The unintended distributional consequences of the 2012 rise in the Mexican minimum wage

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June 2017

Abstract

In this paper we use Mexico’s 2012 harmonization of Zone B’s minimum wages to those in Zone A as a natural experiment to analyse the effect on the distribution of real earnings. We estimate the effect of the policy change on different points of the earnings distribution by implementing the unconditional quantile regression developed by Firpo et al. (2009). We find evidence of significant effects at the bottom of the earnings distribution, which suggests a small improvement in earnings for the targeted lowest income workers. Interestingly, the model also shows the existence of important lighthouse, or spillover effects on the top percentiles of the distribution, having the effect of widening the wage dispersion. Our results therefore confirm that minimum wages played also a ‘reference’ role in the Mexican labour market. The presence of spillover effects in the formal and informal labour markets challenges the Welch–Gramlich–Mincer Two Sector Model by the estimation of positive effects on both sectors.

JEL Classification: J23, J32

Keywords: minimum wage, earnings distribution, spillover effects, informal sector, unconditional quantile regression

1 Introduction

Even though the discussion on the impact of minimum wages is focused on the employment effects, the main goal of minimum wages policies is not to affect the level of employment, but increase real earnings for poorest workers and/or reduce the earnings inequality. Thus, the objective of this paper is twofold: to evaluate if as a consequence of the 2012 Zone B minimum wage increase there is actually an impact on the lowest segment of the earnings distribution, and to verify the existence of a lighthouse effect that can affect its re-distributional impact.
Wage effects beyond the minimum wage threshold (spillovers) may imply undesired effects on inequality. The targeted population is by definition the lowest-paid workers, but if workers with earnings above the minimum are benefited by minimum wage policies, wage dispersion could increase. Empirical research during the decade of the 90’s demonstrated that the loss of purchasing power of the real minimum wage in the United States was largely responsible of the rise in wage inequality (DiNardo et al., 1996; Fortin and Lemieux, 1997; Lee, 1999) revealing the existence of an important lighthouse effect. More recently, Autor et al. (2016) reassessed these estimates concluding that although the effect of minimum wage on inequality is significant, and it is not possible to deny the presence of wage spillover effects, its magnitude is lower than estimates in the decade of the 90’s. Our findings suggest important wage spillover effects in the Mexican labour market, even greater than Lee’s findings.

The success of a minimum wage increase, in terms of its redistribution aims, depends mainly on who pays for the increase and whose wage actually rises (Freeman, 1996). The second issue is not trivial; a minimum wage increase does not imply that earnings for the lowest-paid workers will increase for sure. For instance, a more attractive minimum wage rate may increase the labour supply from middle-class workers that previously were not willing to work at the prevailing minimum wage; if employers prefer to hire them to low-income workers (for productivity reasons, for example) a minimum wage increase does not improve the earnings for the segment of the workforce with the lowest earnings. Depending on the structure of the labour market, there can be different channels through which minimum wage policies can have different re-distributive effects, and not necessarily the desired ones. This paper examines precisely that: what impact the minimum wage increase in Zone B has at different points of the earnings distribution.

Thus, this paper beyond wishing to answer what effect minimum wages has on the conditional mean, estimates the differential impacts along the distribution of real wages. In our previous research we showed that the rise of the minimum wages in Zone B truly had an impact on real wages. As a consequence of the intervention, wage rates increased on average by 3.6% (an implied elasticity of 1.24). But this analysis did not provide any information on how the intervention impacted earnings across different points of its distribution, especially on the targeted poorest segment of the labour force. Given the nature of the minimum wage policy purposes (related to ensuring a minimum level of earnings for the segment of the labour force with the lowest level of income) and the potential lighthouse effects, it is fundamental to evaluate the impact of the minimum wage increase at different levels of real earnings.

Our analysis takes special relevance if we consider the context of the Mexican labour market. First, the loss of purchasing power of the minimum wage has led it to such a low level, that it has generated the belief that there are no workers on the minimum wage (Calva and Picard, 2007). Even though our descriptive statistics in Chapter 1
demonstrate the opposite, if this was the case, the significant mean conditional effects estimated by Heckman pooled OLS regressions would be explained as a consequence of the ‘lighthouse’ effect of the minimum wage, in which minimum wage is taken as a reference rate for wage setting (Bosch and Manacorda, 2010; Castellanos et al., 2004; Kaplan and Pérez-Arce, 2006). Thus, changes to the minimum wage would have an impact on the conditional mean of real wages, but not necessarily on the targeted population: lowest income workers.

Related to this, there is a vast literature arguing that minimum wages in Mexico also work as a reference rate in the labour market. Remunerations in the formal and informal sector are tied to multiples of these minimum wages (Fairris et al., 2008). In addition, until 2016 many government-set prices were tied to multiples of the nominal minimum wage. These included, for instance, pensions, labour bonuses or benefits, social security fees, income brackets for income tax rates, fines, among others. Therefore, changes to the minimum wage are likely to affect not only the lowest paid workers. The findings suggest there are sizable effects on the top deciles of the earnings distribution.

The unconditional quantile regression analysis presented in this paper shows that there is an important minimum wage lighthouse effect; that is, there is an impact beyond the targeted lowest income workers. Even though the policy intervention has small effects on the bottom percentiles of the earnings distribution, interestingly there are also considerable spillover effects on the upper side of the distribution, which increases the wage dispersion.

Second, the size of the informal labour market in Mexico (around 60% of the labour force) makes the practical implementation of minimum wage policies in the labour market very difficult. Although minimum wage regulation is not applicable to the informal sector, Heckman pooled OLS estimates in our previous research suggest that there is also an important effect on the earnings informal workers aged between 30 and 49 (around 3.2%). But once again, the conditional mean regressions do not reveal the effect on the distribution of real wages for informal workers. The estimates presented in this paper suggest that there is practically no impact below the fourth decile of the distribution, although there is a strong and positive effect in the rest of the earnings distribution.

Therefore, our model challenges the Welch–Gramlich–Mincer Two Sector Model (Welch, 1974; Mincer, 1976; Gramlich et al., 1976), which in presence of an uncovered sector—in this case the informal—predicts opposite effects in the two sectors. On the formal sector is expected a positive effect on wages and a negative impact on employment. In contrast,

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15.3% of the workforce in Mexico has earnings below the minimum wage (see also Table 4). Figure corresponding to 2013Q2 with data from the National Survey on Employment and Occupation (ENOE).

2Recognizing the likely price consequences of the lighthouse effect of the minimum wage, in January 2016 Mexican Congress passed a reform called ‘de-indexation of the minimum wage’, in which minimum wage is not tied anymore to any other wages, remunerations or prices. See Section 3 for a more detail on the institutional context of wage setting.

on the informal sector the wage effect would be negative (Gramlich et al., 1976), and positive on the level of employment. We found no evidence of negative effects on any percentile of the wage distribution, on any of the labour markets. Besides, Chapter 4 shows that the effect on employment in both sectors is positive. This is explained by the fact that formal and informal labour markets are not independent, they constitute complementary markets where a non-homogeneous labour force chooses and compete for positions.

The econometric model relies on unconditional quantile regressions. This novel and advantageous procedure developed by Firpo et al. (2009), estimated by the re-centered influence function offers the analytical advantage of estimating directly marginal treatment effects at different points of the distribution. In consequence, it also allows to test straightforwardly the existence of spillover effects. Before the development of this technique, previous studies —exploiting differentiated minimum wage settings at the state level in the US— had to use alternative specifications estimating the minimum wage effect on the log-difference of real earnings between percentiles \( w_{p50} - w_{p10} \) (DiNardo et al., 1996; Fortin and Lemieux, 1997; Lee, 1999; Autor et al., 2016). The importance of unconditional quantile regressions for our analysis is precisely that the lack of regional variations in the minimum wage in Mexico did not allow to use as a dependent variable the earnings differential between percentiles.

