, or the change in the minimum wage.

Discussion

In summary, our results suggest that for our sample of salaried, private sector job stayers, DRWR are the most prevalent in Mexico. Our estimated fraction of wage changes subject to DRWR (83–91 percent) is higher than

the estimate for Brazil (27–53 percent), Germany (72 percent maximum), and Italy (39–58 percent).[60] However, it is comparable to the maximum of 88 percent obtained for Uruguay in 1997–98, but much higher than the 4–8 percent for the same country in the 2000s.[61]

In addition, we find that the extent of such real rigidities stayed roughly constant in Mexico over the period 1996–2011, even though inflation decreased. Such persistence of DRWR in a low-inflation context is mostly associated in the literature with the labor institutions in a given country.

To contextualize our findings, we compare them with those for Brazil and Uruguay and highlight the background similarities and differences. For this comparison, we draw heavily on the findings and discussion of Messina and Sanz-de-Galdeano.[62] Like Mexico, both Brazil and Uruguay experienced an important and relatively rapid disinflation process between 1995 and 2001. In that period, inflation decreased from 66 percent to about 7 percent in Brazil, and from 50 percent to 4 percent in Uruguay. Nevertheless, Messina and Sanz-de-Galdeano find that during the whole period, DRWR remained relatively stable and were more prevalent than DNWR in Brazil, but the latter increased to a moderate level.[63] In contrast, in Uruguay DRWR decreased sharply during this period, and the opposite is observed for DNWR.[64] Thus, even though the three countries experienced a sharp disinflation process around the same period, the estimated patterns in DRWR and DNWR in Mexico are comparable to those obtained for Brazil and not to those for Uruguay.

The similarities and discrepancies in findings among the three countries seem to be related to their labor market institutions. Messina and Sanz-de-Galdeano attribute the differences in estimates between Brazil and Uruguay partly to these institutions.[65] As discussed by the authors, in Uruguay the government actively dismantled the existing tripartite system of wage bargaining at the beginning of the 1990s, which led to an effective decentralization of

60. Messina and Sanz-de-Galdeano (2014); Bauer and others (2007); Devicienti, Maida, and Sestito (2007). For this comparison, we are referring to the estimated probabilities of belonging to each wage regime, $P(N)$ and $P(R)$, in our study and in similar previous ones.

61. Messina and Sanz-de-Galdeano (2014).

62. Messina and Sanz-de-Galdeano (2014).

63. Messina and Sanz-de-Galdeano (2014).

64. According to Messina and Sanz-de-Galdeano (2014), in Brazil the estimated probability of being in the real regime is 46 percent in 1995–96 and 53 percent in 2001–02, whereas the corresponding estimates in Uruguay in those two periods are 72 percent and 8 percent, respectively. Regarding the estimated probability of being in the real regime, for Brazil it increased from almost zero in 1995–96 to 9.3 percent in 2001–02, whereas it increased from 12 to 62 percent in the same period in Uruguay.

65. Messina and Sanz-de-Galdeano (2014).

wage bargaining and a loss of bargaining power for unions. In contrast, in Brazil union coverage remained relatively high and stable during their period of analysis. Furthermore, in Brazil the wage bargaining process seems to be relatively centralized, as argued for Mexico, and the Brazilian law grants automatic extensions of the labor conditions obtained by a given union to uncovered workers in the same firm, sector, or region, just as the Mexican labor law does, as we discuss in the background section.

Regarding the minimum wage, Messina and Sanz-de-Galdeano state that Uruguay has one of the lowest in Latin America, whereas in Brazil it is closer to the median wage.[66] In this respect, the level of the Mexican minimum wage seems to be on the low side, but, as discussed in the background section and shown in figure 11, it is an important reference for wage setting in Mexico.

Thus the wage-setting institutions in Mexico seem to be similar to those in Brazil and not to those in Uruguay, which is consistent with the similarity in their estimated patterns for DNWR and DRWR. In the case of Mexico, the legal provisions that constrain the downward adjustment of wages in the LFT, which remained relatively stable during our period of analysis, could interact with the collective wage bargaining system to explain our findings. Although Fairris presents evidence of a decrease in unionization rates in Mexico from 26 percent in 1984 to 17 percent in 2000, the extension of collective agreements in the Mexican LFT could still lead to a persistence in DRWR.[67]

To recapitulate, wage-setting institutions in Mexico, which remained relatively stable during the period we analyze, together with the importance of the minimum wage, could potentially explain the extent and persistence of DRWR we find.

Regarding DNWR, we do find that, even though they affect a relatively lower fraction of workers in our sample throughout the period, they increase slightly as inflation decreases, as found by similar studies for other countries such as Germany, Italy, and the United Kingdom.[68] In addition, DNWR seem to become particularly acute during the 2009 recession.

A few caveats about our results. We focus on a selected sample of salaried, private sector job stayers, which allows us to compare our results with the previous literature. However, this also implies that one should be careful before extending our findings to all Mexican workers. In addition, the 2012 labor reform could potentially increase the flexibility of the Mexican labor

66. Messina and Sanz-de-Galdeano (2014).

67. Fairris (2007).

68. Bauer and others (2007); Devicienti, Maida, and Sestito (2007); Barwell and Schweitzer (2007).

market in the period after our analysis, leading to changes in the relative prevalence of DNWR and DRWR. Because the literature has found more wage rigidities among job stayers than job switchers, our estimates might be an upper bound for the DNWR and DRWR in the Mexican labor market during the period of analysis. We are not studying wage rigidities arising in the public sector, which is still heavily unionized. We rely on self-reported wage measures typically available in household surveys, and not on administrative records as other previous studies have. Finally, our methodology has less power to distinguish between DNWR and DRWR when inflation is low, as in the later years of our period of analysis.

For Mexico, the appropriate administrative data for wage workers in the private sector would be the individual records from the Mexican Institute of Social Security (IMSS). Although our survey data are potentially more prone to measurement error, they have several advantages relative to the IMSS administrative data. First, the ENEU/ENOE surveys cover both formal and informal wage workers, whereas the IMSS data cover only the former, that is, those who are registered in IMSS by their employer and actively pay contributions. In Mexico, noncompliance makes this a relevant issue. For instance, as shown in table A1 in the appendix, about 32–33 percent of the job stayers in our data are in the informal sector. Second, the wage measure available in the IMSS data is a daily integrated wage (*salario diario integrado*), which is reported monthly by the employer. Insofar as this daily wage is the basis for paying contributions, employers might have incentives to underreport, as suggested by Kumler, Verhoogen, and Frias.[69] In addition, the ENEU/ENOE surveys allow studying the downward rigidities affecting the hourly wage rate, whereas it is not possible to calculate the hourly wage with IMSS data because work hours are not reported. This is relevant because employers might face some restrictions to change the daily wage reported to IMSS or the monthly salary actually paid to employees, but not for changing the hours of work. In sum, the self-reported wage available in the ENEU/ENOE surveys is potentially measured with error, but it might be closer to the total compensation received per hour. To be fair, IMSS records have the advantage of allowing a more accurate identification of job stayers (because the employer ID is available) and providing a large number of observations for estimation. Thus, extending our analysis to IMSS administrative data would be informative, but it would not necessarily provide a robustness check for the results in this paper, in light of the comparability issues discussed above.

69. Kumler, Verhoogen, and Frias (2013).

Summary and Conclusions

In this paper, we provide evidence of the existence and prevalence of DNWR and DRWR in the Mexican labor market in 1996–2011 using data from the ENEU and ENOE surveys and maximum likelihood estimation. We add to previous studies for Mexico in several ways. First, we provide updated evidence on the relative prevalence of both DNWR and DRWR. This is relevant because in recent years, inflation has become lower and more stable in Mexico, which could change the relative prevalence of both types of rigidities, as suggested by previous literature. Second, we estimate the focal point of wage negotiations within the model and account for measurement error in wage changes. Third, we look at year-to-year changes in the estimated parameters to explore their evolution over time and their correlation with the macroeconomic environment.