So, the pooled difference in differences models with data from the National Survey on Employment and Occupation (ENOE), for the period 2012Q1-2013Q4, suggest that the minimum wage harmonization in 2012 had the weakest wage effects on the lowest percentiles of the distribution, while the institutional setting framework led to spillover effects that increased the wage dispersion. The econometric specifications are consistent with those used in Chapter 2. In addition, the results are also robust to different econometric specifications, particularly to the control group used, to the period of analysis, and to the exact specification of the difference in differences variable.

The following section presents the literature review on the distributional effects of the minimum wages. The institutional framework of the minimum wage regulations is discussed in Section 3. The data and some descriptive statistics on wage distribution are displayed in Section 4, as well as the model, including the econometric specifications and the unconditional quantile regressions procedure. The main results, some falsification tests, and the discussion of the estimates are presented in Section 5. The last section concludes the paper.
2 Literature Review

Although the discussion on the implications of minimum wages has focused mainly on the employment effects, there is also much research developed on the distributional impacts of minimum wages arguing the existence of wage spillover effects.

The first paper advocated exclusively to investigate the impact of minimum wages on earnings for nonmininimum wage workers is Grossman (1983). He developed a theoretical model of the wage compression effect of minimum wages, based on the importance of relative wages on the effort supplied by workers, and therefore, on their productivity. According to Grossman, the impact of a minimum wage variation has two different effects on wages for skilled workers.

First, an increase of the minimum wage makes the wage rate paid to workers above the minimum wage (more skilled and with higher productivity levels) relatively cheaper, which increases the demand for this type of labour, and it raises in consequence the skilled labour wage. This effect corresponds to the well-known substitution effect in neoclassical models, which in addition implies an employment decline of unskilled workers. The second effect depends on interpersonal wage comparisons. Labour force legally unaffected by minimum wage legislation can be discontented by the increase observed on wages for the group of workers below them in the wage hierarchy. As a response, the effort supplied diminishes. Thus, in order to keep constant the productivity of skilled workers, firms have incentives to increase their wages. Of course, the magnitude of the effects depends on the elasticities of supply and demand for alternative types of labor, but also on the sensibility of workers to wage comparisons. His empirical results support these theoretical predictions, although workers earning much more than the minimum wage are not affected. Grossman thereby showed that it can be optimal for firms to increase wages beyond the minimum wage boundaries, giving place to redistributive effects of minimum wage policies.

Although the analysis is not focused on the distributional effects of the minimum wage, Katz and Krueger (1992) provided evidence on the existence of spillover effects in low-wage sectors. They collected their own data surveying fast food restaurants in Texas to evaluate the effects of the increases to the US federal minimum wage in April 1990 (raised from $3.35 to $3.80) and April 1991 (raised to $4.25). They found that that those firms paying the minimum wage before the 1991 increase ($3.80) experienced an increase in wages by 12.0%, but firms that initially were paying above the new minimum wage ($4.25) there was also an effect by 4.6%. They argue that these spillover effects can be generated precisely by the importance of the relative wages as Grossman (1983) and Akerlof and Yellen (1986) contended.

The increase in earnings inequality in the United States during the decade of the 80’s attracted the interest of researchers of the field aiming to assess if the loss of the
purchasing power of the federal minimum wage was responsible for the higher wage dispersion. DiNardo et al. (1996) for example, by the novel and influential implementation of Kernel density methods, found that for the period 1979-1988, the reduction of the real value of the minimum wage in the United States was an important factor on the earnings dispersion increase (explaining between 40 and 50 percent of the inequality rise between the 10th and 50th percentile), specially for women and workers in the lower tail of the distribution. In a subsequent paper, Fortin and Lemeux simplified the empirical analyses. They estimated that the minimum wage accounted for 39.3% of the rise of variance in wages (Fortin and Lemieux, 1997).

Similarly, recognizing that the important increase of wage inequality in the United States during the decade of the 80’s coincided with the lack of adjustments to the federal minimum wages, Lee (1999) analysed the impact of the real minimum wage erosion on earnings dispersion. By the use of state variation in the relative level of minimum wages for the period 1979-1991, Lee found that a considerable part of the wage gap between the tenth and fiftieth percentiles was explained by the fall of the real value of minimum wages, although the effect is stronger and more convincing for the female wage distribution (between 70 and 100 percent for women, and around 70 percent for men).

In a reassessment of the significance of the minimum wage on earnings inequality in the United States, Autor et al. (2016) enlarged the analyses by Lee (1999) in two senses. They extended the period of analysis to 2012, and also tested the minimum wage spillover effects for workers earning above the minimum, pointing out that spillovers effects are potentially important, but scarcely understood in minimum wage legislation. They concluded that the significant impacts for higher percentiles estimated in previous literature were upward biased by errors of measurement. Once that the bias is purged by instrumenting effective minimum wage with legislated minimum wage, their results suggest that minimum wage effectively affects the wage dispersion, but only in the lower tail of the distribution: up to the 25th percentile for woman and up to the 10th percentile for men.

For the French labour market, Aeberhardt et al. (2015) evaluated the minimum wage changes between 2003 and 2005 on the earnings distribution. As a consequence of the gradual application of a working time reduction law, several minimum wage levels coexisted, which were forced to converge to a single level generating exogenous variations in the minimum wage level. Using also unconditional quantile regressions, they found that the minimum wage increase had impacts over a large part of the distribution: up to the seventh decile for men and up to the fifth decile for women, but the effect is decreasing with the wage level. In contrast to these previous studies, our estimates suggest not only stronger spillover effects, but also on the top percentiles of the distribution.

With respect to the empirical analyses implemented in Mexico and Latin America, it is necessary to separate them from the developed countries literature, specifically by
The existence of large informal labour markets. Actually, it is necessary to make use of extended theoretical models to characterize the informal sector.

The Welch–Gramlich–Mincer Two Sector Model has been used in the literature of developing countries\(^3\) to characterize a sector outside of the covered sector, in this case formal and informal labour markets. Assuming homogeneous labour and perfect competition, this model predicts that the introduction (or an increase) of the minimum wage reduces the level of employment in the covered sector. A fraction of those workers not hired in the covered sector can find a job in the uncovered sector, but the existence of the uncovered sector only partially offsets the employment loss. The wage in the uncovered sector may rise (Mincer, 1976; Gramlich et al., 1976) or fall (Welch, 1974) depending on the assumptions with respect to the possibility of the workers of choosing between covered or uncovered sectors.

Nevertheless, informal markets in Latin America are more complex than the defined ‘uncovered sector’. It is not only about the non-compliance of the minimum wage regulations, there are other factors not considered in this model, like the differences on the skills distribution and the incentives for working in the informal labour market. Unfortunately, the Welch–Gramlich–Mincer Two Sector Model constitutes so far the only theoretical reference to explain the minimum wage effects given changes to minimum wages.

On this regard, Lemos (2009) by a descriptive analysis showed that there were positive wage spillover effects in both sectors for the Brazilian labour market. She argued that the opposite results to the Welch–Gramlich–Mincer Two Sector Model are explained by the lack of segmented labour markets. Formal and informal sectors could be integrated offering different kind of jobs, which heterogeneous workers can choose from. These results are in line with previous estimates that concluded that minimum wage in Brazil compressed the earnings distribution for both, formal and informal sectors (Carneiro, 2000; Lemos, 2004).\(^4\)

Analysing a group of Latin American countries, including Brazil, Mexico, Colombia, Argentina and Uruguay, Maloney and Mendez (2004) established that minimum wages in the region have a higher effect on wage setting than those found in industrialized countries, as in United States and the United Kingdom. Moreover, minimum wages in the formal sector serve as a reference throughout the economy, including the informal sector, which is not legally bound by it.

\(^3\)See for example, Lemos (2004, 2009) and Mora and Muro (2012).