Our findings suggest that a larger fraction of workers in our sample is subject to DRWR than to DNWR in the period 1996–2011. This might be due to the interaction of some institutional features of the Mexican labor market that remained relatively stable during the period we analyze, such as legal provisions constraining wage adjustment, the collective bargaining system, and the importance of the minimum wage as a reference point for wage negotiations. However, we also find that as inflation decreased, the relative prevalence of DNWR increased slightly, as found by similar studies for other countries such as Germany, Italy, and the United Kingdom.[70] Regarding the focal point for wage negotiations, we find that it decreased with inflation. From 2003 onward, shortly after the Mexican central bank officially adopted inflation targeting, we cannot reject that the focal point was statistically equal to the lagged values of inflation and the change in the minimum wage. Nevertheless, the focal point seems to be positively and significantly correlated with the lagged change in the minimum wage. After 2003, the confidence interval of the focal point also includes the permanent annual inflation target of 3 percent of the Mexican central bank in most years, which could partly reflect an increased credibility achieved by this institution. Finally, in 2009–11, the focal point was not statistically different from zero, which suggests that DNWR were particularly prevalent during the latest recession. A caveat about this result is that our methodology has less power to distinguish between DNWR and DRWR when inflation is low, as in the later years of our period of analysis.

70. Bauer and others (2007); Devicienti, Maida, and Sestito (2007); Barwell and Schweitzer (2007).

Overall, we find evidence suggesting that downward wage rigidities in Mexico exist and persist after successful macroeconomic stabilization. In a low-inflation context, such persistence of downward wage rigidities might hamper the adjustment of the labor market to shocks to a greater extent than in the 1980s and 1990s, thus resulting in higher and more persistent unemployment. For instance, downward wage rigidities could be one of the factors associated with the relatively slow decrease in unemployment in Mexico after the 2009 recession. From a policy perspective, working toward a higher degree of labor market flexibility, or at least not reinforcing such wage rigidities, would potentially counteract their impact. The 2012 Mexican Labor Reform and the abandonment of the minimum wage as a virtual numeraire in the law in 2016 could work in this direction.

Appendix

In this appendix, we show descriptive statistics, some evidence of the attrition rates in the panel, and the evolution of the share of workers classified as job stayers over time.

Descriptive Statistics

Table A1 shows the descriptive statistics of the control variables used in the estimation in the periods covered by the ENEU (1996–2004) and ENOE (2006–11) data sets for our final sample of job stayers. In the latter period, workers are slightly older and more educated. The shares of female workers (39–41 percent) and formal workers (67–68 percent) are similar in the two periods. Similarly, the share of job stayers in each industry remained stable, with most of them in manufacturing (22–25 percent); wholesale, retail, restaurants, and hotels (31 percent); and services (25–29 percent). Regarding firm size, the share of job stayers working in firms with more than 250 employees, the largest firms in the data, decreased from 32 percent in the ENEU period (1996–2004) to 10 percent in the ENOE period (2006–11). In contrast, the share of job stayers in the smallest firms, those with fewer than five employees, remained roughly constant (29–31 percent). Thus the decrease in the share of workers in the largest firms is explained by increases in the share of workers in firms with 6–250 employees. The distribution of workers in the different occupations is relatively similar between the two periods, with

TABLE A1. Descriptive Statistics for Estimation Sample[a]

	ENEU 1996–2004		*ENOE 2006–2011*	
	Mean	*Std. dev.*	*Mean*	*Std. dev.*
Age	32.99	10.79	35.12	11.25
Years of education	8.57	3.98	9.47	3.86
Female	0.41	0.49	0.39	0.49
Formal job (=1 if job is covered by IMSS, =0 otw)	0.67	0.47	0.68	0.47
Industry dummies				
Agriculture, fishing, and hunting	0.01	0.09	0.00	0.02
Mining	0.00	0.05	0.00	0.05
Electricity, natural gas, and water	0.00	0.02	0.00	0.02
Manufacturing	0.25	0.43	0.23	0.42
Construction	0.07	0.26	0.13	0.34
Wholesale, retail, restaurants, and hotels	0.31	0.46	0.31	0.46
Transportation, storage, and communications	0.06	0.23	0.05	0.22
Finance, insurance, and real state	0.02	0.14	0.02	0.15
Services	0.29	0.45	0.25	0.43
Government	0.00	0.00	0.00	0.00
Firm size dummy variables				
5 or fewer employees	0.31	0.46	0.29	0.46
6–10 employees	0.08	0.28	0.13	0.34
11–15 employees	0.05	0.21	0.07	0.26
16–50 employees	0.14	0.35	0.22	0.41
51–100 employees	0.07	0.25	0.10	0.30
101–250 employees	0.04	0.20	0.08	0.27
251 or more employees	0.32	0.47	0.10	0.31
Occupation dummy variables				
Professionals	0.03	0.18	0.04	0.19
Technicians	0.04	0.20	0.04	0.20
Education workers	0.01	0.10	0.02	0.14
Workers in the arts, entertainment, and sports	0.01	0.08	0.01	0.08
Officers and chief executives	0.02	0.14	0.01	0.11
Workers in agriculture	0.00	0.07	0.00	0.02
Production supervisors	0.02	0.15	0.02	0.13
Production workers and operators	0.32	0.47	0.41	0.49
Administrative supervisors and managers	0.02	0.14	0.01	0.12
Administrative employees	0.12	0.32	0.12	0.33
Traders and sellers in establishments	0.15	0.35	0.15	0.36
Street vendors	0.00	0.03	0.00	0.04
Workers in personal services	0.10	0.29	0.11	0.32
Workers in domestic services	0.12	0.32	0.00	0.03
Security and surveillance workers (guards)	0.04	0.19	0.06	0.23
Other	0.00	0.00	0.00	0.00
Worker herself answered survey	0.27	0.44	0.30	0.46
Contract (=1 if the worker has a written contract, 0 otw)	0.66	0.48	0.60	0.49
Hours of work per week (usual)	48.76	9.44	50.09	10.01
Hours of work in the previous week	48.40	9.81	49.36	10.79
Real hourly wage (calculated using usual work hours)	21.08	27.64	24.06	19.31
Real hourly wage (calculated using hours worked previous week)	21.29	27.86	24.79	21.04
Number of observations	50,466		14,623	

a. In both periods, the estimation sample consists of wage workers in the private sector who work full time (30+ hours per week) and who did not change their industry and occupation between their first and fifth survey interview (a year). Only the twenty-seven cities that were surveyed consistently during the whole period 1996–2011 are included. Real wages were calculated using the Mexican consumer price index.

the most notable change being the increase in the share of production workers and operators from 32 to 42 percent. The share of workers who answered the survey themselves, as opposed to someone else in their household answering for them, increased slightly in the ENOE period (from 27 to 30 percent). The share of workers who report having a formal written job contract decreased from 66 percent in the ENEU period to 60 percent in the ENOE period. Work hours are similar in the two periods (48–50 hours per week) with a slight increase of one or two hours in the latter period. Finally, mean real wages per hour are higher in the ENOE period.

In both the ENEU and ENOE surveys, new cities were added over time, and for our estimation, we restricted the sample to the twenty-seven cities that were consistently included the survey throughout the whole period. Table A2 shows the differences in means for our control variables between this sample of twenty-seven cities and the whole survey sample by period. In the first two columns, most of the differences in means are not statistically significant in the earlier ENEU period (1996–2004). The few exceptions in the ENEU period are that the cities in our sample have a higher share of workers in the formal sector, in manufacturing and transportation, in relatively larger firms, in production occupations, and with a written contract. Conversely, these cities had a lower share of workers in construction and services, in relatively smaller firms, and in domestic and retail occupations. Mean real wages seem to be higher in our sample of twenty-seven cities in that same earlier period. The third and fourth columns report the differences between our sample of twenty-seven cities and the national sample of the ENOE survey. Whereas the ENEU targets solely urban areas, ENOE is a nationally representative employment survey that includes both urban and rural areas. Thus, we report the differences in the third and fourth columns for the sake of completeness, but the relevant comparison for the ENOE period (2006–11) is between our sample of twenty-seven cities and the urban sample of the survey, which is reported in the last two columns. In those columns, no differences in means are statistically significant.

Attrition

Both the ENEU and ENOE surveys are rotating panels of dwellings, not households. In this subsection, we show evidence of the attrition rates for our sample. This is relevant because for our empirical analysis, we need to be able to observe the worker in both the first and fifth (and last) quarters in which she was interviewed.

TABLE A2. Differences in Means between the Sample of Selected Cities and the Complete Survey Sample[a]