\(^4\)For a previous period but also for Brazil, Fajnzylber (2001) found evidence of important earnings effects at different levels of income. Although the analysis is not directly on the earnings distribution, he used multiples of minimum wages to evaluate the effect at different points of absolute income. Using data from the Monthly Employment Survey between 1982 and 1997, his estimates suggested that the income elasticity for formal workers earning 0.9 times minimum wage corresponded to 1.43 (1.18 for informal workers). The elasticities decreased monotonically at higher levels of income. For instance, it was 0.39 for formal workers with an income 40 times the level of the minimum wage (0.24 for informal workers). Nevertheless, Lemos (2004) contended that there are important identification problems, and the use of of a high inflation period can explain the magnitude of the spillover effects.
In a evaluation of the minimum wage increase of 1993 Argentina, Khamis (2013) showed that the informal labour market was actually affected by the minimum wage changes and even in a greater proportion than the formal sector. This result reinforced the idea that minimum wage constitutes a reference rate for remunerations even in non-compliant sectors.

During the last two decades, some countries in South America implemented aggressive policies aiming at the recovery of the real value of the minimum wages. Maurizio (2014) analysed the impact on inequality of these kind of policies in Argentina, Brazil, Chile and Uruguay. By a descriptive analysis, their results suggest that except for Chile, raising real minimum wages in the other three countries had as a consequence a decline on inequality. She argued that a likely explanation for the absence of significant effects on Chile is that the minimum wage increase in Chile was not as strong (by around 30%) as in Argentina, Brazil and Uruguay (between 100% and 200%).

Fairris et al. (2008) explored the relation between minimum wages and the wage structure in Mexico for the period of 1988-1992. The analysis suggests that minimum wages had a ‘normative role’ in the whole process of wage setting in Mexico. Thus, minimum wage is used as a reference price, in which remunerations are tied to multiples of minimum wages in both labour markets, formal and informal sector. This is not a spontaneous phenomenon in the Mexican labour market, there are institutional and policy reasons that explain the use of the minimum wage as a reference rate. The following section details that until January 2016 many prices set by the government were tied in terms of multiples or fractions of the nominal minimum wage, for instance, social security fees, income brackets for income tax rates, pensions, fines, and labour bonuses or benefits, among others (Bosch and Manacorda, 2010; Castellanos et al., 2004). In addition, as part of the set of stabilization policies during the 80’s and 90’s, minimum wages had a central role as a price and wage control; Woodruff (1999) showed that the policy agreements among government, unions and employers, with respect to changes in minimum wages at the end of the decade of 80’s, acted as a general guidelines for wage variation, having an important influence on the wage setting for high income workers and even self-employed.

Bosch and Manacorda (2010) demonstrated that real minimum wage reduction in Mexico explained most of the growth of earnings inequality for the period 1989-2001, finding also evidence that minimum wage can affect earnings up to the sixth decile of the earnings distribution, but they failed to find a significant effect on informal workers. However, the main caveat of their analysis is that in absence of a structural change in the minimum wage for that period, they instrumented the called ‘effective minimum wages’ using social security data. Thus, they took the erosion of the real minimum wage as exogenous, which is not necessarily true. Moreover, the database used was restricted to urban areas, impeding to observe a significant segment of the informal labour market.
3 Institutional framework: minimum wages as a reference rate

This section describes the institutional framework in Mexico that gives place to the use of the minimum wage as a reference rate, and in consequence can affect the wage setting for workers with higher remunerations than the minimum wage.

The role of the minimum wage as a reference rate was not spontaneous; specific policies were designed to give minimum wages the function of controlling wages. The decade of the 1980's in Mexico was characterized by macroeconomic crises. The fall in the oil price at the beginnings of that decade, as well as the increase of the government expenditure on bureaucracy led to Mexico’s default in 1982, followed by devaluation and hyperinflation episodes. There was a slow recovery impulsed by fiscal discipline, but in 1987 the annual inflation rate reached the highest level ever recorded: 159.17%. As a response, the government implemented a new set of stabilization policies, among them the Economic Solidarity Pacts and the so called Incomes policies, having as a central objective to stop the increasing inflation, by restraining wages and prices.

The Pact was signed on 15 December 1987 by the government, and representatives of workers, employers, and agricultural producers. The main characteristics of the agreement were deeper fiscal cuts, tighter monetary policy, trade liberalization, and a comprehensive income policy (Lustig, 2000). It was essential to control wage increases as a mechanism to suppress further rises in commodity and service prices as an instrument also to stop increases in government payroll expenses (Fairris et al., 2008). The target of the wage policies was focused directly on minimum wages.

Even though the agreements on wages increases included in the The Pact were applied only to minimum wages, the variations were proposed as a general ‘guide to salary negotiation’ (Woodruff, 1999). For instance, the document of the first renewal of the agreements in February 1988 by the Mexican Presidency explicitly states “The business sector will raise contractual salaries to the same extent that minimum wages are increased” (as cited in Woodruff, 1999).

According to the goals set, the stabilization policies were successful. In December 1988 the annual inflation rate was 51.66% and one year later was 19.70%. These kind of agreements were renewed and maintained until 1995. Even though the key objectives evolved towards strengthening the macroeconomic stability and boosting the economic growth, inflation containment remained as a priority, and in consequence the use of minimum wages as a an instrument of wage setting. In 1995 the annual inflation rate was 7.05%.

Although episodes of hyperinflation had been overcome, the policy on minimum wages

\(^5\)Inflation figures calculated with data from the National Institute of Geography and Statistics (INEGI).
for wage control did not change. In contrast, the use of the minimum wage as a reference rate increased to different spheres, not only wages. This include the setting of social security fees, pensions, scholarships for graduate students, productivity bonuses and retirement benefits for teachers, the eligibility for housing credits, income tax brackets, and even traffic fines.

By the end of 2015, there were 216 legal regulations at the national level that considered the prevailing value of the minimum wage as a reference rate. Under this framework in which minimum wages are used as an index or ‘nummernaire’ to determine other remunerations and other prices, changes to the minimum wage level can have repercussions on workers earning beyond the minimum wage level.

Thus, the referencing of the minimum wage in Mexico came about from a need to impose discipline on wage negotiations at different levels and occupations. So that the role of minimum wages as a reference rate, while it may help to moderate prices may also help to exacerbate difficulties in the implementation of public policies.

This legal framework remained in force until January 2016 when it was reformed. As part of the discussion on the importance of the implementation public policies to recover the value of the real minimum wage level (Gob.Distrito-Federal, 2014), it was recognized that the first stage before increasing the minimum wage value, was to ‘de-index’ it from any other form of retributions, earnings or prices. Thus the National Congress on 27 January 2016 passed the ‘Decree on the de-indexation of the minimum wage’.

Given that the Zone’s B minimum wage increase under evaluation took place in 2012, before the ‘de-indexation reform’, it is expected that its impact on the wage earnings have significant effects on workers above the minimum wage level, as our results demonstrate in Section 5. Definitely, it would be very interesting to investigate the implications of a minimum wage reform after the ‘de-indexation’ reform, but so far there is no source of variation in the minimum wage level that allows the implementation of such evaluation.

4 Data and identification strategy

4.1 The data

As in the previous research for the doctoral dissertation, the data used for the econometric analysis were obtained from the National Survey on Employment and Occupation, which contains quarterly information at the individual level. The National Institute of Geography and Statistics (INEGI) is in charge of collecting and publishing the data, which constitutes the official source on employment and informality. In this regard, one of the main advantages of this database is that it is not limited to the formal labour market; it interviews a representative sample (at the national and the state level) of individuals aged or older than 12, independently of the contractual arrangements between workers
and employers, and the fiscal status of the firms.

We exploit this information to explore the spillover effects of the minimum wage increase not only on workers above the minimum wage level, but also on the ‘uncovered’ informal sector, in which by definition all the minimum wage regulations are not in force.

Aiming at the consistency on the period of analysis among the different models discussed in the dissertation, the period covered for the main estimates corresponds exactly to previous estimates (2012Q1-2013Q4). Although in Section 5.2 some falsification tests are implemented using data for 2011Q1-2012Q4. Given that the estimates are focused on the impact at different points of the earnings distribution, we only consider individuals with positive earnings reported.

The dependent variable is the logarithm of the hourly real wage, although the Appendix A also presents real monthly wage estimates. The set of the sociodemographic control variables included in the regressions are also the same with respect to the specifications to evaluate the average effect on real wages, employment and informality in our previous research.

Nevertheless, there are two important differences with respect to the restriction imposed to the sample. On the one hand, following previous research on wage distribution effects by minimum wage changes, self-employed workers are excluded (Lee, 1999; Autor et al., 2016), independently of their formality condition. On the other hand, in line with the procedure by Autor et al. (2016), in order to reduce the influence of the outliers, the data winsorizes the extreme 0.2 percentiles of the wage distribution by assigning the 0.02 and 99.8 percentile value to the respective quantiles. These modifications do not alter significantly the estimates obtained, nor the conclusions of the analysis.

4.2 Descriptive statistics on real earnings and wage dispersion

In this subsection we analyse graphically the trend followed by mean earnings, its dispersion, as well as the evolution by some selected wage percentiles. The objective is to provide a general description of the earnings distribution in the Mexican labour market before presenting the model to evaluate the minimum wage effects at different quantiles of the distribution.

Following the argument in Section 3, if minimum wage has the role of a reference rate or ‘numméraire’, it should be an important determinant of the whole wage setting process in the Mexican labour market. Figure 1 presents the path followed by the minimum wage and average retributions in nominal terms. The solid blue line corresponds to the average minimum wage weighted by the active labour market population by zone, while the dotted lines show the mean earnings by formality condition. We graph nominal earnings instead of do it in real terms to capture more closely the wage setting dynamics. The reference

\footnote{Real wages are calculated using the National Price Index, also obtained from INEGI.}
period for the index number is 2010Q4, which corresponds to the base period for the construction of the National Price Index.

Figure 1
Nominal minimum wage and mean earnings* by formality condition
(Index 2010Q4=100 , 2005Q1-2014Q4)

*Population figures using expansion factors in ENOE.
Note: Nominal minimum wage is an average weighting by the active labour market population by zone.

Although nominal minimum wage exhibits a higher growth rate, the annual increases to the minimum wage (at the beginning of every year) are usually accompanied by similar raises in the average level of earnings. The graph illustrates that there is a common variation between average retributions and minimum wage, and more importantly, not only in the formal labour market. Indeed, the correlation index of the mean earnings in the formal and informal sectors, with respect to the minimum wage level are 0.94 and 0.96, respectively.

It is also interesting the fact that there is some kind of convergence in the variation—although not in absolute wage levels—between average earnings in the formal and informal sectors.

If we look at the relationship between wage dispersion and real minimum wage, panel (a) of Figure 2 shows that from 2005 to 2014, the variance of the log-hourly earnings has decreased by 0.15 log points. In contrast, the real hourly minimum wage (considering an 8-hour workday) has remained unchanged for the same period. This totally makes sense, the annual increases to the nominal minimum wage aim precisely at adjusting the lost by inflation in the previous year, so the purpose is to keep constant its purchasing power. So, the observed decline in the earnings dispersion does not seem to be related to the minimum wage policy.
Panel (b) of Figure 2 analyses by separately the wage dispersion for the formal and informal labour markets. As expected, the log-hourly variance for informal workers is higher (by around 0.1 log points), but it is interesting that both labour markets respond in a similar way to exogenous shocks.

Thus, figures 1 and 2 suggest that there is a close relationship between minimum wages and wage setting in the formal and informal labour market, but minimum wage is not responsible for the reduction in the wage dispersion between 2005 and 2014.

**Figure 2**
Wage dispersion and real minimum wage
(2005Q1-2014Q4)

In order to analyse in depth the earnings distribution for the same period, panel (a) of Figure 3 describes the evolution of the mean earnings quantiles for some selected percentiles. Following a similar analysis in Engbom and Moser (2017), real log-hourly wage percentiles are normalised to zero in the initial period, which in our case corresponds to 2005Q1. From 2005 to 2008 there is a generalized increase in real wages, but after the financial crises in 2008 there is a negative trend for which only the 10th percentile was able to recover. The 25th percentile exhibits practically the same level in 2014Q4 to that observed 2005Q1, but the rest of the percentiles had an important decrease, including the median of the distribution.

With the objective of having an additional measure of wage dispersion, but at different points of the distribution, panel (b) of Figure 3 depicts percentile ratios also normalised to zero in 2005Q1. In all cases the wage gap within percentiles decreased, but there was a more important decline for the ratio q50/q10. In absolute terms, it decreased by 0.1 log points, while for the interquartile range (q75/q25) the decline observed was by 0.05 log points, and 0.02 points for the ratio q90/q50.
Finally, with respect to the earnings distribution for our specific period of analysis, Figure 4 plots the kernel density estimates of the real log-hourly wages for treated Zone B. The figure shows the earnings distribution by formality condition.

**Figure 4**
Wage distribution density estimates by formality condition, Zone B
(pooled sample, 2012-2013)

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Epanechnikov kernel using the optimal cross validation bandwidth computed by the following calculation: 

\[
h = 0.9 \min(\sigma, IQR/1.349)n^{-1/5}.
\]

Where \(\sigma\) is the standard deviation of the log hourly real wages and \(IQR\) denotes the interquartile range. Self-employed workers are not included in the analysis, and the data winsorizes the extreme 0.2 percentiles of the wage distribution by assigning the 0.02 and 99.8 percentile value to the respective quantiles.
The dotted vertical line expresses the minimum wage considering a workday of 8 hours. So, the first issue to emphasize is that in the Mexican labour market there are actually workers with earnings below the minimum wage, in both formal and informal labour markets. Secondly, as expected we can observe that the level of remunerations for the informal labour market is lower with respect to the formal counterpart.

4.3 The model. Difference in differences specification

To estimate the effect of an increase in minimum wage zone B on real hourly earnings \( \ln(w_i) \) at different percentiles of the distribution, we follow the structure of the econometric specifications used to evaluate the conditional mean effect in Chapter 2. Thus, we use two difference in differences equations, which change depending on the zone used as a control group. In equation (1a) the control group is conformed for the untreated zones A and C. While in equation (1b) only Zone C is part of the control group; to avoid losing all the observations from Zone A, the dummy variable \( ZoneA \) is included as a regressor.

\[
\begin{align*}
\ln(w_i) &= \beta_{0,q} + \delta_{1,q} ZoneB_i \ast Period2_i + \delta_{2,q} Period2_i + \delta_{3,q} Trend + \delta_{4,q} EmpRate \\
&+ \beta_{1,q} ZoneB_i + \sum_{k=2}^{k} \beta_{k,q} X_{ki} + \epsilon_{i,q}
\end{align*}
\]  

(1a)

\[
\begin{align*}
\ln(w_i) &= \beta_{0,q} + \delta_{1,q} ZoneB_i \ast Period2_i + \delta_{2,q} Period2_i + \delta_{3,q} Trend + \delta_{4,q} EmpRate \\
&+ \delta_{5,q} ZoneA_i \ast Period2_i + \beta_{1,q} ZoneB_i + \beta_{2,q} ZoneA_i + \sum_{k=3}^{k} \beta_{k,q} X_{ki} + \epsilon_{i,q}
\end{align*}
\]  

(1b)

Where \( \delta_{1,q} \) is our parameter of interest. It expresses the marginal effect of the minimum wage increase in Zone B on the real hourly wage for the percentile \( q \). \( Period2 \) is a dummy variable for identifying the post-treatment period to capture the ‘shift effect’ of the intervention. \( ZoneB \) and \( ZoneA \) are also dichotomous variables to differentiate from wages zones. By the inclusion of the interaction \( ZoneA_i \ast Period2_i \) in equation (1b), the purpose is not to estimate the effect on Zone A; it is only included for completeness given that \( ZoneA \) is added as an independent variable in the model.