	ENEU 1996–2004		*ENOE 2006–11 (national sample)*		*ENOE 2006–11 (urban sample)*	
	Difference in means	*P value*	*Difference in means*	*P value*	*Difference in means*	*P value*
Age	0.005	0.929	−0.663	0.000	−0.071	0.575
Years of education	−0.023	0.310	−0.328	0.000	0.016	0.721
Female	−0.005	0.067	−0.017	0.001	0.001	0.904
Formal job (=1 if job is covered by IMSS, =0 otw)	0.023	0.000	−0.062	0.000	−0.009	0.107
Industry dummies						
Agriculture, fishing, and hunting	0.0005	0.396	0.001	0.000	0.000	0.839
Mining	0.0002	0.455	0.004	0.000	0.000	0.659
Electricity, natural gas, and water	0.0001	0.226	0.0002	0.416	0.0001	0.748
Manufacturing	0.021	0.000	0.005	0.264	−0.004	0.428
Construction	−0.006	0.000	0.034	0.000	0.004	0.256
Wholesale, retail, restaurants, and hotels	−0.003	0.246	−0.009	0.063	−0.002	0.665
Transportation, storage, and communications	0.006	0.000	−0.003	0.207	0.000	0.984
Finance, insurance, and real state	−0.001	0.069	−0.002	0.221	0.000	0.872
Services	−0.017	0.000	−0.031	0.000	0.002	0.753
Firm size dummy variables						
5 or fewer employees	−0.018	0.000	0.050	0.000	0.008	0.116
6–10 employees	−0.002	0.235	0.001	0.738	0.000	0.928
11–15 employees	−0.001	0.577	−0.004	0.090	0.000	0.987
16–50 employees	−0.005	0.011	−0.021	0.000	−0.002	0.616
51–100 employees	−0.005	0.000	−0.016	0.000	−0.003	0.462
101–250 employees	−0.001	0.518	−0.009	0.002	−0.002	0.598
251 or more employees	0.031	0.000	−0.002	0.436	−0.003	0.394

(*continued*)

TABLE A2. Differences in Means between the Sample of Selected Cities and the Complete Survey Sample[a] (*Continued*)

	ENEU 1996–2004		*ENOE 2006–11 (national sample)*		*ENOE 2006–11 (urban sample)*	
	Difference in means	*P value*	*Difference in means*	*P value*	*Difference in means*	*P value*
Occupation dummy variables						
Professionals	−0.002	0.065	−0.008	0.000	−0.001	0.492
Technicians	−0.001	0.558	−0.003	0.144	0.002	0.480
Education workers	0.000	0.943	−0.003	0.063	0.001	0.483
Workers in the arts, entertainment, and sports	−0.0004	0.315	−0.001	0.062	0.000	0.751
Officers and chief executives	0.0002	0.812	−0.002	0.036	0.000	0.919
Workers in agriculture	0.001	0.096	0.001	0.001	0.000	0.956
Production supervisors	0.004	0.000	−0.002	0.188	0.000	0.780
Production workers and operators	0.015	0.000	0.046	0.000	0.003	0.650
Administrative supervisors and managers	0.0001	0.943	−0.003	0.005	0.000	0.783
Administrative employees	−0.0004	0.831	−0.012	0.000	0.000	0.987
Traders and sellers in establishments	−0.008	0.000	0.004	0.322	−0.001	0.802
Street vendors	0.0002	0.220	0.0005	0.293	0.0003	0.464
Workers in personal services	0.0002	0.897	−0.009	0.007	0.000	0.915
Workers in domestic services	−0.009	0.000	−0.0002	0.522	0.0000	0.903
Security and surveillance workers (guards)	0.0005	0.673	−0.008	0.001	−0.002	0.482
Other	0.000	0.000	0.000	0.000	0.000	0.000
Worker herself answered survey	0.013	0.000	−0.008	0.105	0.003	0.529
Contract (=1 if the worker has a written contract, 0 otw)	0.020	0.000	−0.060	0.000	−0.006	0.278
Hours of work per week (usual)	−0.039	0.468	0.357	0.001	0.001	0.810
Hours of work in the previous week	0.023	0.687	0.364	0.001	0.001	0.807
Real hourly wage (calculated using usual work hours)	0.005	0.001	−0.010	0.000	0.002	0.324
Real hourly wage (calculated using hours worked previous week)	0.005	0.003	−0.010	0.000	0.003	0.300

a. Difference between the mean for the whole sample of cities and the twenty-seven cities used in the estimation, which are consistently surveyed during the period 1996–2011. In all cases, the sample is of wage workers in the private sector who work full time (30+ hours per week) and who did not change their industry and occupation between their first and fifth survey interview (a year). The reported *p* value corresponds to the test for equality in means between samples.