The specifications also include a quarterly common linear trend in order to capture the macroeconomic factors not considered in the model at the individual level. To control for the labour market conditions at the state level, state employment rate is also added in the equations (constructed as the percentage of employed workers over the active population by state). Finally, \( X_{ki} \) is a vector of sociodemographic variables, including age, squared age, gender, schooling level, an indicator variable of rural municipalities, and interactions of schooling level with rurality and gender.
For the quantile regression analysis is not necessary to implement sample section bias correction. The purpose itself of this section is to estimate the effect on the earnings distribution, so there is no reason to consider into the analysis inactive labour market population, which by definition does not have labour activities and therefore does not perceive earnings.

### 4.4 Unconditional quantile regression

Conditional quantile regression (CQR), developed by Koenker and Bassett (1978) became a useful empirical tool to characterize the full distribution of a certain outcome conditioned on a set of covariates. Nevertheless, the interpretation of the estimated parameters in a evaluation program setting is complicated; the coefficients do not translate to the relevant policy questions that are linked to the covariates, they do not summarize the causal effect of a treatment (Borah and Basu, 2013; Frolich et al., 2010). This subsection describes the method recently proposed by Firpo et al. (2009), which allows to evaluate how a marginal change in one variable — in this case, the minimum wage variation in Zone B — affects the entire wage distribution, keeping the distribution of the rest of covariates constant.

Formally, the aim is to estimate the effect of the minimum wage rise, denoted as mw, on the \( \tau \)th quantile of the earnings unconditional distribution, \( F_Y(y) \). In the OLS regression framework, the parameter \( \delta \) is interpreted as the impact on the conditional mean:

\[
\delta = \frac{d\mu(mw)}{dmw} = E(Y|mw = 1) - E(Y|mw = 0).
\]

In contrast, the coefficient \( \delta_{CQR}^\tau \) from conditional quantile regression analysis is generally different from the partial effect:

\[
\delta_{CQR}^\tau = F_Y^{-1}(\tau|D = 1) - F_Y^{-1}(\tau|D = 0) \neq dq_{\tau}(mw)/dmw.
\]

The coefficients of a covariate on a specific quantile outcome are the same by conditional or unconditional quantile regressions only in the following cases: if there are no other covariates influencing the data generating process, or if the effect is constant across levels of other covariates (Borah and Basu, 2013).

The reason of the inequality is simple, conditional and unconditional distributions are not necessarily the same. Following an example in Borah and Basu (2013), the set of workers at the 5\(^{th}\) percentile of the unconditional earnings distribution of \( Y \) may not be the same as the workers at the 5\(^{th}\) percentile of the conditional distribution of \( Y|mw \).

Under this context, Firpo et al. (2009) developed a procedure to obtain directly the marginal effects in quantile regression. They showed that the unconditional quantile partial effect can be obtained by running an OLS regression of the recentered influence function (RIF) of the unconditional quantile on the explanatory variables.

The influence function, \( IF(Y; v; F_Y) \), of a distributional statistic \( v(F_Y) \) represents the

---

\( mw = 1 \) denotes treatment, that is, it identifies those workers performing labour activities in some municipality of Zone B after 26 November 2012; \( mw = 0 \) indicates absence of treatment.
influence of a single observation on that distributional statistic, for instance, variance, quantiles, or the Gini coefficient. For the $\tau$th quantile, the influence function corresponds to: $\text{IF}(Y; q_\tau; F_Y) = \tau - 1\{Y \leq q_\tau\}/f_Y(q_\tau)$. While the recentered influence function is obtained just adding back the statistic $v(F_Y)$ to the influence function, in this case the $\tau$th quantile: $\text{RIF}(Y; q_\tau; F_Y) = q_\tau + \text{IF}(Y; q_\tau; F_Y)$.

Firpo, Fortin and Lemieux demonstrated that the average derivative of the conditional expectation of the RIF, $E[\text{RIF}(Y; q_\tau; F_Y)|X] = m_\tau(X)$, corresponds to the marginal effect on the unconditional quantile of a small location shift in the distribution of covariates, holding everything else constant. Therefore, the RIF regression model can be viewed as an unconditional quantile regression.

Hence, to implement the unconditional quantile regression the first step is to estimate the dependent variable $\text{RIF}(Y; q_\tau; F_Y) = q_\tau + \tau - 1\{Y \leq q_\tau\}/f_Y(q_\tau)$. So, it is necessary to compute each of its components: the sample quantile $q_\tau$, a dummy variable $1\{Y \leq q_\tau\}$ indicating whether the outcome variable is below $q_\tau$, and the density $f_Y(q_\tau)$ at the point $q_\tau$ by Kernel procedures, or other non-parametric methods. Finally, this new dependent variable is regressed on the set of covariates.

The following section presents the estimates of the impact of the minimum wage increase on the unconditional earnings distribution.

5 Results. The impact on earnings distribution

This section describes the estimates of the implementation of the innovative method developed by Firpo et al. (2009), which by the use of the recentered influence function estimates directly the marginal treatment effects (or the unconditional quantile regression) on the quantiles of the distribution. The objective is to evaluate if the Zone B minimum wage intervention is actually affecting positively earnings on the lowest segment of the earnings distribution, but also to test if as a consequence of the institutional framework of wage setting in Mexico, there are minimum wage spillover effects.

The first subsection presents our core results for equations (1a) and (1b), analysing by separately the effect on formal and informal workers. In order to check the robustness of the model, as well as the validity of the use of the intervention as a natural experiment, some falsification tests are implemented in Subsection 5.2, using a different period of time (2011Q1-2012Q4) in which there were no changes to the real minimum wage. The last subsection discusses the main policy implications of our results, emphasizing on the inequality effects.

---

9Firpo et al. (2007) implement variance and quantiles regressions, among others, to generalise the Oaxaca-Blinder decomposition.
5.1 Main results

Throughout this subsection and the following one, for both equations (1a) and (1b) we present graphically the unconditional partial effects of the parameter of interest, $\delta_{1,q}$, as well as its 95% confidence interval from the 10th to the 90th percentile of the real hourly wage distribution. Moreover, Table 1 presents the estimated parameters of interest, as well as their associated standard errors across different percentiles. In all cases, standard errors were obtained by bootstrap methods.

Figure 5 shows the RIF regression coefficients for the pooled sample including formal and informal waged workers. The first aspect to highlight is the fact that the intervention has a positive, although weak effect on the lowest deciles of the distribution. For percentiles 10th, 11th, 14th, 15th, and 16th the effect is not statistically significant, at least at the 5% level. For the rest of the percentiles below the 20th percentile, the effect on earnings is significant with a magnitude of around 1%. Even though the impact is small, there exists evidence of significant and positive effects at the bottom of the distribution, which implies that a 2.9% nominal rise in the minimum wage for Zone B is enough to increase real wages by 1% for the labour force at the bottom of the distribution, which means an elasticity ($\epsilon$) of around 0.34.

Figure 5
Unconditional quantile regressions on earnings distribution.
Pooled sample, formal and informal workers

(a) Equation (1a)  (b) Equation (1b)

Notes: Self employed workers and observations with non-reported wages are excluded from the analysis. The set of covariates included are state employment rate, gender, age, squared age, schooling level, rural, and interactions of schooling level with rural and gender. Standard errors are obtained by bootstrapping, 100 repetitions.

Secondly, it worths to emphasize that the positive effect of the intervention is present among all the wage distribution. In other words, it implies that minimum wage changes have the capacity to affect the wage setting on the whole labour market, not only for the lowest waged workers. The shortcoming of this policy intervention is that the effect is stronger for the upper percentiles of the distribution. For the median of the distribution, the impact is 3.4% ($\epsilon \approx 1.13$), while for the top quartile the effect reaches the highest
level, increasing real hourly wages by around 5.6% — see Table 1, Panel (a). Its implied elasticity is 1.93, which means that for every 1% minimum wage increase, real wages for the 75th percentile increased by 1.93%. Almost twice the minimum wage change.

Moreover, considering that wages for workers at the top of the earnings distribution is by definition higher, the absolute increase on wages for the wealthiest workers is many times greater than the impact on workers at the bottom of the distribution. Clearly, as a consequence of the minimum wage increase in Zone B, the wage dispersion increased.

So, even though the intervention fulfills the primary goal of any minimum wage legislation, which is to improve the wage conditions for the lowest waged workers, it is not possible to consider it as a successful policy in terms of inequality, which definitely is not a minor problem in Mexico.\textsuperscript{10} Section 5.3 discusses in a more detail the policy implications of the intervention.

Table A.1 in Appendix reports the unconditional quantile regression parameters for the effect on the distribution of monthly wages. The conclusions are not different: weak effects at the bottom of the distribution, and evidence of a higher impact on the top deciles of the distribution.

In order to investigate the difference of the impact between formal and informal labour markets, our subsequent analyses separate the sample by the formality condition of the workers.

For the formal workers earnings distribution, Figure 6 (and Panel (b) of Table 1) shows that the impact along the distribution is basically the same with respect to the pooled sample: there is evidence of a positive impact on the workers with the lowest level of earnings, but minimum wage effects are stronger at the top of the distribution.

The size of the coefficients becomes higher as we move to the right of the distribution; the impact on the 50th distribution is around 3.2% ($\epsilon \approx 1.09$), and the strongest effect is observed at the 90th percentile with an estimated impact greater than 5% ($\epsilon \approx 1.87$). This corroborates that the wage dispersion in the formal labour market is increasing by the minimum wage intervention.

The impact for the lowest percentiles of the distribution are slightly higher with respect to the pooled sample: for the bottom decile the estimated effect is 1.3% ($\epsilon \approx 0.45$), while for the 25th percentile is around 1.6% ($\epsilon \approx 0.58$). It is worth highlighting that these estimates confirm that minimum wages are truly in force in the formal labour market. A common argument against minimum wage increases in Mexico, is that the policy target group performs the labour activities out of the formal labour market, and minimum wages are not enforced in the informal sector, so that minimum wage policies cannot affect the lowest income workers. Our results demonstrate that there is a positive, although small, impact on the lowest quantiles of the distribution.

\textsuperscript{10}See Esquivel (2015), Campos-Vázquez et al. (2014), and Esquivel (2011) for recent studies on inequality in Mexico.
Table 1
The impact on the hourly earnings distribution. Full age threshold: 12 ≤ Age ≤ 97

<table>
<thead>
<tr>
<th>Dependent variable:</th>
<th>Pooled OLS</th>
<th>q10</th>
<th>(\ln(\text{hourly wage}))</th>
<th>q25</th>
<th>q50</th>
<th>q75</th>
<th>q90</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Pooled sample, formal and informal workers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equation (1a) ZoneB*Period2</td>
<td>0.0305*** (0.00439)</td>
<td>0.0070 (0.00443)</td>
<td>0.0135*** (0.00417)</td>
<td>0.0339*** (0.00573)</td>
<td>0.0562*** (0.00844)</td>
<td>0.0459*** (0.01200)</td>
<td></td>
</tr>
<tr>
<td>Equation (1b) ZoneB*Period2</td>
<td>0.0277*** (0.00443)</td>
<td>0.0062 (0.00451)</td>
<td>0.0121*** (0.00423)</td>
<td>0.0317*** (0.00577)</td>
<td>0.0521*** (0.00849)</td>
<td>0.0412*** (0.01207)</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>767,006</td>
<td>767,006</td>
<td>767,006</td>
<td>767,006</td>
<td>767,006</td>
<td>767,006</td>
<td></td>
</tr>
<tr>
<td>(b) Formal workers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equation (1a) ZoneB*Period2</td>
<td>0.0291*** (0.00543)</td>
<td>0.0128** (0.00643)</td>
<td>0.0184*** (0.00564)</td>
<td>0.0346*** (0.00758)</td>
<td>0.0338*** (0.00955)</td>
<td>0.0566*** (0.01272)</td>
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</tr>
<tr>
<td>Equation (1b) ZoneB*Period2</td>
<td>0.0251*** (0.00550)</td>
<td>0.0132** (0.00655)</td>
<td>0.0154*** (0.00571)</td>
<td>0.0289*** (0.00765)</td>
<td>0.0297*** (0.00965)</td>
<td>0.0516*** (0.01285)</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>405,217</td>
<td>405,217</td>
<td>405,217</td>
<td>405,217</td>
<td>405,217</td>
<td>405,217</td>
<td></td>
</tr>
<tr>
<td>(c) Informal workers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equation (1a) ZoneB*Period2</td>
<td>0.0268*** (0.00728)</td>
<td>0.0292*** (0.00781)</td>
<td>0.0043 (0.00781)</td>
<td>0.0150** (0.00694)</td>
<td>0.0341*** (0.01155)</td>
<td>0.0413** (0.01842)</td>
<td></td>
</tr>
<tr>
<td>Equation (1b) ZoneB*Period2</td>
<td>0.0256*** (0.00731)</td>
<td>0.0294*** (0.00789)</td>
<td>0.0032 (0.00788)</td>
<td>0.0141** (0.00698)</td>
<td>0.0339*** (0.01159)</td>
<td>0.0386** (0.01846)</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>361,789</td>
<td>361,789</td>
<td>361,789</td>
<td>361,789</td>
<td>361,789</td>
<td>361,789</td>
<td></td>
</tr>
</tbody>
</table>

Note: the covariates included are state employment rate, gender, age, squared age, schooling level, rural, and interactions of schooling level with rural and gender. Observations with non-reported wages are excluded from the analysis. Bootstrapped standard errors in parentheses, 100 repetitions. Statistical significance: *** p<0.01, ** p<0.05, * p<0.1.
Notes: Self employed workers and observations with non-reported wages are excluded from the analysis. The set of covariates included are state employment rate, gender, age, squared age, schooling level, rural, and interactions of schooling level with rural and gender. Standard errors are obtained by bootstrapping, 100 repetitions.

The magnitude of the estimated impacts reveals the relevance of the institutional wage setting. The fact that the intervention took place before the ‘de-indexation reform’ of 2016 can explain the size of the effect beyond the 20th percentile, in which minimum wages were an important determinant of wage setting in the whole labour market, not only for the lowest earnings sector.

Unfortunately, it is not possible to construct a counterfactual to estimate the distributional effects of the minimum wage reform in presence of the ‘de-indexation reform’ to distinguish between the ‘pure’ minimum wage effect on the lowest deciles, and the spillover effects at the top of the distribution.

Nonetheless, our results corroborate the findings in previous literature in two ways. They confirm that minimum wage affects several occupational wages, not only the lower end of the distribution (Grossman, 1983; Lee, 1999; Aeberhardt et al., 2015; Autor et al., 2016). And also that minimum wage in Mexico has a role of a reference rate for wage and price setting (Fairris et al., 2008; Bosch and Manacorda, 2010; Castellanos et al., 2004; Kaplan and Pérez-Arce, 2006).

Yet, it is important to emphasize that even though previous literature recognizes the existence of the lighthouse effect, there is no prior evidence of minimum wage effects on the top percentiles of the earnings distribution. But, neither there is previous international experience on indexing prices and remunerations to the value of the minimum wage.