TABLE A3. Attrition

	No. of individuals remaining	*% of total individuals*
ENEU 1996–2004		
ENEU 1996–2004	3,183,221	
Keep only if 1 and 5	1,766,023	55.48
Keep if usual resident in 1	1,765,885	55.47
Keep if usual resident in 5	1,741,338	54.70
Age between 14–98	1,132,134	35.57
Age between 18–65	932,095	29.28
ENOE 2005–2011		
ENOE 2005–2011	2,990,053	
Keep only if 1 and 5	1,601,317	53.55
Keep if 1 complete	1,601,116	53.55
Keep if usual resident in int. 5	1,601,116	53.55
Keep if 5 complete	1,600,983	53.54
Age between 15–98	1,167,295	39.04
Age between 18–65	953,926	31.90

Source: ENEU 1996–2004 and ENOE 2005–2011, INEGI.

Table A3 shows the total number of individual observations in the ENEU and ENOE data, and the total number that remains after each restriction we impose to end up with a panel. For instance, for the ENEU, the total number of individuals in the period (1996–2004), before any restrictions are imposed, is over three million. Keeping only individuals with the first and fifth (last) interview in order to observe the individual in the same quarter from one year to another leaves us with 55.5 percent of the original observations. Because in this first step we are not applying any other restrictions to the data, this gives us a rough estimate of the attrition rate in the survey: 45.5 percent of individuals who are interviewed for the first time in a given quarter are not interviewed in the fifth quarter. The quarter-to-quarter attrition rate is probably lower.

Even if the household did not move between the last and fifth interviews, the individual might have left the household between those interviews. We further restrict the sample to usual household residents at both interviews, because their employment variables are probably more accurately reported than for those who left the household. Conditional on having a first and fifth interview, of the individuals who are usual residents in the first interview, 1.4 percent (24,547 observations) are no longer in the household by the fifth interview. This suggests that the higher attrition rate comes from entire households moving within five quarters rather than from individuals leaving the household. Finally, keeping only individuals for whom INEGI asks the employment questions (those aged fourteen to ninety-eight) leads us to keep

TABLE A4. Attrition by Year

Survey and year	No. of individuals lost	Lost as % of total of individuals of sample	Lost as % of total sample in year of first interview	Total sample by year
ENEU 1996–2004				
1996[a]	129,498	4.07	27.08	478,167
1997	132,836	4.17	49.77	266,874
1998	142,378	4.47	49.61	286,974
1999	231,062	7.26	58.12	397,591
2000	270,742	8.51	61.65	439,164
2001	266,520	8.37	60.91	437,591
2002	265,799	8.35	63.98	415,422
2003	208,168	6.54	66.85	311,418
2004[b]	150,020	4.71	100.00	150,020
ENOE 2005–11				
2005[a]	246,636	8.25	33.28	741,028
2006	239,192	8.00	60.36	396,270
2007	235,464	7.87	60.27	390,686
2008	230,690	7.72	59.90	385,118
2009	226,048	7.56	59.33	381,010
2010	222,098	7.43	58.81	377,649
2011[c]	318,292	10.65	100.00	318,292

Source: ENEU 1996–2004 and ENOE 2005–2011, INEGI.

a. In these years, some of the individual observations dropped have a fifth, but not a first, survey interview.

b. This is the last year the ENEU survey was carried out, so all individuals who got their first interview in 2004 were dropped.

c. This is the last year of the period of analysis, so all individuals who got their first interview in 2011 were dropped.

only 35 percent of the original sample, and further restricting the sample to individuals aged eighteen to sixty-five for our estimation leads to a final sample of 29 percent of the original sample.

For the ENOE data (2005–2011), the total number of observations is close to three million, and the percentage that remains after each restriction is similar to that for the ENEU data. We seem to have slightly more attrition when keeping only individuals with both the first and last interview (we are left with 53.5 percent instead of 55.5 percent of the original sample), but further restricting the sample to individuals with complete survey interviews and usual residents leads to dropping very few additional observations. Finally, keeping those aged eighteen to sixty-five years old leads to a slightly larger share of the original ENOE sample (31.9 percent), owing to a smaller number of observations dropped when restricted to individuals aged fifteen to ninety-eight who are given the employment questionnaire in this period.