With respect to the distribution of earnings in the informal labour market, the pattern of the effect is different. Figure 7 shows that there are only some isolated significant effects below the 50th percentile, but the RIF regression shows that the intervention increased real wages on the informal sector for workers with earnings above the median, even by stronger proportions than in the formal sector. The impact, for example, for percentile...
86 is around 7%, which implies an elasticity of 2.4.

It is not strange that our model does not find a significant impact at the bottom of the informal labour market distribution. The informal labour activities performed on that segment of the labour market are related to household activities and small family business. So, there is no a formal labour market for these informal jobs. That is, the lack of statistically significant effects for the lowest percentiles of the distribution is explained by the absence of a reference rate of remunerations in that segment of the formal market.

In contrast, for higher levels of remuneration, heterogeneous workers—in terms of skills and qualifications—choose between formal and informal markets. On this issue, Maloney and Mendez (2004) state that although minimum wage is not enforced by law in this sector, it appears to operate as a benchmark for ‘fair’ remuneration.\footnote{\textsuperscript{11}} There is a pressure from informal workers to obtain the same increases observed in the formal labour market. Therefore, the incentives on the highest quantiles are different; the results can confirm the hypotheses that an increase of wages in the formal labour market affect the opportunity cost for high waged informal workers of remaining employed under informal conditions. In response, informal employers increase wages for these workers to retain them.

Our results also corroborate previous findings by Khamis (2013), who argues that minimum wages may have stronger wage effects on the informal labour market. The mechanism behind this phenomena could be an compensation for the lack of formal benefits. That is, increases to the minimum wage would also generate (under formality conditions) an increase of the labour costs for the employers, as higher social security contributions. Given that informal employers are not paying for these extra costs, they may tend to compensate directly the monetary remunerations of their workers.

In all cases, there are no significant differences between the estimates generated by equations (1a) and (1b). This implies that the use of Zone A and Zone C, or only Zone C as a control group does not affect the conclusions reached. It also confirms the validity to the difference and differences procedures.

Thus, the unconditional quantile regression analysis proves that the minimum wage rise actually improved real wages for the targeted workers, even if the increase is only 2.9\% in nominal terms. Simultaneously, it corroborates the presence of the lighthouse effect of minimum wages in Mexico at the moment of the intervention, suggesting that the institutional setting of the minimum wage as a reference price can have negative repercussions on the labour market, specifically on the increase of earnings dispersion.

\footnote{Other studies argue that informal employers may comply the minimum wage regulations even though they do not comply other formal labour market arrangements as social security contributions (Marshall, 2004; Kristensen and Cunningham, 2006).}
Figure 7
Unconditional quantile regressions on informal workers earnings distribution

(a) Equation (1a)
(b) Equation (1b)

Notes: Self employed workers and observations with non-reported wages are excluded from the analysis. The set of covariates included are state employment rate, gender, age, squared age, schooling level, rural, and interactions of schooling level with rural and gender. Standard errors are obtained by bootstrapping, 100 repetitions.

5.2 Falsification Tests

In this section we report tests on whether the Zone B minimum wage increase on 2012 was a valid natural experiment in identifying the effects of minimum wages on the earnings distribution. By the use of a simulated intervention, the central objective is to validate the difference in differences specifications, as well as the control groups used. In addition, this exercise provides some clarification regarding the estimated spillover effects for the percentiles at the upper end of the wage distribution.

Given that minimum wages policies are by definition focused on improving earnings for workers at the lower end of the wage distribution, a valid concern with respect to the estimates presented in the previous section is the magnitude of the difference in differences parameters for the upper end of the wage distribution. The world is moving towards a less equal earnings distribution and this has been widely discussed. Earnings inequality has increased during the last three decades (OECD, 2015; Dabla-Norris et al., 2015). So, the possibility exists that macroeconomic factors, not included in the model, are actually driving the increase in wages for the top earners, and not necessarily the 2012 minimum wage intervention.

If this is the case, we would observe positive and significant effects even in absence of the intervention. We use a specification similar to Autor (2003), in which a placebo treatment is introduced in the difference in differences model. To do so, we restrict the sample to 2011 and 2012, and a treatment is artificially defined for Zone B, but for the period 2012Q1-2012Q4. All the individuals interviewed after the actual intervention on 26 November 2012 are excluded from the sample, for both, control and treatment groups. We use exactly the same specifications described by equation (1) to estimate the marginal
treatment effects (by the re-centered influence function) on the percentiles from the 10\textsuperscript{th} to the 90\textsuperscript{th} centile of the real hourly wage distribution.

**Figure 8**
Falsification Test

(a) Pooled sample, formal and informal workers

(b) Formal workers

(c) Informal workers

Notes: Self employed workers and observations with non-reported wages are excluded from the analysis. The set of covariates included are state employment rate, gender, age, squared age, schooling level, rural, and interactions of schooling level with rural and gender. Standard errors are obtained by bootstrapping, 100 repetitions.
Figure 8 shows the unconditional quantile regressions for the falsification test. Following the structure of our main results, we replicate the model for the pooled sample, for formal workers, and finally for informal workers. These results are reported in panels (a), (b) and (c), respectively. The results are compelling. In all cases, the ‘false’ difference in difference parameters are not statistically different from zero.

It is reassuring that there were no significant effects when there was no actual intervention and this corroborates the finding that the Zone B minimum wage intervention of 2012 can be effectively used as a natural experiment to evaluate the impact on the real earnings distribution. With respect to the model, it also confirms that the implementation of difference in differences models allows us to identify correctly the treatment effect.

Moreover, there is no evidence of differentiated parameters throughout the earnings distribution. This implies that the estimated effects for those workers at the top of the distribution are purely a consequence of the minimum wage change of 2012. Even though the magnitude of the impact is considerable, even higher than 5%, we argue that it is a result of the ‘reference’ role of the minimum wage in the Mexican labour market.

Therefore, the analysis in this subsection also allows to conclude that the parameters for the top earning centiles do not constitute spurious effects.

5.3 Policy implications

It is important to emphasize that the purpose of Zone’s B 2012 minimum wage increase was not to reduce poverty or inequality. As described in Chapter 1, the minimum wage intervention was implemented as an administrative change, aiming to adjust the level of remunerations in two out of three zones according to their convergence in terms of economic development. Furthermore, the magnitude of the increase seems insufficient for a public policy oriented at combating poverty. For this reason, the purpose of our analysis is not to evaluate the impact on poverty or inequality measures.

Nevertheless, the use of the intervention as a natural experiment provides fundamental information on how the Mexican labour market responds to minimum wage changes. The evaluation of the wage effects on the poorest workers, as well as the recognition of spillover effects on jobs with levels of remuneration already above the minimum wage, represent a guideline for further reforms with the explicit objective of increasing the living standards of the lowest income workers.

The estimates presented in this paper demonstrate that the 2012 minimum wage rise increased real wages on the whole earnings distribution. For the lowest percentiles of the distribution, the impact is only present for formal workers, but the minimum wage reform is still accomplishing its central objective: to increase real remunerations for those workers with the lowest level of earnings in the formal, covered sector. The shortcoming
of the policy intervention is that the increase on real earnings is stronger on the segment of the workforce with the highest level of remunerations.

We can implement a simple exercise to illustrate the likely inequality implications of the lighthouse effect: if we apply the estimated coefficients to every log-earning percentile mean, the interquartile range would have increased by 0.014 log points. This means that the wage differential between percentiles 75th and 25th increased by around 1.4% as a consequence of the intervention.\footnote{Exercise restricted to the earnings distribution of the treated Zone B for 2012Q3, just before the policy change.}

Even though the purpose of the intervention was not to compress the earnings distribution, the increase in the wage dispersion constitutes an undesirable effect. This is because incomes inequality in Mexico is already an important economic and social problem. Campos Vázquez et al. (2014) estimate for 2012 that the richest 1% of the population in Mexico earns 21% of the total income. In contrast, the mean earnings for the top 1% for a sample of 23 countries is around 10%.\footnote{Campos Vázquez et al. (2014) use information from the Top World Income Database for the rest of the countries, and for Mexico the National Income and Expenditure Survey, as well as National Accounts data.} According to Esquivel (2015), while GDP per capita increased on average at a rate just above 1% per year between 1996 and 2014, for the same period, the wealth of Mexicans with a fortune higher than one billion US dollars grew on average 23.5% per year.\footnote{Esquivel (2015) compiled the information from Forbes Magazine to construct the mentioned figures.} The main argument by Esquivel is that income concentration has not only negative consequences on inter-generational poverty, it also weakens the domestic market, thus affecting productivity and economic growth.

Then, if the purpose of the minimum wage increase was only to raise real wages for the poorest sector of the labour market, the 2012 intervention could be considered successful. But if reducing inequality is part of the objectives of the policy makers, the message from our research is clear, given the conditions of the Mexican labour market in 2012, the policy change benefited the richest to a greater extent, thus increasing the wage dispersion.

We cannot forget that the legal context of the labour market has also changed. The 2016 ‘de-indexation’ reform was not a coincidence. Indeed, it was a result of the recognition of the likely consequences of the use of the minimum wage as a reference rate. It represents the first step towards a stronger minimum wage reform. So far, it is not possible to determine if the ‘de-indexation’ reform was enough to avoid the spillover effects on workers earning above the minimum wage. It is still likely that other factors, such as changes in productivity generated by interpersonal wage comparisons, are still affecting the setting of wages.
6 Conclusions

The implementation of unconditional quantile regressions in this paper shows that Zone B minimum wage increase had a positive impact on the lowest deciles of the real earnings distribution. It suggests that the minimum wage regulations are actually binding, specifically on the formal labour market, and, moreover, that increases to the minimum wage have a positive effect on the poorest workers.

Exploring the impact on workers with earnings above the minimum wage, we find strong statistical evidence of important spillover effects on the whole distribution of earnings. Nevertheless, the effect exhibits the lowest magnitudes precisely at the bottom percentiles of the distribution. Therefore, the policy intervention can be considered successful in terms of increasing real earnings for workers with the lowest level of wages, but not in terms of the distributional effects.

Independently of whether the workers are formally or informally employed, the model suggests that real wages increased by a higher proportion at the top percentiles. This implies that the 2012 minimum wage intervention increased the dispersion of wages. Previous empirical studies have recognized the existence of the minimum wage lighthouse effect, but not in the magnitude that we are estimating on the wealthiest workers of the labour force.

Previous literature has argued that the institutional wage setting in Mexico, specifically the role of the minimum wage as a reference rate, could be responsible for this lighthouse effect. Even though this institutional setting has been legally modified by the ‘de-indexation’ reform of 2016, so far we do not have enough elements to evaluate if the spillover effects are entirely generated by the ‘nummernaire’ role of minimum wages. So, it is essential to consider the likely distributional repercussions in the implementation of future labour market policies.

New legislation, with stronger changes on the minimum wage is expected to occur in 2017. This would represent a suitable source of variation to test the minimum wage effects on the labour market once the ‘de-indexation reform’ has been implemented. Moreover it would also represent an opportunity to test for the robustness of the estimates presented in this paper, but in presence of deeper variations in the minimum wage level.
References


Maurizio, R. (2014). El impacto distributivo del salario mínimo en la Argentina, el Brasil, Chile y el Uruguay.


Appendix A  The impact on real monthly wages and its distribution

Table A.1
The impact on the monthly earnings distribution. Full age threshold: 12 ≤ Age ≤ 97

<table>
<thead>
<tr>
<th>Dependent variable:</th>
<th>Pooled OLS</th>
<th>q10</th>
<th>q25</th>
<th>q50</th>
<th>q75</th>
<th>q90</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Pooled sample, formal and informal workers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equation (1a)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ZoneB*Period2</td>
<td>0.0305***</td>
<td>0.0070</td>
<td>0.0135***</td>
<td>0.0339***</td>
<td>0.0562***</td>
<td>0.0459***</td>
</tr>
<tr>
<td></td>
<td>(0.00439)</td>
<td>(0.00443)</td>
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<td>ZoneB*Period2</td>
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Note: the covariates included are state employment rate, gender, age, squared age, schooling level, rural, and interactions of schooling level with rural and gender. Observations with non-reported wages are excluded from the analysis. Bootstrapped standard errors in parentheses, 100 repetitions. Statistical significance: *** p<0.01, ** p<0.05, * p<0.1.
Appendix B  The effect on the earnings distribution by gender

As Fortin and Lemieux (1997) contended, institutions can affect men and women in a different way, and the minimum wage regulations should not be an exception. As a consequence, previous studies on the distributional effects of minimum wages have analysed by separately the effect on female and male workers (Lee, 1999; Aeberhardt et al., 2015; Autor et al., 2016).

Figure B.1 presents the UQR coefficients using the same specification as in Subsection 5.1, but restricting the sample to female workers. Of course the indicator variable female, as well as its interactions with schooling level and rural municipalities are omitted in the regressions. In contrast to the pooled sample regression (Figure 5), Panel (a) shows that there is no effect at the bottom half of the distribution. This means that the poorest female workers, are not affected by the 2012 minimum wage increase. Furthermore, there is a clear pattern on the estimates. After percentile 58th there is a drastic increase on the estimated effects reaching proportions around 5%.

The graphs shows two different labour markets. At the bottom of the distribution, minimum wage has no interference on the woman wage setting, but in contrast, there is a segment responding importantly to minimum wage changes. This suggests, as in the case of informal workers, that there can be specific labour activities by female workforce in which the minimum wage is not in force.

Exploring the impact by formality condition, we can observe that for female formal workers, Panel (b), the pattern is similar, but not as drastic as in the pooled sample. There are some significant parameters below the 20th percentile, but in general we cannot talk about significant effects on the bottom half of the earnings distribution. Beyond that point, the effect become stronger, but in a lesser extent, fluctuating around 4%. But, for informal female workers, Panel (c) clearly shows that the 2012 minimum wage intervention had no effect on earnings, which implies that the significant effects on informal workers presented in Figure 7 are driven by the effect on male workers.

Figure B.2 shows the effect on male workers. The impact throughout the earnings distribution is similar to the results shown for the full sample in Figure 5. The intervention affected real earnings on the whole wage distribution. For the percentiles below the 20th the impact is around 1.4%, and it increases as we move to the right of the distribution, although in a smoother way. It reaches its maximum around the median (4.6%).

The effect on male formal workers exhibits a similar trend although with smaller parameters. The impact is around 2% around throughout the distribution, but in general it is statistically different from zero. Finally, for informal male workforce, the 2012 minimum wage increase affects wage setting from the percentile 25th, and by an important magnitude reaching an effect of 8% for the percentile 85th.
Figure B.1
The distributional effect on female workers

(a) Pooled sample, formal and informal workers

Notes: Self employed workers and observations with non-reported wages are excluded from the analysis. The set of covariates included are state employment rate, gender, age, squared age, schooling level, rural, and interactions of schooling level with rural and gender. Standard errors are obtained by bootstrapping, 100 repetitions.
Figure B.2
The distributional effect on male workers

(a) Pooled sample, formal and informal workers

Equation (1a)

Equation (1b)

(b) Formal workers

Equation (1a)

Equation (1b)

(c) Informal workers

Equation (1a)

Equation (1b)

Notes: Self employed workers and observations with non-reported wages are excluded from the analysis. The set of covariates included are state employment rate, gender, age, squared age, schooling level, rural, and interactions of schooling level with rural and gender. Standard errors are obtained by bootstrapping, 100 repetitions.