Table A4 presents the number and percentage of total individuals lost from the original sample per year. The second columns shows the lost observations

as a percentage of the total sample in the corresponding year, which is around 4 percent for the earliest years (1996–98) and ranges from 6.5 to 8.5 percent from 1999 onward. The 10 percent lost in 2011 is due to that year being the final one in the sample. The third column shows lost observations as a percentage of the total sample in the year in which their first interview was conducted. Between 49 and 66 percent of observations are lost this way in each year. The smaller percentages lost in 1996 and 2005 are due to individuals that have a fifth interview but no first interview, a difference in part reflecting that 1996 is the initial year of our analysis and 2005 is the initial year of the ENOE survey. On the other hand, 100 percent of observations are lost in 2004 and 2011 because these are the final years of the ENEU survey and of the sample, respectively. We did not lose all observations in those final years, only individuals who had their first interview then. Overall, the patterns of observations lost in the second and third column seem to be stable, and it is important to note that even in years with atypical values, we find no drastic changes in the estimated parameters of our model.

Share of Job Stayers over Time

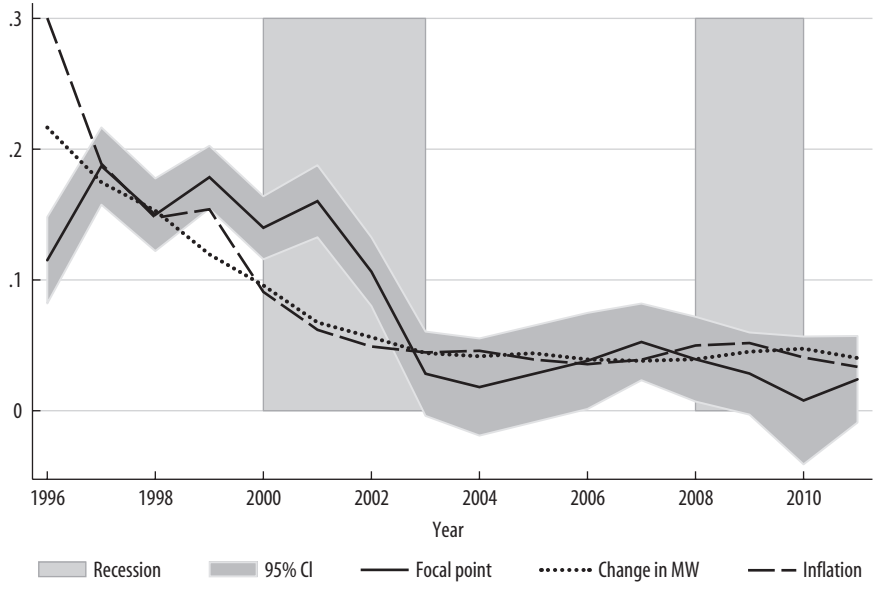
As noted in the main text, after applying the restrictions in table A3, we keep only individuals who are full-time, wage workers. Among them, we classify individuals as stayers if they had the same industry and occupation code in their first and fifth interview. Table A5 shows the percentage of movers and stayers per year, according to this classification. In the earlier ENEU period (1996–2004), between 30 and 33 percent of wage, full-time workers are job stayers in each year. Starting in 2006, in the ENOE period, the percentage of workers classified as stayers increases to 38–40 percent. Admittedly, this might be due to a change in the classification of industries and occupations when the ENOE survey started. However, within each survey period, the share of stayers is stable, and, as mentioned before, we observe no drastic changes in the estimates right when the survey changes.

TABLE A5. Job Movers and Stayers. Full-Time Wage Workers

Year	*Mover (%)*	*Stayer (%)*	*Total*
1996	70.00	30.00	58,500
1997	66.74	33.26	62,761
1998	66.57	33.43	66,608
1999	67.18	32.82	72,923
2000	68.02	31.98	84,119
2001	67.63	32.37	84,482
2002	67.53	32.47	83,910
2003	67.00	33.00	73,329
2004	66.78	33.22	51,274
2005			0
2006	61.83	38.17	47,372
2007	59.41	40.59	49,442
2008	58.95	41.05	49,392
2009	58.72	41.28	49,328
2010	59.93	40.07	48,021
2011	59.78	40.22	47,189
Total	64.40	35.60	928,650

Source: ENEU 1996–2004 and ENOE 2005–2011, INEGI.

FIGURE A1. Focal Point, Inflation, and Change in the Minimum Wage[a]



a. This figure is similar to figure 9 in the main text, but it uses the current values of inflation and the change in the minimum wage instead of lagged variables. The focal point of wage negotiations is estimated by the model, using sampling weights. Inflation is measured as the annual change in the national consumer price index. The annual change in the minimum wage is from CONASAMI. Values (*t*) are those for the reported year. Recession years are those in which any quarter is part of a two-consecutive-quarters decline in real Mexican GDP.

References

Agudelo, Sonia A., and Hector Sala. 2017. "Wage Rigidities in Colombia: Measurement, Causes, and Policy Implications." *Journal of Policy Modeling* 39(3): 547–67.

Altonji, Joseph G., and Paul J. Devereux. 2000. "The Extent and Consequences of Downward Nominal Wage Rigidity." *Research in Labor Economics* 19: 383–431.

Barattieri, Alessandro, Susanto Basu, and Peter Gottschalk. 2014. "Some Evidence on the Importance of Sticky Wages." *American Economic Journal: Macroeconomics* 6(1): 70–101.

Barwell, Richard D., and Mark E. Schweitzer. 2007. "The Incidence of Nominal and Real Wage Rigidities in Great Britain: 1978–98." *Economic Journal* 117(524): 553–69.

Bauer, Thomas, and others. 2007. "Real and Nominal Wage Rigidities and the Rate of Inflation: Evidence from West German Microdata." *Economic Journal* 117(524): 499–507.

Bosch, Mariano, and Marco Manacorda. 2010. "Minimum Wages and Earnings Inequality in Urban Mexico." *American Economic Journal: Applied Economics* 2(4): 128–49.

Card, David, and Dean Hyslop. 1997. "Does Inflation Grease the Wheels of the Labor Market?" In *Reducing Inflation: Motivation and Strategy*, edited by Christina D. Romer and David H. Romer, chap. 2. University of Chicago Press.

Castellanos, Sara G. 2005. "La rigidez a la baja de los salarios nominales en Mexico: Una medicion con datos a nivel individual." *Monetaria* 28(1): 35–75.

Castellanos, Sara G., Rodrigo García-Verdú, and David S. Kaplan. 2004. "Nominal Wage Rigidities in Mexico: Evidence from Social Security Records."*Journal of Development Economics* 75(2): 507–33.

Cobb, Marcus, and Luis Opazo. 2008. "Microeconomic Evidence of Nominal Wage Rigidity in Chile." Working Paper 496. Santiago: Central Bank of Chile.

Devicienti, Francesco, Agata Maida, and Paolo Sestito. 2007. "Downward Wage Rigidity in Italy: Micro-Based Measures and Implications." *Economic Journal* 117(524): 530–552.

Dickens, William T., and others. 2007. "How Wages Change: Micro Evidence from the International Wage Flexibility Project." *Journal of Economic Perspectives* 21(2): 195–214.

Fairris, David. 2007. "¿Qué hacen los sindicatos en Mexico?" *Estudios Económicos* 22(2): 185–240.

Fairris, David, Gurleen Popli, and Eduardo Zepeda. 2008. "Minimum Wages and the Wage Structure in Mexico." *Review of Social Economy* 66(2): 181–208.

Goette, Lorenz, Uwe Sunde, and Thomas Bauer. 2007a. "Real and Nominal Wage Rigidities and the Rate of Inflation: Evidence from West German Micro Data—Technical Appendix." University of Bonn.

———. 2007b. "Wage Rigidity: Measurement, Causes, and Consequences." *Economic Journal* 117(524): 499–507.

Kahn, Shulamit. 1997. "Evidence of Nominal Wage Stickiness from Microdata." *American Economic Review* 87(5): 993–1008.

Kumler, Todd, Eric Verhoogen, and Judith A. Frias. 2013. "Enlisting Employees in Improving Payroll-Tax Compliance: Evidence from Mexico." Working Paper 19385. Cambridge, Mass.: National Bureau of Economic Research.

Messina, Julian, and Anna Sanz-de-Galdeano. 2014. "Wage Rigidity and Disinflation in Emerging Countries." *American Economic Journal: Macroeconomics* 6(1): 102–33.

O'Connell, Lesley D. 1999. "Collective Bargaining Systems in Six Latin American Countries: Degrees of Autonomy and Decentralization." Working Paper 399. Washington: Inter-American Development Bank.

Ramos-Francia, Manuel, and Alberto Torres. 2005. "Reducción de la inflación a través de un esquema de objetivos de inflación: La experiencia mexicana." Research Paper 2005-01. Mexico City: Bank of Mexico.